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A Survey of Ship-Generated Garbage Quantities and Composition in Ports

A Case Study in Haiphong, Vietnam

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ABSTRACT

The survey on garbage composition and quantities was conducted with the aim of providing data of the sources and type of solid waste from ships at Haiphong port, Vietnam. These data are used to design and establish solid waste management plan at port, which is necessary to reduce illegal dumping at sea from ships and properly dispose on shore. International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) with 06 Annexes has declared that Governments and Port Authorities need to ensure the provision of facilities at ports for reception of garbage from ships by making waste management plan. Moreover, the composition survey on ship-generated garbage is significant for Port Authorities in Vietnam because of their ability to fully comply garbage discharge requirement of Annex V (for Garbage) in the MARPOL convention in 2015.

During 18 days, the garbage composition survey has been conducted at Haiphong port – the second biggest port of Vietnam. Total number of ship-calls involved in the survey is 103. In general, discharged garbage from ships at ports were collected, separated and weighted on 07 categories. The survey provides knowledge about the total amount of actually received ship-garbage at port, garbage composition and the differences on garbage characteristics between general cargo ship and container ship. As a result, food waste and paper are recorded as two main substances in ship-generated garbage. Besides, there are huge composition differences between garbage generated from bulk ship and container ship. We also observed a problem of ship-garbage collection and disposal because of mixing between hazardous and normal waste. Finally, policy makers can use results of our survey for garbage management planning as well as assessing the possibility for waste recycle systems.

Keywords: Garbage composition, Port reception facility, Ship, Vietnam

Full text

1. INTRODUCTION

Solid waste management is a key concern for governments due to increasing waste volumes caused by growing urbanization, illegal dumping and improper handling as well as the high associated costs. Such issues are not simply confined to the land but are increasingly impacting marine areas as well. One particular source of marine pollution is ship-garbage. This kind of garbage can be seen as cross-border waste which is generated and stored on board before being discharged into a port reception facility or dumped at sea. Greenpeace estimates that around 6.4 million tons of garbage [1] are discharged into ocean each year during ship voyages.

In order to prevent pollution of the marine environment, the International Maritime Organization has provided the Convention for the Prevention of Pollution from Ships (MARPOL 73/78). Annex V of aforesaid convention (regulations for the Prevention of Pollution by Garbage from Ships) states that all types of garbage are prohibited from being discharged into sea (except for food waste). It also recommends ship operators bring back ship-garbage to shore for disposal. At 54th session in March 2006, the Marine Environment Protection Committee emphasized that "*illegal discharging garbage from ships could only be effectively prevented when there were adequate reception facilities in ports*". Based on requirements of the Committee, Port Authorities have responsibility to ensure adequate reception facilities for garbage according to the needs of ships by carrying out garbage management plans in line with local conditions. Hence, data and baseline information of ship-garbage quantities and composition are important for determining the adequacy of port reception facilities and establishing port waste management plans.

This survey on ship-generated garbage quantity and composition is being carried out in Haiphong city– a port city in Vietnam. With 38 ports and plans to expand further, Haiphong city is known as gateway to the sea in northern of Vietnam.

Despite the importance of quantities and composition of ship-garbage in solid waste management plans, research and papers in this field are really limited not only in Vietnam but also other countries. Haiphong city does not have any statistics or reports, which estimate the quantity of ship-waste at ports. Few studies to calculate quantities of ship-garbage were conducted in Mediterranean Sea (REMPEC, Activity 1, 2004 [2]) and Serbia (Vladanka et al., 2011 [3]). However, these studies are limited as they ignore the influence of factors affecting the calculation process, such as garbage generated during voyage and maintenance waste on ships. Regarding ship-garbage composition surveys, there has been a small informal survey by Haiphong Urban Environment Company on five ships in Haiphong port in 2004. However, the results were not fully reliable and useful for establishing garbage management plans because of the small sample size. Other research (Prelec et al., 2006 [4]), for designing ship board incinerators, used the waste classification created by IIA (Incinerator Institute of America). They estimated that garbage on ships comprises 50% food waste, 35% paper and cardboard, 10% plastic, and 5% others, based on results of survey by IIA. However, further explanation about the survey is not mentioned.

For the above reasons, we decided to conduct a survey on ship-generated garbage quantity and composition in Haiphong city as a case study. Ship-garbage information will be collected and captured from at least 100 ship-calls in Haiphong port.

2. OBJECTIVES

Although a marine-based economy and port systems are being developed in Haiphong city, but as with many developing countries, there is no comprehensive garbage management plan. To establish a garbage management plan, the Port Authority needs to collect and capture the amount of ship-garbage generated and discharged at their ports. There is also a demand for understanding the

composition of garbage to develop collection capacity. Hence, our survey is focusing on the following key aspects:

+ To obtain information regarding the average composition of ship-generated garbage,

+ To know the actual amount of garbage discharged at Haiphong port by type of ship (general cargo ships and container ships)

+ To compare the difference in quantity between ship-garbage generated and ship-garbage collected by Port Reception Facility at Haiphong port.

3. METHODOLOGY

During the preparation phase of the survey, great care was taken to involve all the important stakeholders. Ship-garbage is a kind of cross-border waste which is different from solid waste generated in urban or industrial zones. Due to the movement of ship-garbage, the responsibility for garbage monitoring and governing changes over time. Currently in Haiphong city there are diverse stakeholders in the garbage management system including the Maritime Administration of Haiphong, port owners, Haiphong Department of Natural Resources and Environment, Environmental Services Enterprise, ship operators. In order to obtain comprehensive information and preparation for the survey, interviews and meetings were conducted to understand current garbage management systems as well as to obtain permission from the city.

Ship-garbage quantities and composition were measured by conducting survey at three main port areas in Haiphong city. All discharged garbage from 103 ship-calls(1) and it's physical composition by weight were recorded. Table 1 gives the basic information about number of ships participating on the survey.

Table 1. Number of ship-calls on survey

Port Area	***Name of Terminal***	***Number of ships***
HoangDieu	HoangDieu	40
ChuaVe	Chua Ve	17
	Doan xa	11
	Green Port	3
	NamHai	7
	Transvina	1
DinhVu	Dinh vu	2
	NamHai Dinh vu	10
	PTSC Dinh vu	1
	Tancang Dinh vu	11
Total:		**103**

The survey was conducted in collaboration with Garbage collection enterprises and Ship Agency Company. The first one is conducting party (IP), the second is monitoring party (MP) with specific responsibilities. Employees of Garbage collecting enterprises (IP) are divided into three groups within three port areas (HoangDieu, ChuaVe, DinhVu) respectively. One time per day, during period from 20th Jan, 2015 to 07th Feb 2015(2), garbage collection people came to all of ships which were docking at port areas to ask for using garbage collection services. Because of existing policy at Haiphong port, using port reception facilities is no mandatory action. Therefore, 103/269 ship-calls had requested to discharge garbage on their ships. After collecting garbage on board, each type of garbage on each ship is stored and fully separated before weighing. The following garbage categories are classified by referring the MARPOL Convention Guideline and URENCO's survey

in 2004. Moreover, we distributed 7 type of ship-garbage based on recycle ability of each garbage fraction:

- Food waste
- Glass
- Paper and cardboard
- Animal Wastes
- Plastics (e.g. packaging mater)
- Metal (cans)
- Clothes, Rags
- Other …

During all processes of collecting, transferring, separating and weighing ship-garbage, monitoring party was in charge of checking all processes to ensure the accuracy of survey results. Each kind of garbage on each ship was separated and stored into plastic bags. Garbage separation was done both on shipboard and at collecting points before moving to weight measurement process. In order to facilitate garbage separation process, as much as possible, each type of garbage was stored separately in each nylon bag during collecting garbage on shipboard.

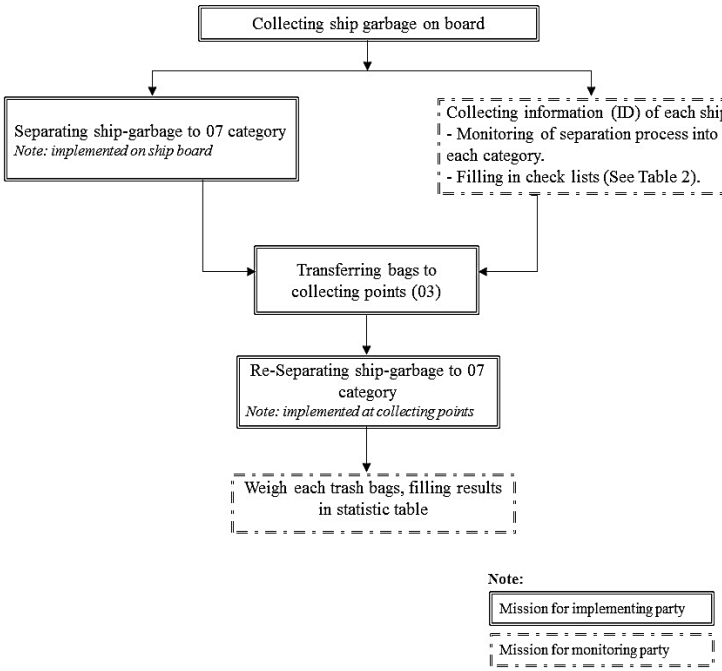


Figure 1. Survey Processes

During survey, monitoring people recorded information of each ship as well as filled in the below checklist. The checklist was used for detecting hazardous and special components that could be included in ship-garbage.

Table 2: Check lists

Check lists	
☐Cargo Residues	☐ Lamp
☐Incinerator Ash	☐ Soot
☐Painting box	☐ Rubber
☐Batteries	

4. RESULTS AND DISCUSSIONS

4-1. Garbage quantity

Total amount of discharged garbage from ship is shown in Table 3. The largest amount of garbage is at Dinhvu port area, 1160 kg during 18 days. The significant difference could be noticed in amount of garbage between HoangDieu and Dinhvu port areas. Even though the number of ship-calls in HoangDieu (40) is higher than those in Dinhvu (24), amount of garbage produced by ship in Dinhvu is larger.

Table 3: Garbage Quantity

Port area	Number of ship	Expected ship-garbage quantity (kg)	Total received volume (kg)	Garbage collection rate (%)	Survey days	Garbage volume/day (kg/day)
Hoang Dieu	40	13122.7	767.7	6%	19	40.4
Chuave	39	12503.4	861.9	7%	18	47.9
Dinhvu	24	7694.4	1158.1	15%	18	64.3

Last year, we did research at Haiphong port to estimate ship-generated garbage [5]. Based on our results and application of same model, we have calculated expected ***ship-garbage quantity*** during survey period in three ports. Then, garbage collection rate is shown in Table 3. There is a big difference between Dinhvu and two others ports (HoangDieu and Chuave). This phenomenon happened due to some reasons: firstly, HoangDieu is loading and unloading cargo of bulker ship, Chuave and Dinhvu are used for container ship. But the size of ships docking in Dinhvu is almost double as size of ships in Chuave. Other reason is the difference in motivation of garbage collection workers among ports. Workers in Dinhvu port have more motivation to collect garbage as much as they can because they can earn money from garbage recycling activity by themselves. Workers in other ports have less promotions for garbage recycling because of time and space constraints. Furthermore, Dinhvu's workers are using truck as mean of transportation while other groups are using Cyclos for ship-garbage collection.

4-2. Garbage Composition

Figure 2 shows the distribution of ship garbage components at HoangDieu, ChuaVe and DinhVu port areas.

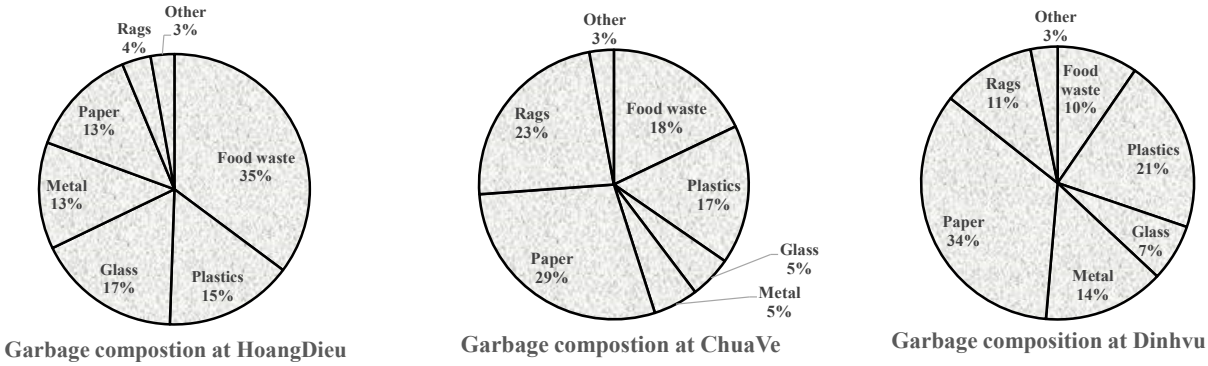


Figure 2. Garbage Composition by weight

According to the Figure 2, while food waste fraction is highest in ship-garbage at HoangDieu port (35%), largest amount of ship-garbage component is paper in both ChuaVe and DinhVu ports,

29% and 34 % respectively. In Dinhvu port, food waste fraction occupies only 10% of total garbage quantity. It is noticed that rag fraction is around 4% at HoangDieu port while a larger portion of this waste is recorded in ChuaVe, 23% and DinhVu ports 11%. During the survey, we found that rag including oil was detected in ship-generated garbage. That means this kind of garbage is hazardous waste, which cannot be discharged as normal solid waste.

The plastic fraction of the ship-garbage is around 15% to 21%. It consists mostly of packaging materials, plastics bags. Glass fraction, such as glass bottle and broken lamps is varied from 5% to 17% while metal is accounted for 5% to 13% in total amount of garbage. Some kind of hazardous items were also detected in collected garbage for example paint box or fluorescent lamp. Other waste occupied 3% of total garbage amount, which consists of wood, porous, rubber.

5. CONCLUSIONS

The composition survey of ship-garbage provides the amounts of each type of waste actually received at three port areas in Haiphong. During 18 days of the survey, quantity and composition of ship-garbage has been recorded. Data from the survey is necessary information for Government and Port Authority to assess the adequacy of the existing garbage reception systems. Further, the results of survey would be used for Haiphong Port Authority to improve Solid Waste Management Plan at Port with the aim to comply fully requirements of MARPOL Convention Annex V in this year.

During the survey, some problems and issues in garbage collecting system were defined. That is the lack of transportation vehicle and facilities for ship-garbage collection. Furthermore, it is serious problem of mixing between hazardous and normal garbage, which leads to improper garbage disposal. The high composition of recyclable material (paper, glass, metal) suggests idea of introducing garbage recycling system at ports.

EndNotes:

[1] Ship-calls means number of ship docking at survey areas (HoangDieu, ChuaVe and DinhVu).

[2] Composition survey was conducted from 20th Jan 2015 at three port areas; finishing time at HoangDieu port was 07th Feb, 2015; Chuave and Dinhvu port area was 06th Feb, 2015.

References:

[1] Greenpeace, 2006. Plastic Debris in the world's oceans, Greenpeace

[2] Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea, 2004. Assessment of the existing situation and needs of Albania, Croatia and Slovenia regarding port reception facilities for collecting ship generated garbage, bilge water and oily wastes, REMPEC.

[3] Vladanka Presburger Ulnikovic, et al. 2011. Ship waste quantities of Prediction Model for the port of Belgrade, Journal of Chemical Industry and Chemical Engineering Quarterly. 17; 239-248.

[4] Zmagoslav Prelec, 2006. Technical and environmental aspects of shipboard incinerators design, Annals of Maritime Studies.43; 207-217

[5] To, Ngoc Thang, and Kato, Takaaki, 2014. An estimation of ship waste quantities at port: A case study in Haiphong, Vietnam, Eco-Balance Conference, 27-30 October 2014, Tsukuba, Japan.

A Temporal Consideration of the Efficacy of Education -Based Solutions to Environmental Challenges

Yoon Soo Shin

Abstract:

The correlations between environment, education, and health have evolved into close interdependency over the past decade as urgent environmental and health issues have arisen and proposals for education and preventive measures have been put forth. While environmental and health issues have rapidly arisen, the education system is lagging in innovation to address these problems.

Through the inquiry into a survey of policy studies from the last decade regarding the correlations between the environment and the food system, an implicit trend was found in the timeline for attempting to limit environmental degradation. Waters, for example, advocates the use of local foods due to its environmental safety by educational curriculums surrounding the need for solving the problems. Barlow believes in teaching the economical aspect of the environment and how it relates to our lives. Moore Lappe stresses preserving the natural world through education of the broader community. However, none present a plausible timeline responsive to the urgency of curbing carbon emissions that has emerged in the past ten years.

Different forms of education for promoting environmentalism have varying levels of efficiency in correlation to the newly emerged chronology of ecological necessity. Lecture-style classes should be seen as less effective than hands-on forms of learning, which encourage individuals to take part in the actual preservation of the world. Whereas exclusively classroom learning does not capture the realities of addressing global needs, an interactive experience gives the learner a chance to make progress in real time while also benefitting pedagogically.

Analysis of Geothermal Energy Resource using RETScreen, A Case Study in Lahendong Site, Indonesia

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Abstract

The utilization of geothermal energy for the electrical energy generation reduces the dependence on the fossil fuels, which are very expensive and also produce GHG that are dangerous to the environment. Geothermal energy resources are locally available as an energy supply option for many areas in the entire of Indonesia. Indonesia has huge resources for the wide-scale use of geothermal energy as one of the environment-friendly and sustainable renewable energy sources. The first purpose of this study is to generate geothermal energy mapping in Indonesia using geographical information system. The second purpose of this study is to conduct the financial and emission analysis of the proposed project at the Lahendong site as a case study of geothermal powerplant in Indonesia. The output of RETScreen performs technical, emission and financial analysis of the proposed project. The outputs of energy model in RETScreen worksheet are power capacity, electricity generation, annual GHG emission reduction, the Internal Rate Return (IRR) and payback period. By putting inputs, i.e characteristic of geothermal resources, it was found that the power capacity 30 MW and 241,065 MWh per year electrical energy can be produced from this power plant with 160 $kTCO_2$ per year emission mitigation opportunity. It is clear that the proposed geothermal project is promising worth investment. Based upon the IRR, payback period and emission CO_2 reduction, this study shows the geothermal proposed project has attractive investment economically and has eco-environmental benefits to be developed.

Keywords :

Geothermal energy, Emission analysis, Financial analysis, CO_2 mitigation, Payback period, Internal Rate Return

1. **Introduction**

The utilization of geothermal energy for the electrical energy generation reduces the dependence on the fossil fuels, which are very expensive and also produce GHG that are dangerous to the environment. In comparison to fossil fuels, geothermal energy has more advantages such as being renewable resources, reliable technology, clean energy, and available locally. Present status and development of geothermal technology has shown that geothermal technology is mature, clean, economical feasible as the energy supply alternative for many countries in the world, include Indonesia. Recently, geothermal energy has increase in utilization over the world.

The environmental benefits of geothermal energy are locally, regionally and globally. Geothermal energy can displace power from fossil fuel-powered plants, and thereby help to improve local air quality, mitigate regional effects such as acid rain, and reduce greenhouse gas emissions globally. Continuous uses of fossil fuels are bound to pollute the atmosphere and consequently unwanted greenhouse and climate change effects will come to dominate every part of the earth (Erdogdu, 2009). Therefore, it is importance to exploit clean energy resources, and for many nations in the world to try to assess their environmentally friendly, clean energy resources such as geothermal energy.

Geothermal energy resources are locally available as an energy supply option for many areas in the entire of Indonesia. Indonesia has huge resources for the wide-scale use of geothermal energy as one of the environment-friendly and sustainable renewable energy sources. Straddled along the Pacific Ring of Fire, an arc of seismic activity, Asia's geothermal reservoirs are among the world's largest. Indonesia alone holds 40 percent of the world's total reserves, but less than 4 percent is being developed, leaving the sector wide open for growth (Lcrichter, 2011). Indonesia's total geothermal energy potential is equivalent to 27,710 MW of electricity-the largest geothermal energy capacity in the world. Of this total 11,369 MW is confirmed as probable reserve, 1050 MW as possible reserve and 2288 MW as proven reserve. The remaining 13,000 MW is still speculative and hypothetical resources. However, progress in this sector has been slow present installed capacity is only 4.3% of its potential, or around 1200 MW (PCI, 2010). The status of geothermal energy among Indonesia energy sources for electricity generation was presented in Fig. 1.

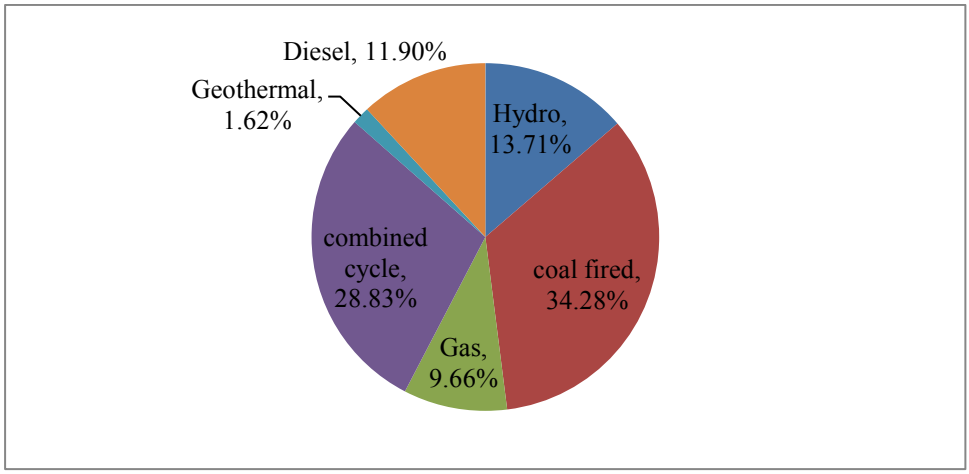


Fig. 1. The share of energy source for electricity generation in Indonesia

(Data was provided by PLN, 2007)

Figure 1 presented that only 1.62% of the geothermal energy use for electricity generation in Indonesia so far. Though Indonesia has a huge potential of geothermal energy resources which is spread over in many areas, the present use of geothermal energy for electricity generation accounts small fraction, among the total energy generation in Indonesia. Therefore, the development studies and investments in geothermal energy analysis should be supported.

Geothermal energy is very important to explore as alternative solution for the power shortage problem which is occurs as nation problem and environmental problem regarding with GHG emission for global consideration. Geothermal resources are environmental friendly and have technical as well as economical advantage should be evaluated for geothermal development in Indonesia. The purpose of this study is to conduct the financial and emission analysis of a proposed geothermal project as a case study.

In order to calculate both emission analysis and financial analysis, a proposed case geothermal power plant was considered in RETScreen software. For this study, the output of RETScreen performs technical analysis in term of power capacity and electricity generation that can be exported to grid. The emission analysis of proposed project in term of the nett annual GHG emission reduction. The financial analysis of the proposed project, in term of the Internal Rate Return (IRR) and payback period.

Due to availability of the data, geothermal resources potential in Lahendong was proposed to be analyzed as a case study. The Lahendong geothermal site is located at the coordinates: 1°16'19"N 124°50'7" E in North Sulawesi province, one of the major geothermal resources in Indonesia. The map of the Indonesia with the highlight of North Sulawesi province, which is the location of the case study situated, is presented in Figure 2. It is necessary to conduct the case study analysis for proposed project as a preliminary analysis method for the entire resource in Indonesia.



Fig. 2. Map of the Indonesia with the highlight of North Sulawesi province, the location of the case study.

2. Literature Review

Renewable energy technologies are essential contributors to the energy supply as they contribute to world energy supply security, reducing dependency of fossil fuel resources, and providing opportunities for reducing emissions of greenhouse gases. Among the renewable energy sources, the geothermal energy offers a good potential for producing electrical power with a high energy level in the short and medium terms. Also, geothermal energy systems are simple, safe, and adaptable with modular 1–50 MW plants capable of providing continuous base-load, load following, or peaking capacity and environmental friendly (Ramazan, 2002).

The RETScreen Clean Energy project Analysis Software is an advanced mathematical model to evaluate the energy production, emission reduction, financial analysis for various types of the Renewable Energy and Energy-efficient Technologies. This energy tool is developed by CANMET Energy Technology Centre. RETScreen International can be used world-wide to evaluate the energy production, life-cycle costs and greenhouse gas emission reductions for various types of renewable and energy-efficient technologies (RETs). RETScreen was used to analyze the Solar Water Heating initiative in Oman through case study for the Seeb district. It was found that the annual energy produces by 38.3 MW powerplant (CANMET, 2006).

The software was designed for energy model in the proposed case power system worksheet, emission analysis worksheet as well as financial analysis worksheet. The geothermal power was selected in the option of technology in the RETScreen (CANMET, 2006). The RETScreen simplified analysis allows the user to calculate the IRR and the simple payback of power production projects using only the power capacity, the capacity factor, the electricity export rate, and the initial and annual costs.

A feed-in tariff is a policy mechanism designed to accelerate investment in renewable energy technologies. The goal of feed-in tariffs is ultimately to offer cost-based compensation to renewable energy producers, providing the price certainty and long-term contracts that help finance renewable energy investments (Couter and Gagnon, 2010).

Carbon credit is a mechanism to mitigate the growth in concentrations of greenhouse gases (GHGs) by estimating the carbon emissions saved by the proposed project. The Collins English Dictionary defines a carbon credit as “a certificate showing that a government or company has paid to have a certain amount of carbon dioxide removed from the environment”. One carbon credit is equal to one metric tonne of carbon dioxide, or in some markets, carbon dioxide equivalent gases. Carbon credits create a market for reducing greenhouse emissions by giving a monetary value to the cost of polluting the air. Accessing carbon financing mechanisms is need for a concise, practical guide, including examples, calculations and cases studies (EPA,2008).

The model calculates the simple payback (in year), which represents the length of time that it takes for a proposed project to recoup its own initial cost, out of the income or savings it generates. The basic premise of the simple payback method is that the more quickly the cost of an investment can be recovered, the more desirable is the investment. For example, in the case of the implementation of an energy project, a negative payback period would be an indication that the annual costs incurred are higher than the annual savings generated.

The Internal Rate of Return (IRR) is the implicit interest rate that exactly balances the present value of the net cash flows at zero, at the front end cost of the project. A simple decision-making criteria can be stated to accept a project if the IRR exceeds the cost of capital and rejected if this IRR is less than the cost of capital. IRR is a decision tool to decide whether a single project is worth investing in. IRR analysis begins with a cash flow stream, a series of net cash flow figures expected from the investment (or business case scenario). The scenario (or investment) with the higher IRR is the better choice (Schmidt, 2011).

3. Methodology

The method used in this study consists of 4 steps, i.e.: proposed the power project, emission analysis, financial analysis and sensitivity analysis. All the processes were done in RETScreen by putting the input needed. The method used including the input and output of this study were presented in Fig 3.

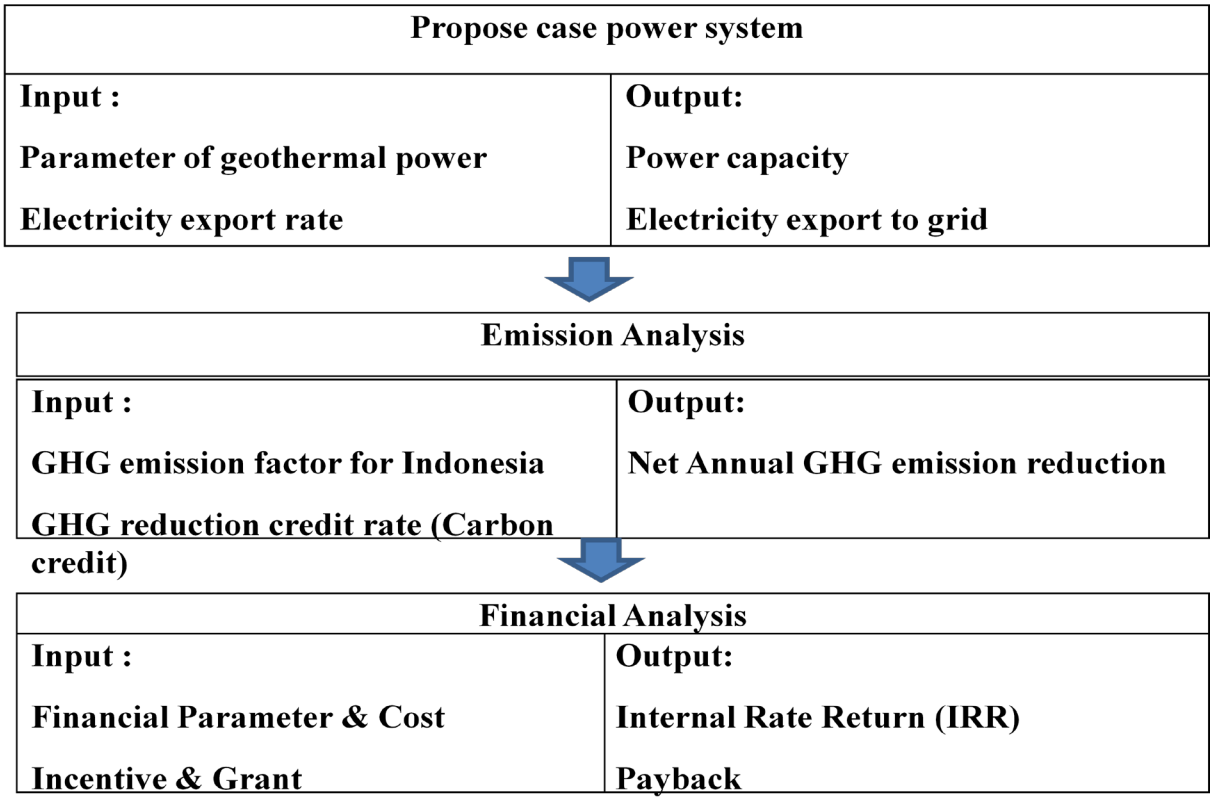


Fig. 3. The method used including the input and output of this study

The process and the detail inputs were described in the following:

3.1 Proposed case power system

An energy model was developed for geothermal powerplant in Lahendong, Indonesia using the RETScreen worksheet. The data needed as the input has been searched

and collected from several references. Based on the previous study about characteristic of Lahendong geothermal by [9] the technical data about steam pressure and temperature can be found. The data completed of characteristic to support as the input in the RETScreen worksheet are listed in Table 1.

Table. 1 The parameters and characteristics of the geothermal power system

Input parameter	Value	Reference
Project located	Lahendong	-
Steam flow	144,000 kg/h	(Yani, 2006)
Operating pressure	150 bar	(Yani, 2006)
Steam temperature	350 C	(Yani, 2006)
Back pressure	8 kPa	(Yani, 2006)
Steam turbine efficiency	77%	Typical assumption
Minimum capacity	40%	Typical assumption
Installed initial cost	US$ 2500/kW	(Shibaki, 2003)
Operating and Maintenance cost	US$ 0.04/KWh	(Shibaki, 2003)
Electricity price sold to grid	US$ 0.10/kWh	Energy Minister Law No. 31/2009

The characteristics of Lahendong geothermal have high temperature, range in between 300 and 350 C with pressures about 150 bar. It has steam flow 40 kg/s, equal to 144,000 kg/h. It was assumed the plant will be operated as base load in 7884 h (90%), with minimum capacity 40% (Yani, 2006).

Incremental initial costs which is the sum of the design, purchase, construction and installation costs of all the elements of the power system. The incremental capital cost is counted based on the capital cost of geothermal plant of 2500 US$/kW (Shibaki, 2003). The electricity export rate based on Feed in Tariff as the regulator by the Indonesia government as 0.01 US$/kWh. The government of Indonesia plans to set tariff of electricity from renewable energy as Rp. 1000/kWh (equal to 0.01 US$/kWh) as a policy to encourage the development of electricity generation from renewable energy sources (Energy Minister Law No. 31/2009).

3.2 Emission analysis

RETScreen adjust the annual reduction to account for transmission and distribution losses and GHG credit transaction fee. In this work, GHG emission factor was done based on coal as substitution fuel type with the 10% (PLN, 2007) of transmission and distribution losses into account, the result equal to 0.752 tCO_2/MWh. The input value for GHG credit transaction fee was 2 %, GHG reduction credit duration was 20 year, and the GHG reduction credit escalation rate was 3%, GHG emission credit rate vary 10-18 US$/ton CO_2 (EPA, 2008).

3.3 Financial analysis

The input of the financial analysis in RETScreen worksheet are the inflation rate, project life, debt ratio, debt interest rate, debt term as well as initial cost data. For the financial analysis, it is assumed that the project life for 30 years and the tax burden is ignored.

Summary of financial parameters for the proposed geothermal power plant are shown in Table 2.

Table 2. Summary of financial parameters for the proposed geothermal power plant

Input parameter	Value	Remarks
Inflation rate	5%	Data (Indonesia economics)
Project life	30 year	Typically
Debt ratio	20%	Data (Indonesia economics)
Debt interest rate	6.5%	Data (Indonesia economics)
Debt term	20	Assumed
Initial cost	75,000,000 US$	Calculated from 2500 USS/kW

It is assumed that the geothermal power plant operates on the 90% of base load for 7884 h/year, with maintenance and mechanical cleaning of wells and equipment taking approximately 360 h/year. There are many factors affecting the cost of geothermal power generation, including investment, capital structure, government policy and management capacity and skill. Total initial investment in a geothermal power plant is US$ 2500/kW.

Geothermal power plant operating and maintenance costs range from $0.004 to $ 0.014 per KWh, depending on how often the plant runs. Geothermal plants typically run 90% of the time (Shibaki, 2003). If the geothermal proposed project power plant can produce 241,065 MWh, then the minimum O&M cost ($0.004) for this project for 3,615,975 US$. By taking the minimum O&M cost (0.004 US$/kWh), the total O&M cost for generating 241,065 MWh would be 964,260 US$. Plant lifetimes are typically 30–45 years. Financing is often structured such that the project pays back its capital costs in the first 15-20 years. Costs then fall by 50–70%, to cover just operations and maintenance for the remaining 15–30 years that the facility operates.

4. Results and Discussions

The result of the RETScreen model can be obtained by providing the input to the RETScreen worksheet with the characteristics of geothermal site such as steam flow, operating pressure, steam temperature and back pressure. The initial cost was set to be 75,000,000 US$ and the case of electricity export rate was 100 US$/MWh, obtained from the value of FiT taken at 0.10 US$/kWh.

The output shown that the power capacity of the case study is 30 MW and the total electricity export to the grid is 241,065 MWh. The RETScreen Energy model worksheet with characteristic geothermal plant inputs, power capacity and the electricity exported to grid, and the input parameter of sensitivity analysis (at FiT equal to 0.10 US$/kWh) is presented in Fig. 4.

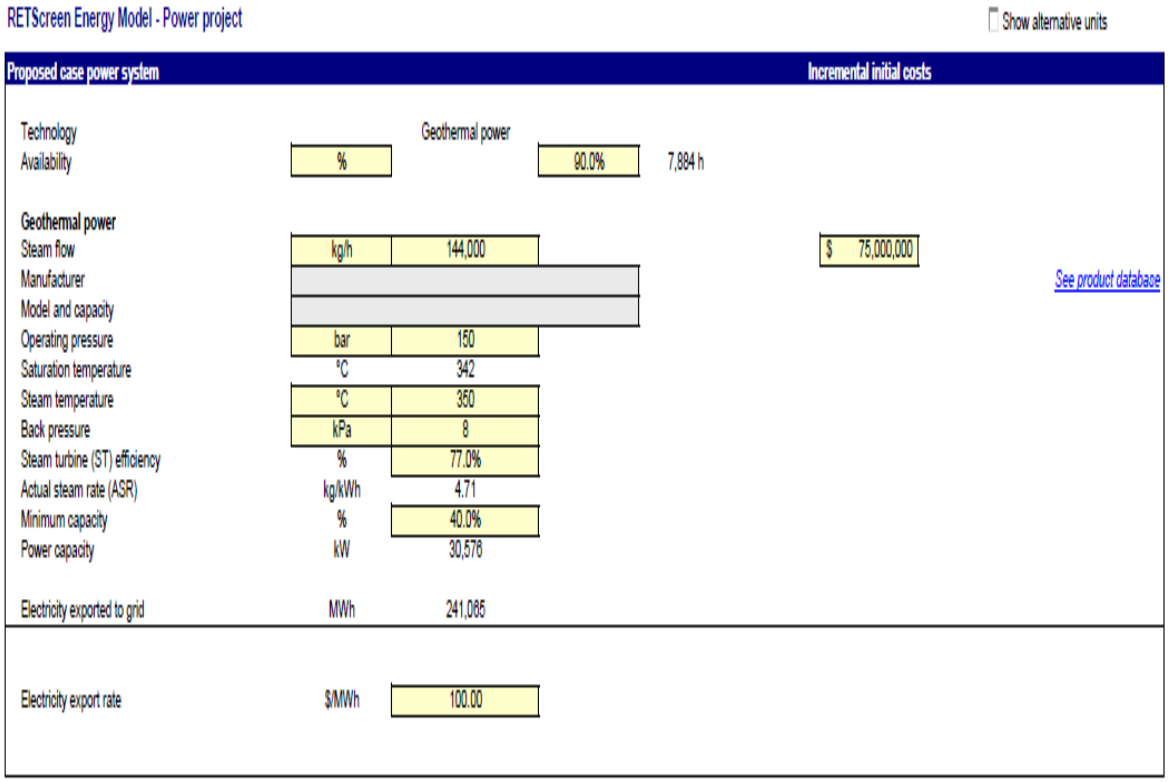
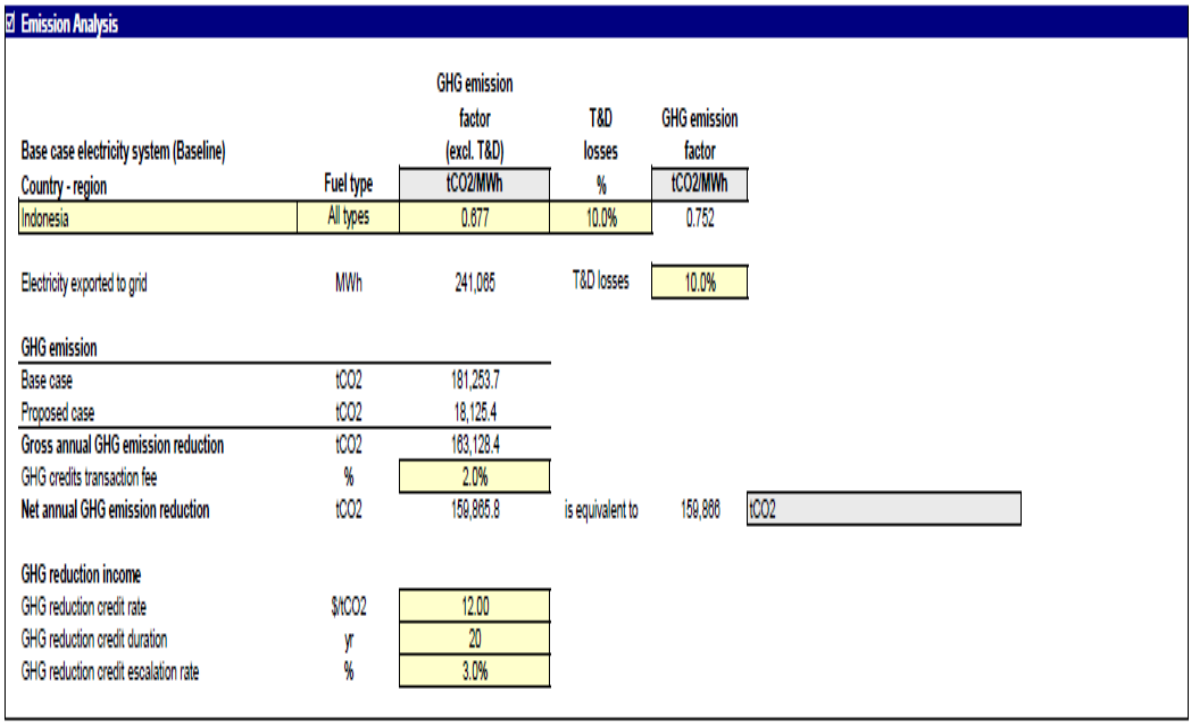


Fig. 4. The result of RETScreen Energy model for the case study of Lahendong geothermal site

4. 1 Emission analysis Result

RETScreen result of the emission analysis of proposed project is presented in Fig. 5.



Emission Analysis

Base case electricity system (Baseline)		GHG emission factor (excl. T&D)	T&D losses	GHG emission factor
Country - region	Fuel type	tCO2/MWh	%	tCO2/MWh
Indonesia	All types	0.877	10.0%	0.752

Electricity exported to grid	MWh	241,065	T&D losses	10.0%

GHG emission		
Base case	tCO2	181,253.7
Proposed case	tCO2	18,125.4
Gross annual GHG emission reduction	tCO2	163,128.4
GHG credits transaction fee	%	2.0%
Net annual GHG emission reduction	tCO2	159,865.8

			is equivalent to	159,866	tCO2

GHG reduction income		
GHG reduction credit rate	$/tCO2	12.00
GHG reduction credit duration	yr	20
GHG reduction credit escalation rate	%	3.0%

Fig. 5. The RETScreen result of the emission analysis of the case study

It was found that the value of GHG emission base case at 181,253 tCO2, while the value of GHG emission proposed case at 18,125 tCO2. By reducing the GHG emission base case to proposed case, the gross annual GHG emission proposed case was found to be 163,128 tCO2. Due to the 2% of GHG credit transaction fee, the net annual GHG emission reduction becomes 159,865 tCO2. This same calculation results for two scenarios, with grant and without grant.

4. 2. Financial Analysis Result

To give an idea of the result of financial analysis in RETScreen worksheet with the case with FiT equal to 0.1 US$/kWh and Carbon credit equal to 12 US$/ton CO_2 were chosen to represent the result of analysis.

The cumulative cash flow analysis result for scenario 1 and scenario 2 were presented in the Fig. 6 and Fig.7 respectively.

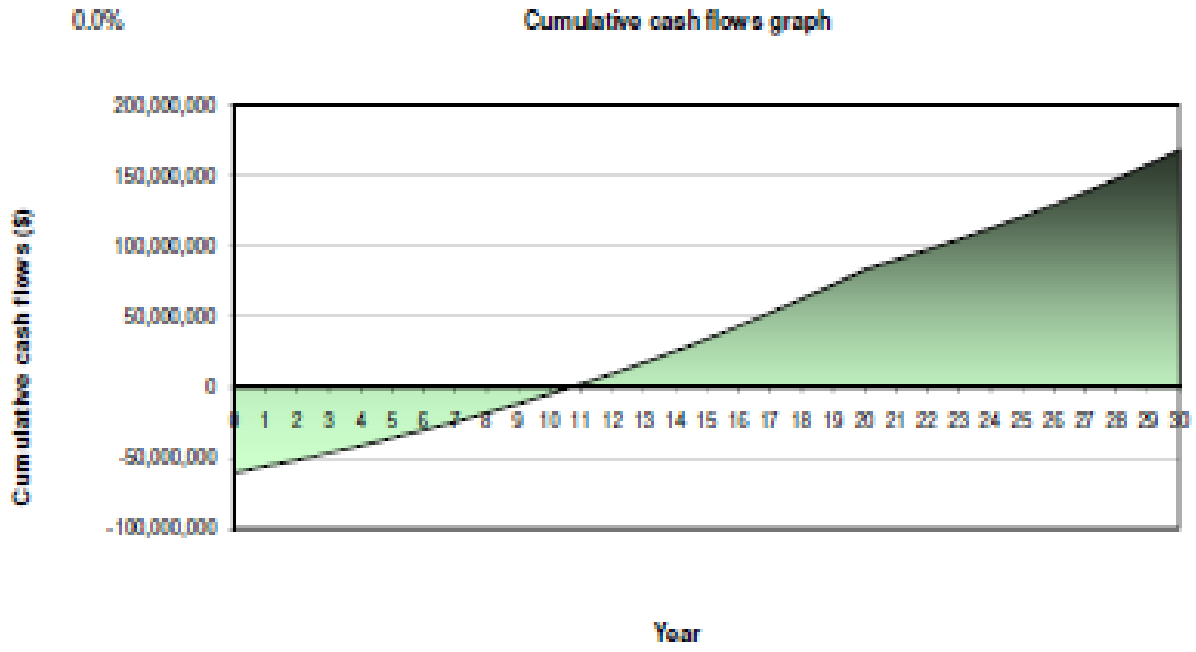


Fig. 6. The cumulative cash flow analysis result for no grant scenario for the case of FiT value at 0.10 US$/kWh and carbon credit at 12 US$/tCO$_2$

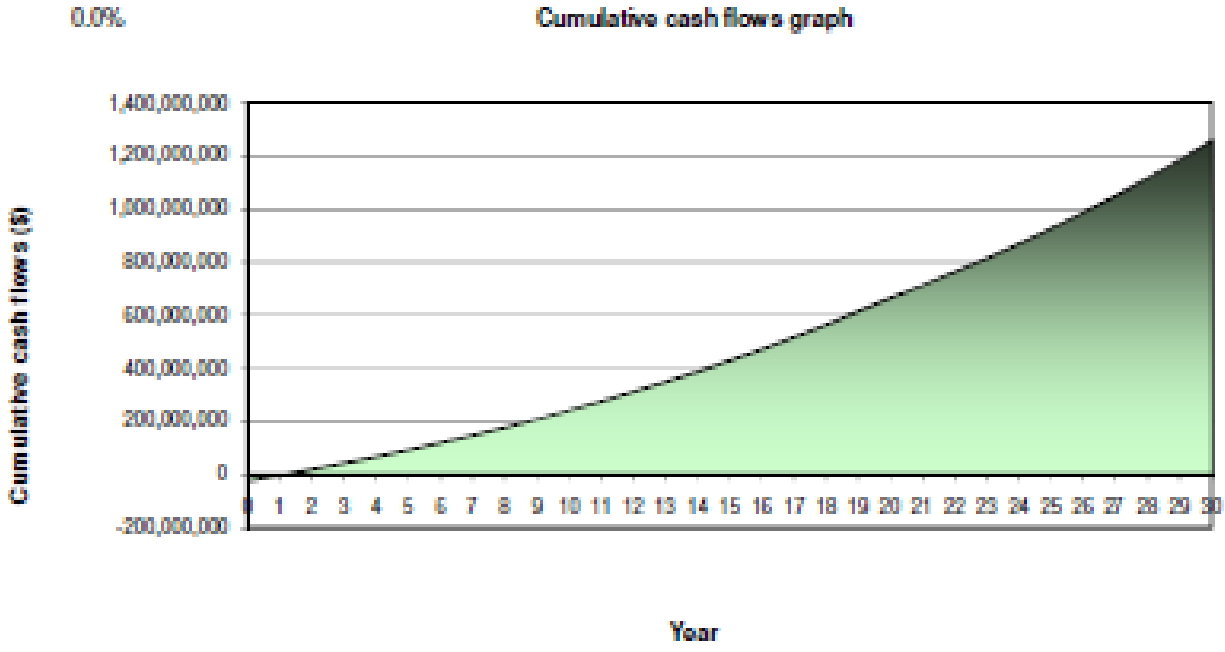


Fig. 7. The cumulative cash flow analysis result for 50% grant scenario for the case of FiT value at 0.10 US$/kWh and carbon credit at 12 US$/tCO$_2$

It was found that the value of IRR for scenario 1 and scenario 2 were 41.3% and 77.5% respectively. The more IRR, the more interesting of the project. The payback period for scenario 1 and scenario 2 are 2.8 years and 1.4 years respectively. It is obvious that if the proposed project with grant subsidized will be more attractive than without

grant. However, it is clear that both scenarios have positive IRR as well as short payback period that indicate the proposed projects are attractive.

5. Conclusion

The case study of proposed project for geothermal energy in Lahendong, Indonesia has been carried out in this work. It is found that the proposed project of geothermal power plant with characteristic input given in the RETScreen worksheet, the Lahendong site can produce 30 MW as installed power capacity, and 241,065 MWh /year electrical energy can be produced from this power plant. This project can be considered as a project for CDM, with criteria renewable energy project activities with emission reduction 169 ktCO2 per year.

The emission analysis and financial analysis has been carried out, the results indicate that the project is economically feasible and applicable. Besides that, the proposed project can benefit locally and globally to the environment due to the GHG mitigation by utilizing geothermal energy to substitute fossil energy. A support mechanism should be established and more financing grant should be assigned for the geothermal development projects in Indonesia. It is clear that beside carbon credit and government grant, a support mechanism such as FiT can be good option to encourage the utilization of geothermal energy in Indonesia. The geothermal energy has the potential to play an important role for the future energy supply in Indonesia. This case study can be a preliminary analysis to explore more potential of geothermal that spread in the islands of Indonesia.

References

CANMET Energy Technology Centre, (2006). RETScreen software online user manual, RETScreen International Clean Energy Decision Support Centre, http://www.retscreen.net.

Couture, T., Gagnon, Y., (2010). An analysis of feed-in tariff remuneration models: implications for renewable energy investment. Energy Policy, 38 (2).

EPA, 2008. Carbon credit. Environment Protection Authority Victoria. 2008-09-02. Available from http://www.epa.vic.gov.au/climate-change/glossary.asp#CAM. Retrieved 2010-02-16.

Erdogdu E. A snapshoot of geothermal energy potential and utilization in Turkey. Renewable and Sustainable Energy Reviews, Volume 13, Issue 9, December 2009, Pages 2535-2543.

Gastli A, Charabi Y. Solar water heating initiative in Oman energy saving and carbon credits. Renewable and Energy Reviews 2011:36:789-796.

Lcrichter, 2011. Japan's geothermal resources could help to replace nuclear capacity, article post on April 5 2011, available from http://thinkgeoenergy.com/archives/7346.

PricewaterhouseCoopers Indonesia, 2010, Investor survey of Indonesia oil and gas industry, available from http://www.pwc.com/id/en/publications/assets/Oil-and-Gas-Survey-2010.pdf.

PLN, 2007, PLN Statistics, Annual report of Electrical Power Company. Indonesia.

Ramazan K, 2007. Geothermal energy potential for power generation in Turkey: A case study in Simay, Kutahya. Renewable and Sustainable Energy Reviews, 11 (3), 497-511.

Schmidt, 2011, The Meaning of Internal Rate of Return (IRR) as a Cash Flow Metric. http://www.solutionmatrix.com/internal-rate-of-return.html

Shibaki M, Geothermal Energy for Electric Power, REPP, 2003 http://www.repp.org/geothermal/geothermal_brief_economics.html.

Yani A, 2006. Numerical modeling of Lahendong Geothermal system, Indonesia. Report on Geothermal training Programme No. 24.

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Meita Rumbayan was born in Manado, Indonesia, in 1976. She received the Bachelor degree in electrical engineering from the Sam Ratulangi University, Manado, Indonesia in 1998, and the M.Eng from Asian Institute of Technology, Thailand in 2001, and Ph.D. degrees from the Tokyo University of Agriculture and Technology, Japan in 2013. In 2001 until now, she joined the Department of Electrical Engineering, Sam Ratulangi University, Manado, Indonesia, as a Lecturer.

Carbon Footprint Analysis of Schools in NCT of Delhi, India

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Abstract

With the changing and depleting environment around us, unexpected climate conditions, deteriorating air quality index and several other acute problems arising due to our enhanced life style and standards of living, it has become crucially important to include Sustainability as the foundation of all the objectives to a city's development. Sustainability refers to a synchronized network of operation and maintenance between Social, Economic and Environmental Sustainability. It is very important to make children as Smart Decision Makers with the help of education, skill and technology to achieve ultimate goals of sustainability. But it is not possible by only qualitative tools. Hence there is need to quantify the loss and impact that is deteriorating the atmosphere. Carbon Footprinting is one of the methods to estimate an individual's contribution to the deteriorating atmosphere. Therefore, the paper intends to present the carbon footprint data of 8 schools scattered over various zones of Delhi pertaining to their consumption of paper and electricity inside the premises. The paper also compares the observed consumption levels with pre defined national and international standards as prescribed by various bodies. In addition to highlighting the issues and concerns, the paper also recommends some simple and easy to implement suggestions to modify the behavior of students, school management and authorities. The solutions have been framed with a consideration of the reluctance of the schools to put in extra investments for sustainability. Hence the suggestions to do not require huge capital on their implementation. But, if we strive to save our environment, it will pay back its cost. In other words environment can be protected by reducing our consumption, this means we need less resources for our operation and if the consumption is less, the expenditure will automatically come down significantly.

Keywords: Sustainability, Carbon Footprint, Schools, Consumption, Education, Paper, Electricity

Introduction

Climate Change is one of the biggest challenges that we face in the 21st century. The continued release of greenhouse gases will lead to severe changes in the Earth's climate. In addition to the environmental hazards, the climate change also poses severe threat to the social and economic sustainability of the country. Climate change is the result of advancements in the lifestyle of the people that accounts for the release of majority of green house gases in the atmosphere. People often tend to confuse Global Warming and Climate Change as congruent concepts. But global warming is actually the result of climate change that has lead to several problems and hazards. Schools are playing the role of silent emitters in the city. Their activities and practices are responsible for greenhouse gas emissions in the atmosphere, but a very less emphasis is laid on its improvement and reducing the emission contents.

As per the Directorate of Education (DoE), Government of Delhi, in 2010, there were 5017 schools in the National Capital Territory of Delhi with 2806 government schools, 265 government aided schools and 1946 private schools. According to the International Centre for Education Statistics, an average school building is 42 years old and was not designed to meet the growing demands of today's energy loads. It is an undisputed matter of fact that schools do not play a major role in degrading the environment of any city, it is the industrial and residential land uses that are accountable for major emissions, but there have been extensive studies on the operation and maintenance of these land uses and we have several national and international rating systems (GRIHA, LEED, ECBC etc.) that guide their activities, but no such studies are found particularly for schools. Schools are the birthplace of the architects of the Nation. If the values of environment sustainability and conservation are inculcated in the students at such a primary level, they will carry forward their behavior to their work places in their higher pursuits and this will automatically lead to a cleaner environment. Through the curriculum and through their practices, they can set an example to today's children and young people, who will be the vanguard of tomorrow's green economy. Schools can set an example in almost every community in the country, helping all of society to visualize and realize a low carbon future. The declining air quality is a primary health concern for school students as it decreases their output efficiency.

Objectives

The general objective of this research is to calculate and compare the Carbon Footprints of the schools in Delhi and suggest measures to switch to low-carbon emitting schools.

The specific objectives of the study are as follows:

- To identify the fields of consumption that are majorly responsible for maximum emissions in the school.
- To calculate the carbon footprint of the school buildings and provide a perspective view of their resource consumption.
- To analyze the per capita values of carbon footprint of individual factors calculated from various schools.
- To compare the per capita carbon footprint value of each category of school with the pre defined national average.
- To propose and suggest methods to reduce the resource consumption in the schools.

Methodology

The research involved extensive literature study to understand the core concept of climate change and sustainability, carbon footprints, environmental planning laws and green building rating systems majorly prevalent in India. The study was carried out mainly through primary

surveys. A small sample of 8 schools within the boundaries of the national capital territory of Delhi was selected. These schools were scattered over various zones of Delhi and included 6 private schools and 2 government schools. The private schools varied on the grounds of their plot area, student population and style of functioning. Several meeting were held with the Department of Education, Government of Delhi in order to formulate survey schedules for the research. After the data collection, the focus was shifted towards the analysis and assessment of the data. The carbon footprints calculated from the schools were compared with the pre defined averages prescribed by various national and international organizations in order to identify the major problem areas and suggest necessary proposals and recommendations.

Climate Change

According to United Nations, Climate change is not a far-off problem. It is happening now and is having very real consequences on people's lives. Climate change is disrupting national economies, costing us dearly today and even more tomorrow. But there is a growing recognition that affordable, scalable solutions are available now that will enable us all to leapfrog to cleaner, more resilient economies. Climate Change is defined as a change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels. Climate change is a change in the statistical distribution of weather patterns when that change lasts for an extended period of time (i.e., decades to millions of years). Climate change may refer to a change in average weather conditions, or in the time variation of weather around longer-term average conditions. Climate change may be limited to a specific region, or may occur across the whole Earth. Except for climate change studies there are few reliable records of past changes in land use. One way to build up a better picture of the effects of past changes is to combine surface records of changing land use with satellite measurements of the properties of vegetation cover. Such analyses show that forest clearing for agriculture and irrigated farming in arid and semi-arid lands are two major sources of climatically important land cover changes. The two effects tend, however, to cancel out, because irrigated agriculture increases solar energy absorption and the amount of moisture evaporated into the atmosphere, whereas forest clearing decreases these two processes.

Carbon Footprint

A carbon footprint is historically defined as "the total sets of greenhouse gas emissions caused by an organization, event, product or person. The concept name of the carbon footprint originates from ecological footprint, discussion, which was developed by Rees and Wackernagel in the 1990s which estimates the number of "earths" that would theoretically be required if everyone on the planet consumed resources at the same level as the person calculating their ecological footprint. An individual's, nation's, or organization's carbon footprint can be measured by undertaking a GHG emissions assessment or other calculative activities denoted as carbon accounting. Once the size of a carbon footprint is known, a strategy can be devised to reduce it, e.g. by technological developments, better process and product management. A shortcoming of carbon footprinting as a methodology for evaluating environmental impacts of processes is that it does not take into account other important environmental factors. For instance, a product with a low carbon footprint might be deleterious to biodiversity, or water quality, but these negative impacts would not be noticed if only the carbon footprint is considered.

Carbon Footprint is used to assess the amount of Carbon Dioxide (CO2) and other greenhouse gases (GHGs) emitted by a person, organization, industry in a given frame of time. . Carbon footprint is defined as sum total of all greenhouse gas emissions because of our daily

activities including usage of different kind of products. Very simply, it quantifies your impact on the environment in the form of total weight of greenhouse gases being emitted because of how you live your life. By personal behavior we mean activities like working on the laptop, using the mobile, using a car, buying of food & other products etc. For example, the more distance we travel by car, consumes more fuel, thus emits more GHGs and the larger footprint we generate that in turn affects the environment and earth.

Carbon footprint is measured in terms of tons or kg of carbon dioxide equivalents. While we measure all greenhouse gases when we calculate carbon footprint, we convert all of them into their carbon dioxide equivalents because carbon dioxide is the most widely present greenhouse gas in the atmosphere.

An emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. For this study, all the emission factors have been referred to from the database of Intergovernmental Panel on Climate Change, UNFCCC.

Almost all the activities that humans perform in their day to day lives, they affect the environment whether directly or indirectly. For instance, when any individual travels from his place of residence to his place of work using a 4 wheeler, he directly emits pollutants in the atmosphere. But when a tube light of a room is switched on, there is no direct emission of GHGs, but it still has a visible carbon footprint. This is because it uses electricity, and the mode of production and transmission of electricity from transformer to the room involves burning of fossil fuels and hence emits GHGs. In a similar manner, from the slippers that we wear to the food that we eat, there can be innumerous examples that illustrate the impact of an individual of the environment. But considering the activities carried out in schools, the following factors have been identified that are responsible for a commercial building's carbon footprint at the maximum extent.

- Paper
- Electricity
- Transport
- Waste
- LPG
- Furniture
- Building Materials
- Building Operation and Maintenance

But after the consideration of data availability from the schools and the time frame of this study, 2 factors namely Paper and Electricity have been selected to conduct this project in schools.

- Emission Factor of Paper = 2.9 kg CO_2 per kg of Paper used

- Emission Factor of Electricity = 1.56 kg CO_2 per kWh of Electricity used

Paper

The main raw material of paper, trees, is a vast carbon store and the prime absorber of carbon dioxide from the atmosphere. Comparing the precise carbon footprint of the all paper grades

is difficult to pinpoint as it depends on how the paper is made and the source of energy used in production. Hydro, biomass and geothermal energy, heavily used by some paper making countries, are all low carbon, while fossil-fuels are carbon intensive. On average it takes 500 kilowatt hours (kWh) to produce 200kg of paper; this is comparable to driving an average family car 600 miles.

In India, the paper industry is primarily social-farm forestry-based, with close linkages to the farming community. Over the last decade, industry-led farm-social forestry has brought around 0.5 million hectare under pulp wood plantation, which was mainly degraded marginal land of farmers. At present, the industry sources 80% of its requirement of wood through farm forestry. India's paper consumption has grown at a steady rate of 8% in the last five years. From deforestation till recycling, all the stages in the life cycle of the paper degrade the environment to a large extent. Following is the flow chart showing the life cycle of the paper.

A Finnish study has concluded the greenhouse gas emissions produced by a single newspaper during its entire life cycle correspond to a car journey of approximately one kilometer. About half of those emissions are attributed to the electricity and heat required in the production process.

Electricity

Electricity is a very important factor of carbon footprint calculations. If we analyze the life cycle of electricity generation and distribution, we will see that every step and process releases greenhouse gases in the atmosphere. Following are the important stages of electricity life cycle.

As per the ministry of Power, Govt. of India, 59% of the electricity in India is still generated using coal which is a fossil fuel. In addition to being more polluting compared to other renewable sources of energy, it’s also limited. Therefore it’s important to save fuel not just from the point of pollution, but also because of our heavy reliance on something which is limited.

1. Extraction of Coal and other fossil fuels
2. Transportation of fossil fuels to the site of electricity generation
3. Processing of coal at power plants
4. Construction and installation of transformers and power stations
5. Operation and maintenance of transmission lines and cables
6. Supply and decommissioning of electricity to households

Study Area

The red dots on the Figure 1 below show the positioning of various schools in the NCT of Delhi. From this map 3 zones have been identified namely North, East and North West that have maximum concentration of schools. After identifying the zones, 8 schools of different characteristics were selected through random sampling method in these 3 zones to conduct the study. Figure 2 shows the position and location of the selected 8 schools.

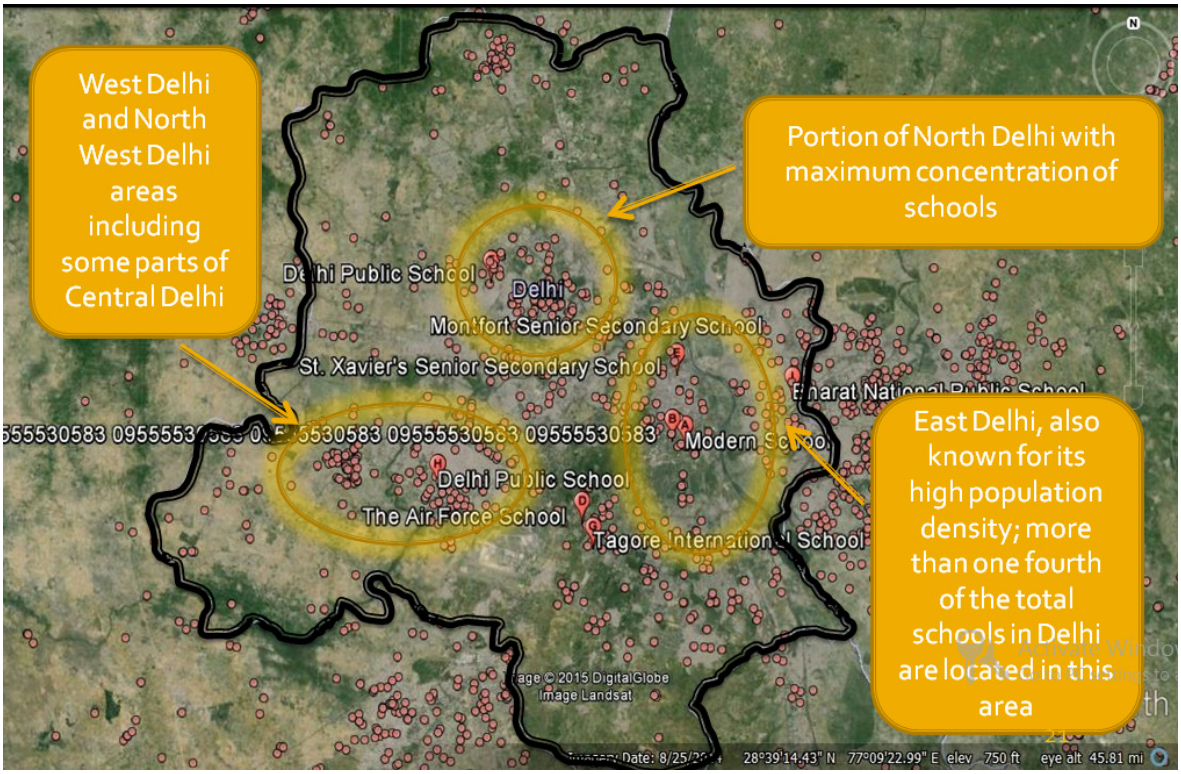


Figure 1: Map Showing the location of schools in Delhi

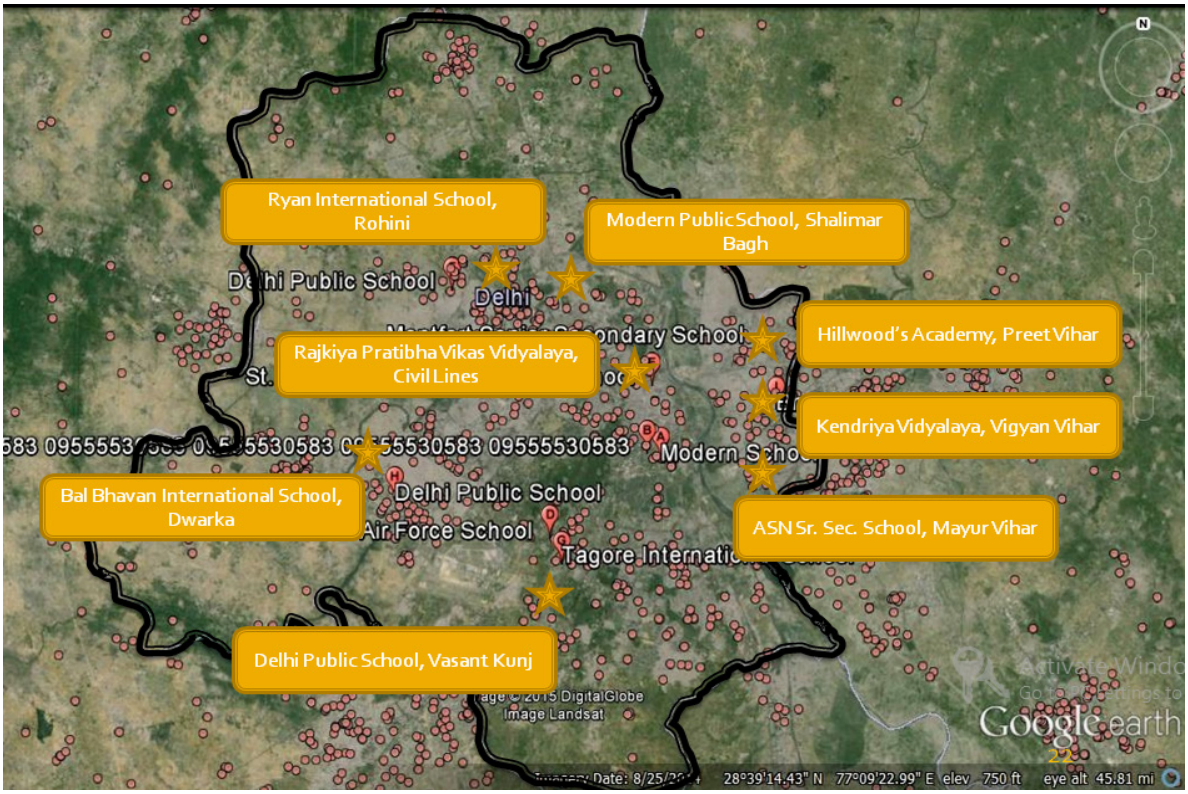


Figure 2: Position of the Schools Selected for Study

Data Analysis

Name of the School	Paper CF (Tons of CO_2 per annum)	Electricity CF (Tons of CO2 per annum)
Modern Public School	215.69	246.91
Bal Bhavan International School	69.94	160.04
Ryan International School	174.29	202.24
ASN Sr. Sec. School	206.16	406.45
Hillwood's Academy School	195.89	332.95
Delhi Public School	373.80	1092.99
Rajkiya Pratibha Vikas Vidyalaya	101.74	357.95
Kendriya Vidyalaya	227.49	383.71

Table 1: Carbon Footprint Values of the Schools

Table 1 shows the values of carbon footprint of different schools studied during the study. The data so obtained is not comparable. This is because every school differs in their plot area, student population and the facilities offered. Hence a better option for the comparison of data is to calculate the per capita footprint of each student of every school. The Chart 1 shows the per capita CF in terms of Kg of CO_2 per student per annum.

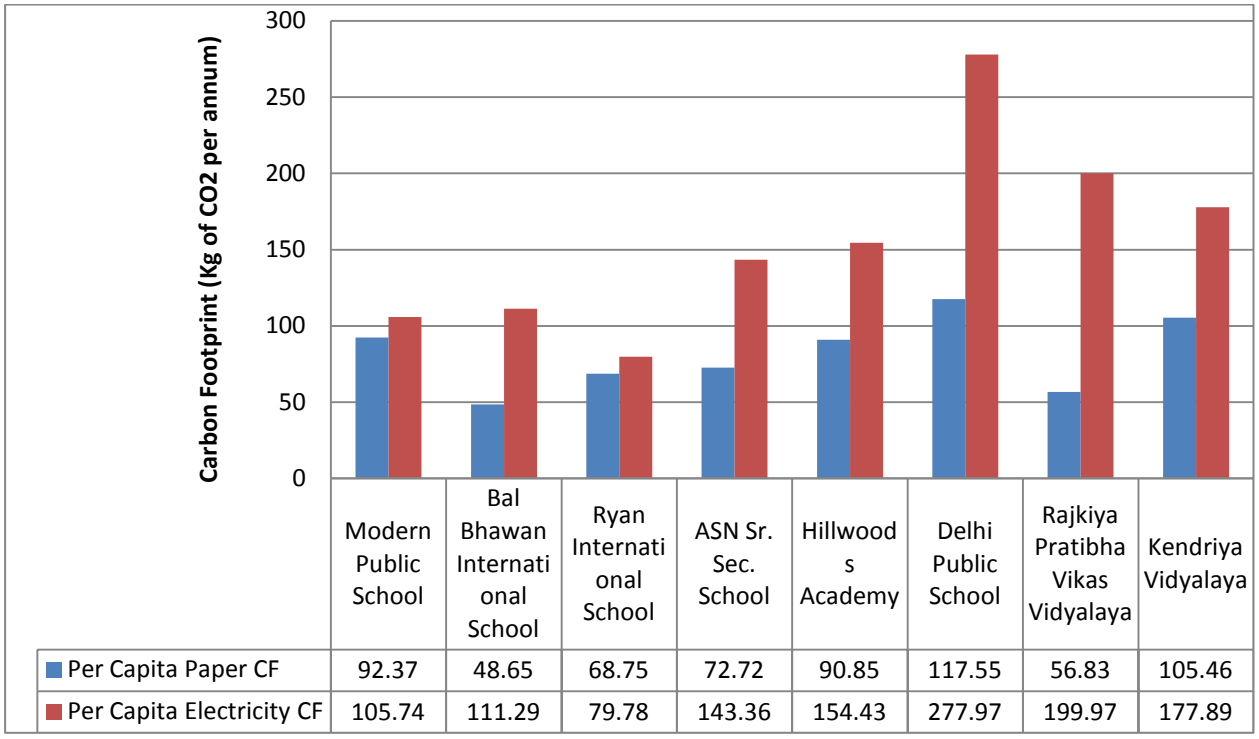


Chart 1: Per Capita Carbon Footprint Comparison of Schools

Now, the data can be seen on a comparable scale. The next step is to compare this data with the pre defined values of the average paper and electricity consumption in India.

According to the Indian Paper Manufacturer's Association, in 2010 The Average Annual Per Capita Paper Consumption of schools in India was 10 kg.

According to this figure, we can calculate that the Average Paper CF per student in a school is 29 kg of CO_2 per annum.

When we compare this average value of CF with the values of our schools, we get the following graph.

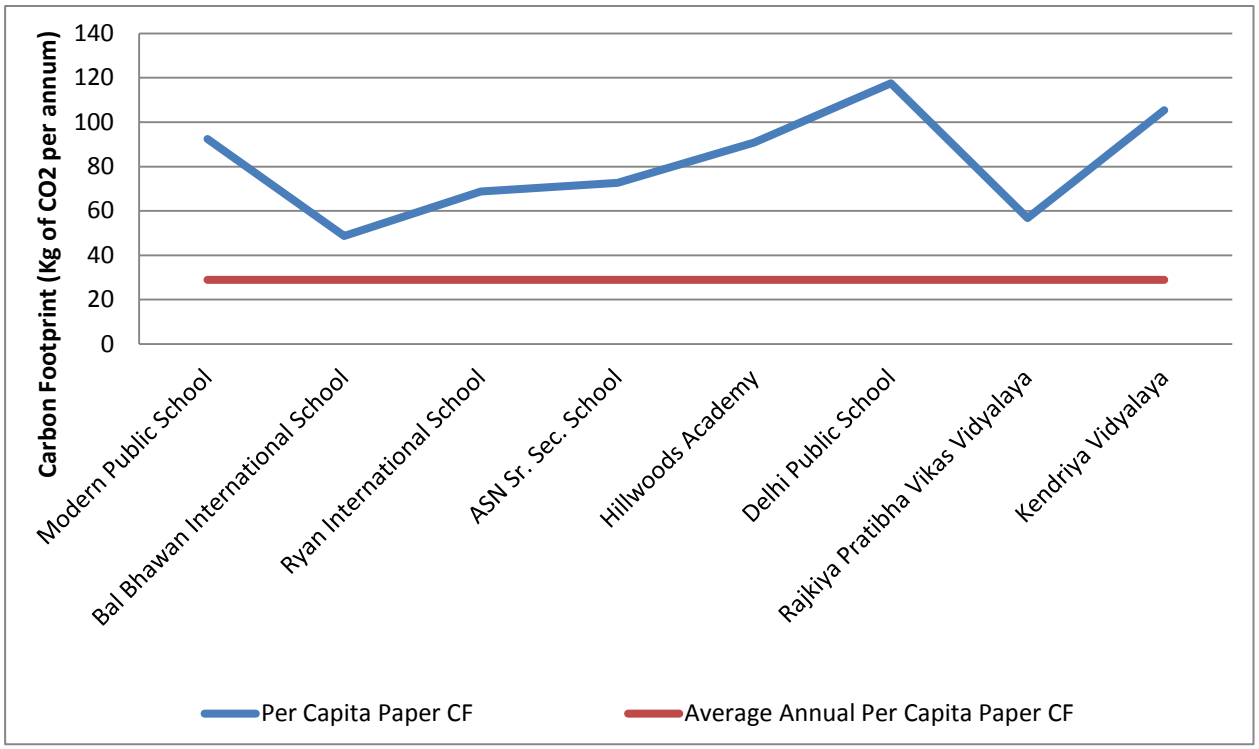


Chart 2: Comparison of Paper CF from study with the national average of Paper CF

The national average consumption of electricity is not available in terms of per capita units consumed. It is estimated on the grounds of units consumed per square feet of area. Hence the per capita values of electricity CF were not used in their analysis. The net electricity CF values were converted into the CF per square feet from the plot area of every school.

It was found that the Average Electricity Consumption of Schools is 13.5 kWh per square feet according to the Orange County Public Schools, USA.

Hence, the average per sq ft CF of electricity was calculated to be 21.06 kg of CO2 per annum.

Finally the average values and the calculated values were plotted on a graph as follows.

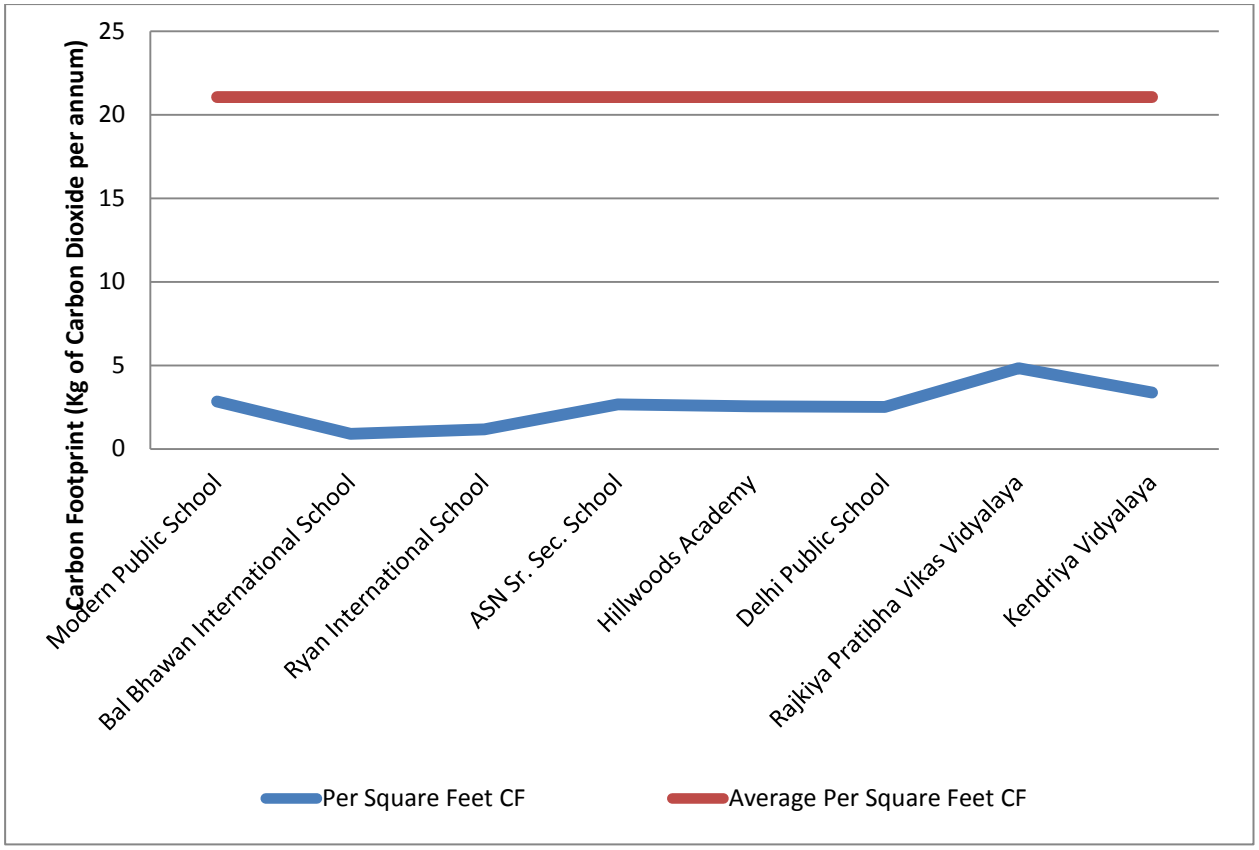


Chart 3: Comparison of per sq feet electricity CF from the study of schools with the national average of per sq ft electricity CF

With the current levels of average CO2 emissions, the mankind is facing several acute problems in the form of Climate Change and Global Warming with the alarming increase in the average temperature of Earth and considerable rise in the sea levels leading to inadequate precipitation and health concerns.

If we look at the present condition, we might see our carbon footprint towards a positive side. But on analyzing its rate of increase since past few years, we can conclude that if the Carbon Footprints continue to rise at the same rate, the per capita carbon footprint of school students will cross the present national average of carbon footprint of the two factors under consideration in over next 3 decades.

The situation at that time can be beyond our control and could lead to major devastations. Hence it is extremely important to check our carbon emissions and if not decrease, at least limit them at the current stage. Doing so for schools can be a major contributing step towards sustainability of life on Earth.

Proposals

1. The schools should start following the practice of issuing the books at the beginning of the session and recollecting it at the end of the session so that they can be reused by the next batch of students. One third of the paper carbon footprint could be directly reduced by this method. This proposal can be implemented voluntarily by the schools authorities. The pilot project for this can be first done in senior classes. Effective maintenance of books is very important to implement this proposal. For this we need to create awareness among students on how to maintain their books.
   This proposal if implemented can be a revolutionary step in mitigating the Paper Carbon Footprints and could reduce deforestation up to a large extent but publishers of books would be the biggest threat in successful implementation of this proposal.

2. The schools should establish a portable recycling machine in their schools.
   There are many varieties of such machines depending upon their capacity and mode of operation. There are huge amounts of waste paper in the schools. They should primarily try to reuse their waste paper and if not possible, then they should put it in recycling machines. This paper can be used to make files, covers and other decorative materials. This machine could be established by the schools authorities in private schools with incentives and subsidies from the government. But in the case of government schools, the government authorities should establish such machines. For effective implementation of this proposal, the establishment of machines should be made mandatory by the government.
   On an average, a paper recycling machine can recycle one ton of paper in a calendar year; the segregated paper waste being generated in the school itself. Each ton of recycled paper saves 3 tons of wood and 100,000 litres of water providing huge environmental value.

3. Most schools are using out dated and very old electrical equipments. Such equipments are not BEE star rated and use very high wattage of electricity. There should be a survey of all the schools of the capital to check their appliances. They should be strictly ordered to replace old equipments with latest star rated appliances. This survey could be conducted by the Ministry of Power, Government of NCT of Delhi, in collaboration with NGOs.

4. The schools should start the installation process of rooftop solar power plants. Schools are currently interested in the off grid solar panels that they install and operate privately. The Ministry of power along with the Department of Environment of the Government of Delhi should promote the use of on grid solar panels. The power DISCOMS can be given the task of manufacturing such solar panels and proving schools with necessary support.

The above proposals are the technological advancements in the operation and maintenance of the school. We need Creative Solutions and Technology in order to build a sustainable school. Before pitching extra investment on technological equipments by schools, we need to clarify the importance of sustainability in schools. There should be training seminar in all the schools to explain them their contribution to the degradation of environment. Then those solutions should be figured out which involve behavioral changes in the part of students and teachers. After stopping the wastage of resources, the implementation of above proposals should start.

The pay back of all the investments should be clearly explained to the school authorities, students and their parents. Below are given some other suggestions and recommendation for the resource optimization through changes in the behavior of the students and teachers.

Reduce

- Schools especially private schools can develop Student-Teacher-Parent interface on internet to facilitate the online communication between them instead of printing circulars and notices.
- Rather than work out in-class activities on paper, students could use small white boards with ultra low-odor dry-erase markers. Some marker brands are even made from recycled materials and are refillable, too.
- Computers in labs and smart class projectors are often kept on stand by mode throughout the working hours of the school. This leads to the huge amount of wastage. Hence schools should shut down the systems when not in use.
- Instead of each student getting newspaper individually, the school should arrange one newspaper of the entire section.
- One of the simplest, yet most effective, ways of planning the urban cities to cope with global warming is to increase the reflectivity of the cityscape so that more of the incoming sunlight is directed back into space. As the cities these days are concrete jungle of apartments and residential towers, these small steps help in reducing the heat islands which are created due to excessive trapping of heat. Two years ago, Professor Steven Chu, the US Secretary of Energy, suggested at the Royal Society in London that one of the most effective engineering measures to tackle rising temperatures is to paint roofs in light color. Schools should put their foot forward in painting their roofs with white color.

Reuse

- The schools should start following the US practice of issuing the books at the beginning of the session and recollecting it at the end of the session so that they can be reused by the next batch of students.
- Schools collect practical files, project reports etc. from the students. It is generally observed that many pages of such reports and files are unused. Schools should collect all such unused pages. They can either be used to make notebooks for auxiliary works or they can be used in school printers for printing of official communications.

Recycle

- Local businesses often have reams of unused paper goods that might include outdated letterhead, envelopes of the wrong size and old signs. Ask companies in the neighborhood or from parents' places of business to donate these paper goods to the school.

Conclusion

It is hence evident, that the sustainability is a very important factor of the operation and maintenance of school buildings. Also there is a huge scope of optimization in the GHG emissions from the resources consumed in the school annually. For every factor and parameter, I have discussed and analyzed the observations of the carbon footprint survey along with the suggestions and proposals that could be extremely helpful to the school in reducing their impact on the environment. I further hope that this presentation will give an insight into the trends of resource consumption and would assist in observing individual's role in the degradation of the environment and how it can be reduced. I culminate this presentation with a hope that together we shall strive to create that culture and work together towards creating a future which is healthy, clean and sustainable.

References

Australia, c. o. (n.d.). *Australian Government, Department of the Environment*. Retrieved from Australian Government : http://www.environment.gov.au/climate-change/climate-science/greenhouse-effect

Guardian, T. (2014). *Climate Change*. Retrieved from http://www.theguardian.com/environment/2014/aug/26/global-warming-irreversible-un-panel-report

International Paper. (n.d.). Retrieved from Down to Earth: http://www.internationalpaper.com/apps/d2e/down2earthonline/carbon_footprint.html

Munna Loa, H. (n.d.). *Green House Effect*. Retrieved from http://hyperphysics.phy-astr.gsu.edu/hbase/thermo/grnhse.html

Nations, U. (2014). *UN and Climate Change*. Retrieved from http://www.un.org/climatechange/

Student's Guide to Global Climate Change. (n.d.). Retrieved from http://www.epa.gov/climatestudents/basics/today/greenhouse-effect.html

Thapelo Letete, M. G. (2010). *University of Cape Town, Carbon Footprint.* Rondebosch: Energy Research Centre.

Thomson, L. G. (2010). *Climate Change: Evidence and Options.* Ohio: The Ohio State University.

Wiedmann, T. (2008). *The Crabon Footprint and Ecological Foorprint of the Scottish Parliament.* Dorham: ISA, UK.

About the Author

I, Anshu Gupta am a graduate in Urban Planning from Amity University, Noida and am currently pursuing independent research in the field of sustainable development. I am preparing for admission to the post graduation course in environment science. I am a university scholar and completed my graduation with a 50% scholarship on tuition fees. I was also awarded for excellent performance in activities related to placement and industry interaction. I have been an intern under the Department of Environment, Government of Delhi and worked on the literature study of green building rating systems in India and around the globe. During my college, I have worked on several city development plans including those of Jaipur, Delhi and Varanasi in India. I have been an active participant in several extracurricular activities since my school period. I was selected as the Student of the Year by leading media house, Times of India in 2009. Apart from being a researcher, I am a Hindi Poet and have penned down over 100 unpublished poems. I have to my credit the award for Best Public Speaker in Hindi and have performed at various shows and poetic events inside and outside the university.

Changes in Newspaper Representations of Urban Nature for a Century: Cheonggyecheon Stream in Seoul, Korea

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In 2003 the Seoul Metropolitan Government began tearing down an elevated highway that ran through the center of the downtown, the Cheonggyecheon Stream Restoration Project created a 5.8㎞ long linear park (Lim et al., 2013).

The restored the stream is now the most attractive cultural civic space in downtown Seoul. Yet, because of the political connotations attached to it, its intrinsic character remains as controversial as it was when it was first proposed (Cho, 2010).

Public perceptions towards urban nature are important part of environmental management and planning. This study focuses on print media representations of “Cheonggyecheon Stream” in Seoul, Korea, during about one century (1920-2014).

Standard content analysis procedures were followed (Krippendorff, 2004). The results shows that a variety of harms and nuisances related to Cheonggyecheon Stream are brought up and discussed by the media. The key claim is that new demands on river management and requires frameworks that are able to integrate social and scientific goals while core objectives, including legislative requirements.

Keywords: Cheonggyecheon Stream, Newspaper, Content Analysis, Public Perception

References

Asakawa et al. (2004) Perceptions of urban stream corridors within the greenway system of Sapporo, Japan

Cho (2010) The politics of urban nature restoration The case of Cheonggyecheon restoration in Seoul, Korea

Chou (2013) Exploring the quasi-naturalistic landscaping design of a Taiwanese culverted urban stream

Krippendorff (2004) Content Analysis

Krippendorff et al. (2009) The Content Analysis Readers

Lim et al. (2013) Urban regeneration and gentrification: Land use impacts of the Cheonggye stream restoration project on the Seoul's CBD

Lyytimäki (2014) Bad nature: Newspaper representations of ecosystem disservices

House et al. (1997) Public perceptions of river corridors and attitudes towards river works

Smith et al. (2014) The changing nature of river restoration

Tunstall (2000) River restoration - public attitudes and expectations

Citizens' Needs for Marine Environmental Education: The case of Marine Festival in Kaohsiung, Taiwan

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Abstract

With increasing attention to sustainable development, environmental education is becoming a prerequisite mechanism for enhancing publics' awareness of environmental protection. Taiwan is an island country thus marine environmental education plays an important role for local marine resources conservation. However, citizens of Taiwan have insufficient marine awareness and there is little understanding about what topics of marine education are of interest to the citizens of Taiwan. This research therefore investigates citizens' needs for marine environmental education by the case example of marine festival in Kaohsiung, and explores the association between participants' demographic characteristics and their needs of marine education.

The results showed that participants of Kaohsiung Ocean Expo have a medium need of marine education. Participants would like to learn more about marine environmental protection and ecological preservation. This study supports the necessity of marine education and indicates what content the participants would like to introduce to environmental education in a marine festival. Moreover, participants' demographic characteristics including age group, education level and marital status are significantly associated with the needs of marine education. These findings have implications for the development of more efficient marine educational programs.

Key words: Environmental education; Marine education; Marine Festival

Introduction

With increasing attention to sustainable development, environmental education is becoming a prerequisite mechanism for enhancing publics' awareness of environmental sustainability (Ballantyne & Packer, 2011). Environmental education imparts knowledge and creates experiences to change individuals' beliefs, attitudes and behaviors (Frantz & Mayer, 2014). Studies have noted that environmental learning experiences have the potential to influence, encourage and support participants' awareness and adoption of environmentally sustainable behaviors (Ballantyne & Packer, 2011; Cheung & Fok, 2013; Finger, 1994). However, plans of environmental education are still poorly developed (Zorrilla-Pujana & Rossi, 2014). Therefore, further examination of what content individuals expect to learn is useful for the development of effective environmental education programs.

Taiwan is an island country. It is surrounded by oceans and therefore has a long coastline, which offers diverse coastal landscape. There is a growing recognition that ocean conservation in Taiwan is essential to protect vulnerable marine habitats and species. Marine environmental education plays an important role for local marine resources conservation. Under these circumstances, the Ministry of Education of Taiwan issued a White Paper on Marine Education Policies in 2007 (Kuo, Yang, & Lin, 2012). The curriculum guideline of marine education was also proposed for elementary and junior high school education (Ministry of Education, 2008). However, citizens in Taiwan have been observed to continually have insufficient marine awareness and knowledge (Kuo et al., 2012). The creation of effective and beneficial marine educational programs has thus become critical in Taiwan.

Although formal education programs are undoubtedly important, informal environmental educational programs, such as interpretive activities, provide opportunities for public to learn about environmental sustainability issues. It is extremely important not to underestimate public's informal educational needs of ecological conservations (Andersen & Miller, 2006). Environmental learning in informal has increasingly been the object of study (Ballantyne & Packer, 2005, 2011). Festivals can be considered a type of cultural tourism with interesting activities that draw people to explore the unique resources of a destination (Lee, Kyle, & Scott, 2012). Informal educational activities have been involved in a festival for providing opportunities for participants to enhance their awareness and knowledge of environment. With the increasing recognition of the importance of informal marine education in Taiwan, there is still a lack of literature about what topics are of interest to the public. To fill the research gap, this study investigates citizens' needs for marine environmental education in Taiwan, by the case example of marine festival of Kaohsiung. In addition, the association between citizens' demographic characteristics and their needs of marine education are also examined.

Methodology

Kaohsiung City is located at the southern Taiwan, as illustrated in Fig. 1. With Taiwan Strait in the west and Bashi Channel in the south, Kaohsiung City presented itself as a waterside city. The Kaohsiung Ocean Expo marine festival has been launched in 2005 and held annually at the city's wharfs. Lover's Wharf (Fig. 1), located in Qieding District in the northern part of Kaohsiung City, is apt for various leisure activities and is known for specific local resources such as abandoned saltpans, diverse wildlife, and coastal communities. It is recognized as an attractive location of marine festivals.

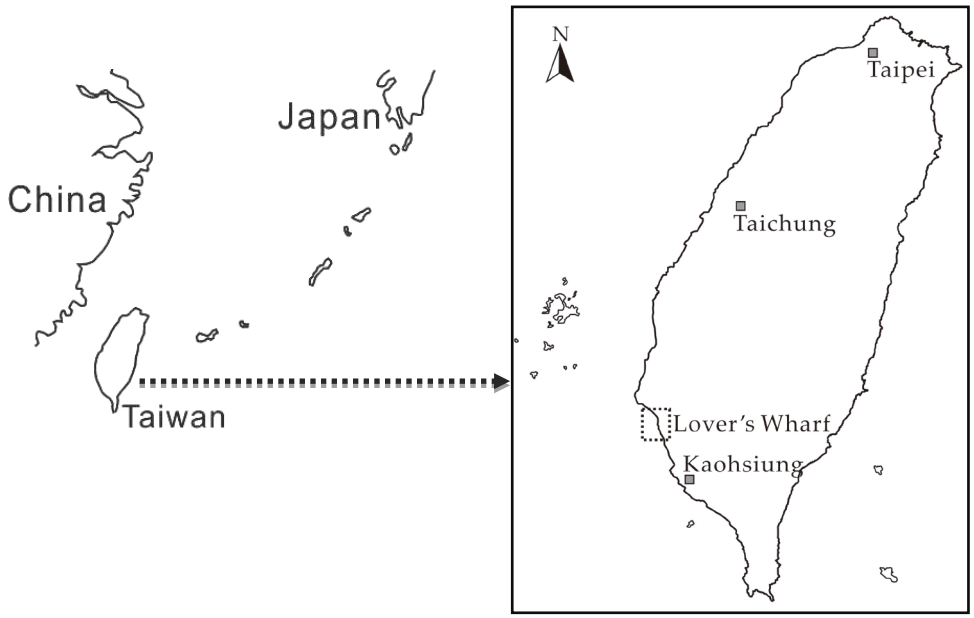


Fig. 1. Location of the study site

In this study a questionnaire was designed to evaluate citizens' opinions about the needs of marine education and their demographic information. Sixteen items for measurement participants' needs for marine education were developed on the basis of curriculum guideline of marine education which was proposed by Taiwan Ministry of Education. The framework of the curriculum consists of five topics, including oceanic leisure, oceanic society, oceanic culture, oceanic science and oceanic resources respectively (Ministry of Education, 2008). Each topic is composed of two or four items (See Table 1 for more detail). The measurement of 16 items was in a 5-point Likert scale format, ranging from 1 = "strongly disagree" to 5 = "strongly agree".

For data collection, an on-site survey was conducted during the Expo in 2012. Citizens who had joined in the marine educational activities and were aged 16 and above were invited to participate in the survey. A total of 556 responses to the self-administered questionnaire were

collected and 388 of these were considered valid and retained for analysis in a response rate of 70%.

Results and Discussion

Table 1 showed respondents' overall desire for marine education. The marine education curriculum contains 16 lesson items. Participants of Kaohsiung Ocean Expo showed that they have a medium need of marine education. They expressed relatively strong interests in environmental education for marine environmental protection and ecological preservation, marine art, and marine ecotourism. The findings are consistent with other studies, indicating that education was indeed an expectation of participants of marine educational activities (Andersen & Miller, 2006; Lück, 2015). Tourists who want to enjoy nature-based activities are looking to gain an understanding about the environment of the local area, including its culture and wildlife (Lück, 2003). These results could contribute to the development of marine educational programs that are based on the desire of the participants, enhancing the educational benefits of marine festivals.

Table 1
Mean agreement level of needs of marine education

Items (n=388)	Mean	SD
Oceanic leisure		
Lessons on aquatic recreation	3.65	.856
Lessons on marine ecotourism	3.74	.867
Oceanic society		
Lessons on marine economical activities	3.54	.881
Lessons on marine law and politics	3.39	.913
Oceanic culture		
Lessons on marine history	3.48	.840
Lessons on marine literature	3.50	.818
Lessons on marine art	3.75	.856
Lessons on marine folk belief and festival	3.62	.855
Oceanic science		
Lessons on marine physics and chemistry	3.49	.905
Lessons on marine geography and geology	3.63	.881
Lessons on marine meteorology	3.67	.900
Lessons on marine applied science	3.61	.927
Oceanic resources		
Lessons on marine food	3.67	.895

Lessons on marine biological resources	3.73	.924
Lessons on marine non-biological resources	3.64	.903
Lessons on marine environmental protection and ecological preservation	3.85	.922

Note. 1 = strongly disagree; 2 = disagree; 3= neutral; 4 = agree; 5 = strongly agree.

An independent sample t test and analysis of variance (ANOVA) with a suitable post hoc procedure were employed to investigate whether demographic characteristics (gender, age group, educational level and marital status) govern the participants' needs of marine education, and these results are listed in Table 2. The results of the t test showed that there is no statistically significant effect for gender. Besides, the ANOVA results revealed that the variables in age group, education level and marital status are significantly associated with the needs of marine education. Age group indicated a significant association with needs of all five lessons topics. The mean scores of needs of marine education of young participants (19 or below) were nearly the lowest comparing with other age categories. In terms of educational level, the respondents' educational level was significantly associated with the needs of topics related to oceanic leisure, oceanic science and oceanic resources. Surprisingly, the respondents with college or university qualifications were recorded with the lowest mean score of the needs of three lesson topics. The study results were in line with other studies, indicating that young participants are likely having lower environmental concern (Cheung & Fok, 2013) or not keen on environmental conservation (Lee, 2008). Marital status is another demographic characteristic indicating a significant association with needs of marine education. Single participants recorded the lower mean score of needs of five lessons topics comparing with married participants with children. This may be because parents have higher concern with environmental issues.

Table 2
Differences in needs of marine education within participants' demographic characteristics

Variables	n	Oceanic leisure	Oceanic society	Oceanic culture	Oceanic science	Oceanic resources
Gender						
Male	170	3.65	3.46	3.53	3.61	3.68
Female	218	3.74	3.47	3.63	3.60	3.75
t value	388	-1.071	-0.106	-1.415	0.130	-0.967
Age groups						
19 or below[1]	137	3.34	3.14	3.37	3.28	3.38
20-29[2]	73	3.83	3.55	3.62	3.71	3.79
30-39[3]	93	3.95	3.73	3.79	3.85	3.93

40-49[4]	55	3.97	3.73	3.79	3.77	4.05
50-59[5]	19	3.53	3.26	3.32	3.46	3.59
60 or above[6]	11	4.05	3.73	3.84	4.09	4.27
F value	388	10.240***	8.469***	6.159***	8.618***	10.327***
Post hoc test		1 < 2, 3, 4	1 < 2, 3, 4	1 < 3, 4	1 < 2, 3, 4, 6	1 < 2, 3, 4, 6
Educational level						
Junior high school or below[1]	24	3.69	3.44	3.66	3.81	3.85
High school[2]	77	3.71	3.51	3.56	3.56	3.69
University or college[3]	251	3.64	3.42	3.56	3.54	3.65
Graduate school[4]	36	4.07	3.68	3.81	3.95	4.17
F value	388	2.992*	1.088	1.396	3.427*	4.685**
Post hoc test		3 < 4	-	-	3 < 4	2, 3 < 4
Marital status						
Single[1]	238	3.56	3.34	3.50	3.48	3.58
Married[2]	20	3.70	3.45	3.46	3.55	3.59
Couple with children[3]	128	3.93	3.69	3.76	3.82	3.99
Others[4]	2	4.50	4.50	4.50	4.50	4.50
F value	388	6.692***	6.168***	5.237**	6.334***	8.663***
Post hoc test		1 < 3	1 < 3	1 < 3	1 < 3	1 < 3

Note. *p<.05; **p<.01; ***p<.001.

Conclusions

While environmental education has been regarded as a vital part of marine festival, it remains unclear what content the participants would like to learn during the festival. This study revealed participants of the Kaohsiung Ocean Expo have a medium need of marine education. It was outlined that education is indeed an expectation of participants of marine educational activities. In addition, the results suggested that adults, participants with master degree or above, and married couples with children have higher desires for marine education. This study could help authorities and organizers of the marine festival for developing more appropriate strategies for effective marine education.

Acknowledgements

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References

Andersen, M. S., & Miller, M. L. (2006). Onboard marine environmental education: Whale watching in the San Juan Islands, Washington. Tourism in Marine Environments, 2(2), 111-118.

Ballantyne, R., & Packer, J. (2005). Promoting environmentally sustainable attitudes and behaviour through free-choice learning experiences: What is the state of the game? Environmental Education Research, 11(3), 281-295.

Ballantyne, R., & Packer, J. (2011). Using tourism free-choice learning experiences to promote environmentally sustainable behaviour: the role of post-visit 'action resources'. Environmental Education Research, 17(2), 201-215.

Cheung, L. T. O., & Fok, L. (2013). Assessing the role of ecotourism training in changing participants' pro-environmental knowledge, attitude and behaviour. Asia Pacific Journal of Tourism Research, 19(6), 645-661.

Finger, M. (1994). From knowledge to action? Exploring the relationships between environmental experiences, learning, and behavior. Journal of Social Issues, 50(3), 141-160.

Frantz, C. M., & Mayer, F. S. (2014). The importance of connection to nature in assessing environmental education programs. Studies in Educational Evaluation, 41, 85-89.

Kuo, L.-H., Yang, H.-J., & Lin, Y.-W. L. L. (2012). Overcoming the imbalance in the supply and demand of professionals in the marine industry: Professional development of marine education in Taiwan. African Journal of Business Management, 6(32), 9202-9209.

Lück, M. (2003). Education on marine mammal tours as agent for conservation—but do tourists want to be educated? Ocean & Coastal Management, 46(9–10), 943-956.

Lück, M. (2015). Education on marine mammal tours – But what do tourists want to learn? Ocean & Coastal Management, 103, 25-33.

Lee, J., Kyle, G., & Scott, D. (2012). The mediating effect of place attachment on the relationship between festival satisfaction and loyalty to the festival hosting destination. Journal of Travel Research, 51(6), 754-767.

Lee, K. (2008). Opportunities for green marketing: Young consumers. Marketing Intelligence & Planning, 26(6), 573-586.

Ministry of Education (2008). Program for infusion fundamental conception of Marine Education in primary and secondary school curriculum guideline. Taipei: Ministry of Education, Taiwan (R.O.C.).

Sabah, A. A. W., Mahmood, Y. A., & Melanie, H. (2003). The need for inclusion of environmental education in undergraduate engineering curricula. International Journal of Sustainability in Higher Education, 4(2), 126-137.

Zorrilla-Pujana, J., & Rossi, S. (2014). Integrating environmental education in marine protected areas management in Colombia. Ocean & Coastal Management, 93, 67-75.

College Students' Conceptual Understanding and Misconceptions About Climate Change

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Climate change is among the most serious challenges that confront humanity. This phenomenon haunts people from various walks of life across generations. With impacts ranging from extreme weather events and periodic inundation and droughts, to property damage and food scarcity, it has been an alarming reality the Philippine community faces. Severely affected are those residing in coastal and lower rung urban communities, as well as typhoon prone regions, which constitute a large areas of the country. But pressing as it is, there is a growing gap on the degree of understanding and awareness people have on its nature, mechanism, and the concepts and principles that govern its occurrence.

Whether concepts and principles on climate change are learned and correctly understood by college students are the objects of this study. Furthermore, this study aims to determine if students are being provided with necessary requisites to improve knowledge gains and correct misconceptions to a levels of learning and thinking skills that will promote effective translation of knowledge into meaningful decision making, behavior and practices.

Using the Climate Change Key Concept and Principles Inventory, college students from different year levels and course programs were invited to participate in this study. Deeper exploration was accomplished by focus group discussions to unveil beliefs, perceptions and misconception on climate change.

Data gathered suggested variable levels of conceptual understanding among students, and the existence of some misconceptions. Discernible patters are established in relation to some demographic characteristics of this group of respondents. Students pursuing science-related courses on the last two semesters of their degree completion demonstrated the highest level of conceptual understanding, and with minimal misconceptions.

More discourse relating to this area of exploration may lead to an in-depth picture of how education, through the science curricular framework address the need to educate the students toward sound environmental practices that promote resilience and mitigation initiatives to avert the devastating effects of climate change.

Keywords: *Climate Change, Conceptual Understanding, Misconception*

Corporate Social Responsibility as a mechanism of Community Development

A Study of the Nigeria Liquefied Natural Gas Limited's CSR for Bonny Kingdom, Niger Delta Nigeria

Wopara Goodness Ruhuoma

Abstract

The study focuses on how the Corporate Social Responsibility (CSR) of a gas company can be a factor in the development of the local community in the Niger Delta. To understand the perceptions of the company and the community about how CSR can be a vehicle for community development. This research employs various qualitative research methods such as interviews, focus group interviews, semi- structured questionnaires and document analysis. The research argues that CSR as a mechanism of community development is like the 'icing on a cake': It is supposed to be an added advantage to compliment government and community efforts towards development, rather than the overall answer to community development.

Keywords: Corporate Social Responsibility, Community development, Partnership, Power relations.

Introduction:

Today, there is a persistent call for companies operating in the Niger Delta to act socially and environmentally responsible from a range of stakeholders like host communities, government, and shareholders (Eweje, 2011). This, means that there is an acknowledgement that business can play a crucial role in reducing poverty and social inequality prevalent in the Niger Delta. The concept of Corporate Social Responsibility (CSR) has therefore been debated for a long time on how large companies like the Nigeria Liquefied Natural Gas Limited (NLNG) can assist in sustainable community development (Moon, 2004).

Previous researches on how CSR can be a means to community development has shown that poorly designed and implemented CSR strategies and projects can lead to waste of resources, hamper company objectives of the triple-bottom line of profit, social licence to operate and competitive advantage. It can also have negative impacts on the recipient community, worsen corporate-community relationships and hamper corporate- community partnership (Newell, 2005). Partnership is said to have the potential to create an enabling environment in which the company and its host community can thrive (Idemudia, 2007). For CSR to have the intended and expected impact on the host community and also benefit the company, corporate-community relationships and partnerships have to be based on balanced power relations, trust and social cohesion and adequate engagement of all interested stakeholders (Garvey & Newell, 2005).

Most companies believe that CSR is a voluntary management decision to give back to the society by doing philanthropic gestures to their host communities (Eweje, 2006, p.93). The findings of this research reflects the opposite as host communities believe that CSR is the company's payment for the negative externalities resulting from their operations This research seeks to understand how CSR can be a means of achieving community development by comparing the perceptions of Bonny Kingdom as the host communities to that of NLNG's perception on its CSR policies and practices. This is necessary in order to find a common ground. Qualitative research method of interviews, focus groups and document analysis were utilized and analyzed using the thematic tools. These were used to sample the opinions and perception of the community people and the company on the NLNG-Bonny Kingdom relationship and partnership, the internal community processes and its implications for the development of the Bonny Kingdom.

The Bonny Kingdom is an ancient community located in Rivers State, Nigeria. As characteristic of other Niger Delta communities, Bonny Kingdom hosts major oil and gas companies that explores and produces crude oil and gas for export and national consumption. Despite the contribution of Bonny Kingdom to the national economy, it faces socio-economic development and environmental challenges. The Nigeria Liquefied Natural Gas Limited (NLNG) is one of the companies operating in Bonny Kingdom. The company has embraced CSR as a means of securing its triple-bottom line objectives of profitability, social licence to operate and competitive advantage. There is a possibility of CSR becoming a means of achieving community development of NLNG's host communities. However, the Bonny Kingdom has a unique characteristic that distinguishes it from the rest of the communities in the Niger Delta. The kingdom has an already established monarchy and a social hierarchical structure that is respected by both the NLNG and the people. This has impacted the discourse of CSR as a corporate strategy and a vehicle of community development. The unique power relations and social processes in Bonny Kingdom plays a significant role in the attainment of both NLNG's CSR strategies, relationship and partnership, business goals and community objectives of development.

This research realized that the adoption of corporate social responsibility (CSR) policies and corporate–community partnership (CCP) strategies by the NLNG has not fulfilled the intentions of the company nor the expectations of the people of Bonny Kingdom. The

absence of an enabling environment for CSR to thrive has been blamed on government failure. Faulty internal community relations, ineffective conflict management mechanism, corruption, self-seeking, lack of community cohesion and trust factors have also been identified by this research as the reason for the problem. There is an over-emphasis on the responsibilities of oil and gas companies on the negative consequences of their business operations on the environment and livelihood of the Niger Delta people in the CSR and community development literature. This debate borders on the question of who has the responsibility of community development in the Niger Delta. Is it oil and gas companies through their CSR policies or is it solely the responsibility of the Nigerian government? This has created the blame game syndrome for development tragedies in the Niger Delta. The host communities increasingly agitate for oil wealth benefits and are in constant opposition to both the government and the companies but the companies tend to receive more criticisms and demands for oil wealth benefits than the Nigerian government.

The research argues that corporate social responsibility is not the sole answer to the challenge of community development of the Niger Delta in general and Bonny Kingdom in particular. The main concerns for companies like NLNG is profit making, wealth creation and contributing to the Nigerian economy. The Nigerian government on its part is to ensure that national wealth is distributed equally in the country by championing development. While the government and the local communities are to ensure that they provide the enabling environment for CSR to be effective, community development should not be left at the mercy of CSR, the government or the community alone. There should be cooperation between government, NLNG and Bonny Kingdom. There should also be adequate multi-stakeholder partnership and engagement. Trust, social cohesion within and between the communities are also important and thus, should be encouraged.

Therefore, CSR is supposed to be the 'icing on the cake. An added advantage that host communities should enjoy because of the presence of NLNG in their community. CSR is meant to compliment government and community effort in the pursuit of community development.

Research Objectives:

The main objective of this study to investigate corporate social responsibility (CSR) as a vehicle for community development. The study also investigates how CSR generates mutual benefits to both business and society. For NLNG, CSR would be an achievement of business goals and community development for Bonny Kingdom. The empirical evidence used in this study is based on a case study of NLNG's CSR strategy, projects and initiatives and for the development of its primary host community. CSR was used throughout the thesis in contextualizing the social and environmental responsibilities of oil and gas companies operating in Bonny Kingdom like the NLNG. The meaning of CSR was discussed in details in chapter 3 of this research.

Research Questions:

The general research question is;

- To what extent can Corporate Social Responsibility lead to community development?

Sub-Questions:

- How does NLNG (the company) perceive their CSR strategy to lead to community development?

- How do host communities perceive NLNG's CSR strategy to lead to community development?
- What ways do the perceptions of the company and the communities differ?

Research Methodology

The methodology employed for this research is qualitative research. The data used to undertake this research included; focus group interviews and individual in-depth interviews. Due to difficulties in obtaining research access with the company, the data used to understand the perceptions of the company was gathered from official NLNG documents and an emailed questionnaire for NLNG. The research also undertook document reviews of past researches, journal articles and books to aid the researchers understanding on the topic under investigation. The focus group and individual in-depth interviews made use of a semi-structured interview guide. The sampling method used in the research was purposive in nature using snowball method. Lastly, the data generated was thematised using the data analysis software called Nvivo 10.

Part 1

Background:

Nigeria, is the most populous nation in Africa with an estimated population of 177,155,754 (CIA, 2014). Nigeria is a country blessed with substantial petroleum deposits. Oil production started in 1958 with the discovery of crude oil in commercial quantity at Oloibiri, Bayelsa State in the Niger Delta (Oviasuyi & Uwadiae, 2010, p. 111). Nigeria is the world's 13th largest oil producer, and the 6th largest in Organisation of Petroleum Exporting Countries (OPEC). Petroleum production accounts for 80% of government revenue, 95% or export earnings and 90% of foreign exchange earnings (Watts, 2004 p. 50). After an April 2014 statistical "rebasing" exercise, Nigeria has emerged as Africa's largest economy. The GDP for 2014 is estimated at US$ 479 billion. Oil has remained a dominant source of government revenues since the 1970s (CIA, 2015).

However, the recent economic diversification, strong growth and increasing oil wealth have not resulted in a significant decline in the poverty levels of Nigerians. Statistics from the World Bank demonstrates that Nigeria remains a middle income country. Indicators also show that 46 % of population are within the national poverty line. Also that 62% of the Nigerian population live on less than 1.25 per day[1] (World Bank, 2015). Nigeria is a country marked by lack of infrastructure, unreliable conflict resolution mechanisms, insecurity, and pervasive corruption, etc. (CIA, 2015). Scholars like Sachs (2005) and Collier (2007) believe that this situation is caused by 'resource curse'. This is because of the combination of, or a strong association between over- dependence on natural resources, corruption and poor economic performance (Watts, 2004). Thoughts about the important role of oil and gas companies in the development of a country has spurred the Corporate Social Responsibility (CSR) debate among businesses and scholars like Henderson (2001). Nigeria Liquefied Natural Gas Limited is among those companies that believe in Corporate Social Responsibility (CSR). CSR becomes a way the company can contribute to the development of local communities in the Bonny Kingdom.

The Niger Delta and Efforts towards Its Development:

[1] 2010 estimates

The Niger Delta region is made up of nine states. They are; Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, .Imo, Ondo, Rivers states. The region has an estimated population of about 28 million people. The region has a rich cultural heritage with about 40 different ethnic groups speaking 250 languages (NDDC, 2004 p.49, 53). The region is recognized as the world's third largest wetland and is characterized by significant biodiversity. The region hosts 11 major oil producing companies with a total of 159 oil fields and 1481 oil wells. The region also hosts a petroleum refinery, a petro-chemical plant and the Liquefied Natural Gas (LNG) Plant located at Bonny Island in Rivers State (NDDC 2004. P. 75).

The vast oil wealth of Nigeria is generated from the Niger Delta Region. Despite this, there is a major disparity between the wealth the region generates and the level of the region's human and infrastructural development (Oviasuyi & Uwadiae, 2010, p. 111). The socio-economic reality of the Niger Delta region is a paradox of poverty amidst plenty. Per capita income is low and there is a high rate of poverty. More so, 70% of the population are living at subsistence level mostly from agricultural activities (Ite 2007, p.219). This is as a result of the insensitive oil exploration and production processes of the oil companies. This has under-determined the traditional occupation of the people: fishing and farming. Another reason being the neglect of the people's welfare by the Federal Government of Nigeria (Oviasuyi & Uwadiae, 2010, p. 111).

Under the section 16 of the 1999 constitution, all government revenues of the Federation are paid into the Federation Account. The revenue allocation formula consists of; Federal Government 48.5%, States 24%, local governments 20% and special funds 7.5 % and the 15% derivation funds allocated to meet the development challenges of the Niger Delta states. The revenue is shared vertically among the three tiers of government and horizontally between the state and the local governments (NDDC 2004, p.52). Based on this, efforts have been made by different government administrations to solve the development challenges of the Niger Delta. As early as the colonial administration, the Niger Delta Development Board (NDDB) was established in 1960. This was based on the recommendation of Sir Henry Willink's Commission in 1958. The recommendation stated that the region be given special development attention. However, the establishment did not survive nor accomplish much because of the Nigerian civil war in 1967 (Okolo, 2014 p. 37-38). The President Shehu Shagari administration (1979-1983) also made an attempt at tackle the developmental problems of the region. He did this by setting up and allocating 1.5% of the federation account to a Presidential Task Force (PTF) or the '1.5% Committee' in 1980. The committee executed few projects. But the projects did not reflect the funding allocated nor did it reflect on the wellbeing of the people in the region (Osaghae, 2015, p.5; NDDC, 2004, p. 102, Okolo, 2014 p. 38).

Furthermore, in 1992, the General Ibrahim Babangida administration set up the Oil Mineral Producing Areas Commission (OMPADEC). This establishment was allocated 3% of the federation account for the same purpose. This establishment made the Niger Delta people hopeful about a possible solution to their development challenges. But the establishment was marred with high level of corruption, mismanagement of funds and excessive political interference, lack of transparency and accountability. As a result, it brought disappointments especially due to the numerous abandoned projects and huge debts it incurred. (Osaghae, 2015 p.4; Omotola, 2007, p.79)

After these numerous failed attempts by the government, the region became volatile as frustration and discontent mounted. The people lashed out on the oil and gas firms and the government. In the local communities of the Niger Delta, there were massive crisis where the

youths pitched against the oil companies and government. The youths shut down oil installations, damaged oil facilities, and kidnapped company employees. It was tedious to the extent that the youths from the oil-producing states threatened the Federal Republic of Nigeria to break away and become an independent Republic. The youths blamed the government for being incapable of resolving the environmental degradation, and ensure payment of adequate compensation to the people. The land use decree of 1978 gave the federal government ownership of all land. Thus, the people felt deprived of their rights to their ancestral land. The people also protested the destruction of their traditional sources of livelihood. (Orubu, Odusola & Ehwarieme 2004, p.203-204)

The Niger Delta Development Commission (NDDC) was therefore introduced in 2000 as the current solution to the Niger Delta challenge. Funding for the NDDC includes; 15% of the Federation account, 3% contributions of oil and gas companies' total budget, 50% ecological funds to oil producing states, and other sources like grants, loans etc. The NDDC has the vision;

> *"...to offer a lasting solution to the socio-economic difficulties of the Niger Delta Region"*. The mission is *"to facilitate the rapid, even and sustainable development of the Niger Delta into a region that is economically prosperous, socially stable, ecologically regenerative and politically peaceful"* (NDDC, 2004, p.103).

From the findings of his research, Okolo (2014) believes that NDDC as an intervention is based on a *'fire-brigade approach'*. This is has resulted in the various ad-hoc remedial measures the commission uses (p. 47). Some issues tend to limit the commissions' effectiveness one of which is corruption. Another is the frequent leadership change in the NDDC. Finally, the inadequate evaluation of the NDDC also presents a performance measurement dilemma (Omotola, 2007 p. 82-83).

About Bonny Kingdom:

Bonny Kingdom is an Island located within the tidal mangrove swamps of the eastern part of the Niger Delta. Bonny Kingdom lies about 50km southeast to the industrial and commercial centre of Port Harcourt. The kingdom is also surrounded by other Ijaw communities, like the Elem Kalabari to the west, Okrika to the north, and the Andoni, Opobo, and Ogoniland to the east all in Rivers State, Nigeria (Fentiman, 1996 p. 87). Bonny has a population of about 254,820[2] people. Historically, Bonny was regarded as 'the most powerful kingdom in nineteenth century Eastern Niger Delta and its hinterland' (Wariboko 1998, p.3). Occupationally, the Ibanis were fishermen as Fish are in abundance in the surrounding creeks, waterways, and swamps. Bonny had a central role as a trading centre with the Ibo hinterland and the European traders. Trade consisted of food stuffs like yams, fish, salt, livestock, and slaves. The Bonny traders became the middlemen in the Trans-Atlantic slave trade as a result of the growing demand for slaves in Europe and Americas. Bonny's coastal location also, informed her participation in the flourishing slave trade that lasted until the 19th century (Fentiman, 1996 p. 88).

[2] Projected population growth for Local Governments in Rivers State. Based on 2006 census figures. Annual Abstract of Statistics (2012)

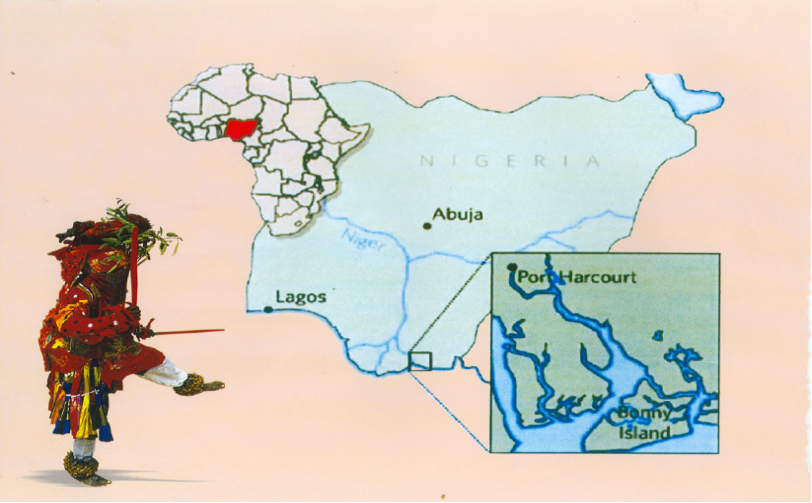


Figure 1 Map showing Bonny Kingdom. (NLNG, 2007).

Bonny Kingdom was engaged in a civil war with Andoni its neighbour in 1869 in which it was defeated. The slave trade and the war were central because, it expanded trade opportunities by unlocked new trade routes for the slave trade. More importantly, it was influential in reshaping the political and institutional landscape of the Bonny Kingdom. This is because of the defeat suffered to the Andonis. There was an urgent need to make the war leaders their kings and thus have an 'all-powerful' centralized authority (Jones 1963 in Lovejoy & Richardson, 2004, p.384). The Ibanis have long a long genealogy of Kings or Amayanabos. The current Amayanabo and natural ruler of the ancient Grand Bonny Kingdom is King Edward Asimini William Dappa Pepple (iii) Perekule XI, (CON), JP. Bonny Kingdom is made up of communities or houses. There are 34 Houses or communities. 14 of these are major houses (i.e. Opuwari and Duawari) while the remaining 20 minor houses are under the Kalawari major house. The king is the head while the chiefs from the major houses forms the Bonny Council of Chiefs. However, there are also some chiefs from the minor houses in the council (NLNG, 2010 p. 13).

The Role and Importance of Traditional Authority:

The importance of traditional rulers in the socio-political scene in the Niger Delta cannot be over-emphasized. Before the colonial period, the traditional rulers were responsible for the development of their communities. The traditional rulers exercised executive, legislative and judiciary powers over their domains. During the colonial period, the British colonial government did not discard the traditional power structures. Instead the British government backed up their powers with constitutional provisions. Constitutions like; the Clifford Constitution of 1922, the Richard constitution of 1946, etc recognized the traditional authority (Peter 2014, p. 138). The post-colonial administrations including military regimes also recognized that the traditional authority was powerful and respected among the peoples. However, the military regimes absolved the traditional authority from formal governmental affairs. The administrative powers of the traditional authority was limited to advisory roles. This was captured in the Local Government Reforms of the 1976, 1979, 1989 & 1999 constitutions (Emordi & Osiki, 2010 in Amusa & Ofuafor, 2012 p.410). However, this does not mean that traditional institutions lost their influence and authority over their domains, instead they have continued to play a conspicuous role in socio-political system of Nigeria (ibid p.411).

The people living in the rural areas where these traditional rulers wield their authority hardly experience the impact on government. This is due to the rurality of their locations. Rural people seem not to understand and follow government activities and policies. As a result, these people depend on their traditional rulers for information and guidance rather than the government (Antwi-Boasiako & Bonna, 2009 p. 113). There is also a perceived distance between the government and the people arising from continued government's inattention to the peoples' needs. These traditional rulers practically become the only institutions of governance the people get to experience. Generally, Nigerians still have strong affiliation and respect for the traditional authority (Akume 2013, p. 30). Traditional rulers play an active role in the socio-economic development of their communities by facilitating labour and revenue mobilization. Traditional rulers can also initiate and facilitate partnership with the federal, state or local government. This can be done by planning and executing development projects. They can channel resources from the government or private institutions to fund local development projects, etc (Olowu & Erero, 1995 p.6, 7).

The traditional rulers in Bonny Kingdom exercise strong governance, authority or influence over the communities in their domain. Traditional political system is communist and the authority structure is hierarchical in nature (Akume, 2013 p. 30). The office of the traditional rulers in the Bonny Kingdom are permanent and hereditary. At the apex is the King (Amayanabo). Next in authority are the district and regional chiefs (Amadabo) which forms the Bonny Council of Chiefs. These are followed by the Council of Elders who are also the King's cabinet members and advisers. As part of the established procedures based on custom and tradition, decisions are arrived at after a consensus on all matters. This is necessary to curtail autocracy and abuse of powers by the king. The king and his cabinet work together as the custodians of customary law, cultural values and religious practices. They preside in matters like conflicts resolution and are the custodians of communal land (Olusola & Aisha, 2013 p. 120). The people on their part are absolutely submissive and loyal to the authority of their rulers while the rulers are expected to work for the good and welfare of the entire community (Amusa & Ofuafor, 2012 p.408).

There is a well-established system of traditional flow of authority and information in the Bonny Kingdom. This includes; traditional rulers, council of chiefs, councils of elders and the community development committee (CDC) in charge of development issues. The CDC is a body that relates with oil companies, INGOs, NGOs, the government or specific governmental agencies and international organisations on community development matters (Akpan, 2006 p.232). In Bonny Kingdom this body is known as the Bonny Kingdom Development Committee (BKDC). The BKDC was set up by the king and his cabinet comprising of appointed chiefs and community group heads (youth and women groups) and other trusted community members.

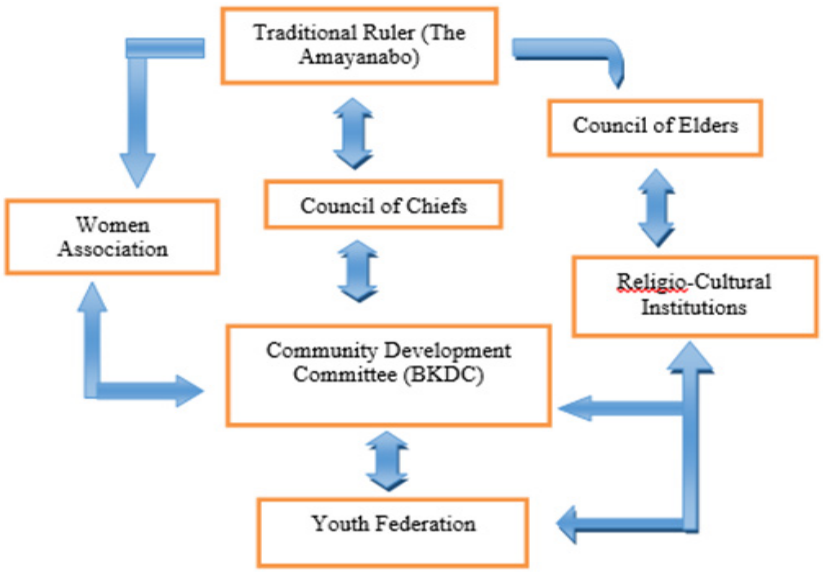


Figure 2: Structure of traditional authority and information flow in oil-producing communities. (Orubu, et.al., 2004, p. 210).

The Youth Association and Women's Council are also important in the community hierarchy. The former, an association of men and women with age ranging between 18 and 40 years function as a vehicle for mobilising youth dynamisms directed towards community projects requiring voluntary (or paid) local manual labour. Much of the oil-related grassroots mobilisation in the Niger Delta takes place under the auspices of youth associations (Akpan, 2006 p. 233). The traditional organisational structure is one in which consultation, decision making, conflict resolution and distribution of CSR benefits rests solely on the king and his cabinet, BKDC plays and advisory role but the entire process enjoys explicit support from all subsystems, including the religio-cultural institution (Orubu, 2004 p. 209).

Some other communities in the Niger Delta like the Igbo tribes do not have this kind of institutional makeup. Some of these communities have a kind of 'stateless', and 'acephalous' traditional system both historically and contemporarily. This means that these communities were governed by 'diffused' authority without formal, permanent, or hereditary kingship positions (Olowu & Erero 1995 p. 9; Hameit-Sievers 1998, p.59). The political and administrative system has at the base of the hierarchy, the family which constitutes the kindred or Clan. These clans or kindreds make up the village structure. Male heads of each clan constitute a 'representative assembly' of the village. Decisions are based on consensus and are respected and accepted as binding on all members of the community. (Hameit-Sievers 1998, p.59) There are also other traditional ruling bodies like Council of Elders (Ndichie) that resolve conflict in the community (Olowu & Erero 1995 p. 9). The elders are advanced in age and are given high regard because of their experience and often join in the decision making. Youth associations in other Niger Delta communities are challenging the status quo because they believe the chiefs are 'slow' in obtaining the expected benefits from both the government and the oil and gas companies (NDDC, 2004 p. 52). In Bonny Kingdom, the youths do not challenge the traditional authority and also do not make independent decisions and act on them without the permission of the traditional authority mostly because of the cultural implications. But in other Niger Delta communities, youth council and women associations can make independent decisions and act on them. However, these actions and decisions are often expected to have received the 'blessings' of the traditional authority and the support of the whole community. The acknowledgment of this intricate system of authority and information flow is central to conflict resolution from petroleum related

conflicts in the Niger Delta (Orubu et. al., 2004 p. 209). These differences are important in order to distinguish the uniqueness of the Bonny Kingdom and will drive the understanding of power relations and community relationship in the kingdom

About Nigeria Liquefied Natural Gas Limited (NLNG):

Nigeria LNG Limited (NLNG) is a limited liability company incorporated on May 17, 1989 to exploit Nigeria's vast natural gas resources. The company's role in Nigeria was seen as a solution to the problem of gas flaring in the Niger Delta region of the country (NLNG, 2014). The Plant was built on 2.27 sq.km of largely reclaimed land in Finima, Bonny Island and produces Liquefied Natural Gas (LNG) and Natural Gas Liquids (NGLs) for export purposes. Ownership of the company constitutes four shareholders, namely, the Federal Government of Nigeria, represented by Nigerian National Petroleum Corporation (NNPC), Shell SPDC, Total LNG Nigeria Ltd and Eni AGIP. In 1995, a Final Investment Decision (FID) was signed by the shareholders to build a Liquefied Natural Gas (LNG) plant in Finima, Bonny Island. Other facilities are a materials off-loading jetty, a passenger jetty terminal and residential area (NLNG, 2014 p.20, 21). NLNG is currently one of the major supplier of Liquefied Natural Gas in the Atlantic Basin, serving the European, North American and far Eastern markets (NLNG, 2014 p. 21). Bonny Kingdom is the main host community of the NLNG. This is because, the main Liquefied Natural Gas plant is located in Finima. Finima also hosts other major facilities like the water-wells and the residential area. Six communities in Bonny Kingdom are hosts of the company's Gas Transmission System (NLNG, 2014). NLNG Gas Transmission System (GTS) cut across 110 communities in nine Local Government Areas of Rivers State, Nigeria.

Part 2

The Concept of Corporate Social Responsibility (CSR):

During the last decade, we have witnessed an important debate about the social responsibilities of corporations in assisting in the social and economic development of their host communities (Eweje 2006 p. 95). Corporate Social Responsibility (CSR) is seen not only as a means by which business can mitigate the impact of the negative externalities that arise from its operations but also as means to contribute to sustainable development as part of their obligation to their host communities, their stakeholders and to the host nation at large.

There has been different definitions of CSR. A recent study identified 37 definitions of CSR (Carroll & Shabana 2010, p.89). This is because, the definition of what the social responsibility of businesses are, is constantly changing. There are core disagreement between critics and advocates of CSR as relates to the nature and scope of what constitutes the social responsibilities of businesses. It also relates to the differences in perceptions and understanding of the function and objectives of the company in any given society (Idemudia & Ite 2006, p.194). Two of the popular definitions of corporate social responsibility are:

> *"The firm's consideration of, and response to, issues beyond the narrow economic, technical and legal requirements of the firm to accomplish social benefits along with the traditional economic gains which the firm seeks"* (Davis 1973, p. 312).

> *"Encompassing the economic, legal, ethical and discretionary expectations that society has of organizations at a given point in time"* (Carroll 1979, p. 500).

Some common themes can be recognised from these definitions of CSR. The most prominent theme is that a company's CSR activities should exceed what the law requires in its obligations towards the society. For example if an oil and gas company abides by the

environmental laws, it does not necessarily mean that it is socially responsible. It means that it is a law- abiding corporate citizen. However, if the company uses its resources to promote community welfare like providing free health service, it can be termed a socially responsible company (Banerjee 2007, p.18). Another recurring theme in these definition is the discretionary and voluntary views on CSR. It means that CSR cannot be imposed on the company by the law. Companies that choose to engage in CSR activities are however expected to do so following local, regional, national and international codes of conduct that are not legally binding (Carroll & Shabana 2010, p.88). Finally, the conceptualizations of 'society' and the 'social' tend to have been narrowed over the years to mean 'stakeholders'. This is based on the assumption that stakeholders are representatives of societal interests and pressurize these companies to respond to these interests (Banerjee 2007, p.18).

Carroll (1979), classified CSR into economic, legal, ethical, and voluntary responsibilities. According to him, the economic responsibility entails businesses can achieve their multiple corporate goals and long-run profit maximization by incorporating CSR into its business objectives. The legal aspect entails expectations that businesses should 'play by the book' by carrying out its business within the legally ascribed frameworks. Laws defines the limits of tolerable behaviours of businesses, but do not define ethics (i.e. the right or wrong of business character. This means the expectation of society is that businesses should be ethical and 'do the right thing'. For instance; preventing social and environmental harm like pollution, etc (Jamali & Mirshak, 2006 p. 247). Most businesses have subscribed to the voluntary CSR. The four responsibilities as a whole form the crust of social expectations and CSR of businesses. For example, businesses that want to be ethical (do the right thing) must be economical (not just seek profitability alone but to allow the economy to inform clear-cut incentives and opportunities to do CSR). More so, businesses can be legally responsible (Follow the established laws of the state as a good corporate citizen. They can engage in philanthropic and voluntary activities as a way to prove their responsibility. Carroll's pyramid of the social responsibility of businesses as represented in figure 3 below explains the concept.



Figure 3: Hierarchy of Corporate Social Responsibilities (Carroll, 1991).

Economic and legal responsibilities are socially mandatory, ethical responsibility is socially expected, while philanthropy is socially desired and each of these responsibilities embraces a piece of the total social responsibility of a business organisation (Jamali & Mirshak, 2006 p. 248).

Reasons for Engaging in CSR:

There are four broad reasons why companies embrace CSR as part of their business policies and strategies. They are; moral aspects, sustainability, social license to operate, and reputation (Porter & Kramer 2006, p. 3). The moral aspect has to deal with 'doing the right thing'. Some of the ways businesses apply morality as CSR is for instance, honestly reporting its financial statements, obeying environmental laws, etc (ibid, p.4). Sustainability on its own

appeals to the triple bottom line of environment, social and economic performances. It is by avoiding detrimental social and environmental activities that companies reflect sustainability in their CSR (Eweje 2011, p.127). In addition, the aspect of social license to operate concerns the concrete ways in which a company can identify social challenges which the stakeholders consider important and act proactively to resolve them. Gaining social license to operate encourages constructive dialogues with identified stakeholders. This reason is popular among extractive companies since they rely on government consents and the tolerance of their immediate neighbours like host communities (Prno, & Slocombe, 2012 p. 351; Hah & Freeman, 2014, p. 128).

Finally, concerns about reputation is based on acquiring a positive social license to operate and the ability to satisfy the expectations of the society. However, most oil and gas companies have reputation issues especially due to environment related concerns. Hence, they pursue CSR in hopes that their consciousness for the environment may cushion public criticisms of their business operations. Sometimes, they pursue these through massive marketing campaigns and public relations (Porter & Kramer 2006, p. 4; Banerjee 2008, p. 62). Competitiveness is an added advantage which companies achieve from engaging in CSR. Every company operates in a competitive environment. However, when a company is noticed by its stakeholders as having quality corporate agendas towards CSR that incorporates social and economic benefits, they have justifiable pride to be associated with that company as against similar companies (Porter & Kramer, 2006, p. 4). All these reasons entails that CSR is a worthy cause that presents opportunities to create shared values that is mutually beneficial to both business and society.

CSR and Sustainable Development:
The debate of integrating sustainable development into CSR was introduced by the 1987 Brundtland Report. The main ideology is that, the development of a community must be balanced with the necessity to satisfy human needs. The corporations are to focus on negative consequences of their business operations which could threaten the existence of the future generations (Eweje, 2011, p. 127). Integrating sustainable development into corporate strategy can be challenging and complex and these companies have to deal with these challenges and complexities. This can be achieved by identifying opportunities, and their responsibility towards the environmental, social, and economic aspects of their operations (Baumgartner 2014, p. 259).

The concept of sustainable development in CSR connotes a company's capacity to resolve the expectations of their present direct and indirect stakeholders without jeopardizing their capacity to meet the expectations of future stakeholders (Dyllick et al., 2002, p.131). In the same vein, Székely and Knirsch (2005. p.628), argued that it entails companies being able to maintain its corporate reputation, profitability, embrace ethical business practices, build and maintaining positive relationship with their stakeholders. There is a growing national and international interests on the role of CSR in the society as regards to the perceived and real effects of globalisation and development vis-à-vis in meeting the growing demands and expectations of the society. These interests hinges on the ideology that globalisation must grow in consideration or support of sustainable development not at the expense of it (Eweje 2014, p.4).

Stakeholder Theory and Corporate Social Responsibility:
Freeman (1984), one of the most influential scholars on Stakeholder theory, identified the stakeholders as a series of groups (e.g. workers, customers, suppliers, local community, etc)

that both affects and are affected by the company's actions. Stakeholders are those people who have certain interest in a venture; they may be either the beneficiaries of that venture or sponsors or those undertaking such venture (Russo & Perrini 2009, p. 209). So a "stakeholder" can be defined as;

> *"any individual, group, or institution who has a vested interest in the natural resources of the project area and/or who potentially will be affected by project activities and have something to gain or lose if conditions change or stay the same".*
> (Golder, 2005 p. 1)

Stakeholders are important as they must be considered if a CSR initiative will achieve its goals because their participation and support is vital to its success. A CSR development initiative must first identify all primary and secondary stakeholders and then develop a strategic view of the relationships between the different stakeholders and the issues they deem as important (Moura-Leite, Padgett, & Galán, 2014, p. 47).

Donaldson and Preston (1995) divided the stakeholder theory into three types of attributes: descriptive, instrumental, and normative. The descriptive is used to describe how a company operates and shows the merits and quality of the company's activities. The instrumental aids them to examine how stakeholder management can contribute to the achievement of organisation goals. And lastly, the normative attribute helps a company to carry their stakeholders along i.e. they provide an ethical justification for managing stakeholder relationship (Moura-Leite, et.al., 201, p. 47). There are two types of stakeholders identified by Ralston (2010); the primary stakeholders who are directly affected by a business' activity e.g. customers and investors. While the secondary stakeholders are those who influence or are affected by the company's activities, but do not directly participate in the company's business activities and are also not crucial for the company's survival examples e.g. local community, media and NGOs (p.401).

In CSR, stakeholders' theory stresses the importance of companies being able to recognize and embrace their responsibilities towards their local host communities when pursuing legitimacy vis-à-vis focusing on justifying the ethical considerations and meeting up with legal requirements. This means that implementing CSR initiatives has the ability to reinforce the relationship between the company and its host communities. (Hah & Freeman 2014, p. 128). The incentive for CSR lies in the company's need to attain and maintain trustworthiness and legitimacy i.e. for their host community to trust them and recognize them as a legitimate entity (i.e. grant them the social licence to operate). This ranges from passive conformity to active concessions, the company may need to prove itself by responding ethically to the demands, pressures and increasing expectations of local communities (ibid).

Community Development:

The interest in the concept and functionality of community development stems from the multidimensional ways in which communities take part in development efforts. This includes other external actor's inputs or capacity towards finding effective solutions to community challenges (Matarrita-Cascantea & Brennan, 2012, p.293). Debates about the conceptualisation of community development have taken place overtime. Previous conceptualizations of community development were accused of being narrow and centred on specific areas of specialization. For instance, definitions of community development were confined to economic growth or urban and infrastructural development. Recently, holistic and inclusive conceptualization of community development is being sought for. But without a straight forward definition of community development, scholars have defined the concept in relation to specific groups and to specific problems. Nowadays, community development is being discussed in the context of 'community' as a social phenomenon that involves

interaction, among a group of people with shared situations and geographical boundary (Theodori 2008 p.63). Based on this perception Theodori came up with a definition that sees community development as;

> *"The process … that depends largely on the intentional actions of people in a locality coming together and interacting with the intent of solving their local problems, improving their quality of life, and shaping their future wellbeing"* (Theodori 2008, p.64).

According to Azzopardi (2011), community development was intended to *"focus on the challenges facing families, neighbourhoods and communities, and the opportunity to reflect on how to regenerate positive and upbeat dynamics*" (p.183). He stated that past definitions had the tendency to be utopian and blind to the challenges that results from working with real people rather than with abstract beings (Ibid). Community development can be aimed at economic development i.e. improving the community's economic and financial resources. This can be through integrated efforts among community members aimed at negative conditions like poverty reduction, jobs creation, and income generation. More so, the concept has a human development aspect that strives for healthy and educated individuals, stronger social bonds and the ability to come together to pursue a purposeful collective action. Lastly, community development can be achieved through infrastructure development. (Richard & Dalbey, 2006, p.20).

Therefore, communities want to enjoy the benefits of economic growth, minimal impacts to environment, protection of natural areas, etc. Communities are looking for development approaches that achieve multiple benefits to help improve local economies and quality of life, etc (Richard & Dalbey, 2006 p.20). Though this sounds rather utopian, it reflects the desires of the community people. Local organisations, governments and community groups can work individually or in partnership aimed at bringing about or pursuing this utopia. This essentially buoys down to human needs. Human needs are not just physical but also non-physical. Physical needs are the basic needs of people like quality food, water, and shelter. While the non-physical needs are broader "quality of life" concerns like access to quality health; political and spiritual freedom; human rights; clean, healthy and natural environments, etc (Roseland, 2000 p 87). Most interventions to resolve development challenges in the developing countries tend to border on the aspects of needs (Ibid).

Corporate – Community Partnership (CCP):

Partnerships between the oil company and local community is gaining recognition as a channel for building local community support, strengthening the company reputation, and gaining legitimacy or the social license to operate (Loza, 2004, p.298). Partnerships can enable oil companies to be agents of building the capacity of their host communities. This can be accomplished by enabling local communities to make informed choices and take charge of their development needs. This is necessary to reduce dependency on the company or other development agents (Esteves & Barclay, 2011, p. 189). Corporate-community partnership (CCP) involves contributing capital and human resources such as assets like land, time, skills and leadership in order to meet the socioeconomic needs of the community where the company carries out its business operations. It involves strategic and innovative ways in which business interests can align with community interests so that there is a win–win solution to community problems and issues (Loza, 2004, p.299).

The purpose of partnership is to build collective idea and put together approaches that will enable them to tackle issues that might exceed the scope of the individual parties involved (Bowen 2005, p.74). The idea is to find a centre point (agreement) on how to solve a problem in an interactive manner that is guided by shared rules when making decisions pertaining to

their objectives (ibid). CCP is a broad concept and can refer to a wide range of activities like philanthropic activities done voluntarily or complex business and community partnerships that can also offer some financial benefits to the company (Idemudia 2014, p.3). However, the CCP model is criticized for seeing the company as a separate entity that is external to the community. It has also been criticized for being too 'western oriented' and narrow hence, it is not mostly appropriate for operation in developing countries (Idemudia 2014 p.156). According to Idemudia, (2014), oil and gas companies have adopted three major CCP strategies in dealings with their host communities across Niger Delta; they are traditional in-house corporate-community partnership model, the corporate-community foundation model and the global memorandum of understanding (GMOU) (p.157). The paper will however discuss two main CCP models adopted by the oil and gas companies operating in the Niger Delta.

Traditional In-House Corporate-Community Partnership Model

This model is the initial partnership undertaken by oil and gas companies operating in the Niger Delta. Under this model, the companies through their community relations department govern and make decisions on matters of community relations and social investments like infrastructures. The primary interaction with the host communities is through the local elites, such as chiefs and elders, religious leaders, etc and so relies heavily on traditional authority for information flow (Idemudia 2014, p.157).

Some of the advantages oil and gas companies stand to enjoy from this model are; because, it is administered by the management of the company, it enables them to display objectivity, discretion and flexibility over CCP decisions and practices. The model relies on the positive relationship with the local elites, it enhances the company's capacity to devise suitable corporate-political strategies and adequately respond to situations that might affect its business. (Idemudia 2014, p. 158)

The disadvantages of this model are that it can lead to community dependency instead of community empowerment. This is said to be the reason for increased community demands on oil companies. There is also the tendency for incompatibility between CCP objectives and the priority needs of the community. This is because, local elites often tend to push their selfish interest as against the community interests. More so, CCP projects do not give the community people a sense of ownership so they are likely to be unsustainable. Thus, it might hamper the possibility of a long-term positive relationship between oil companies and local communities (Idemudia 2014, p. 15).

Global Memorandum of Understanding (GMOU)

The global memorandum is a model that is geared towards addressing the development needs of the host communities. The company and the community enter a 'stand-alone' arrangement that is formalised by signing a Memorandum of Understanding or partnering agreement (Esteves & Barclay, 2011, p.196). In the Niger Delta, this model was initiated by Chevron following the aftermath of the 2003 Ijaw and the Itsekiri ethnic violent and destructive clashes in Delta State. This was as a result of the fact that previous models did not yield a stable operational environment for the company nor did it contribute to community development. Hence, the need for a new community engagement approach in the Delta. (Hoben, Kovick, Plumb & Wright 2012, p. 4). The model was a direct alteration from traditional method of negotiations with host and non-host communities by bringing together similar ethnic groups within close geographic proximity to form a GMOU cluster in most Niger Delta states (Idemudia 2014, p. 158). The model is usually operated under the sponsorship of a separate 'Community Fund' which is often used to address the social,

environmental and economic needs of the host communities (Esteves & Barclay, 2011 p.196).
According to Idemudia (2014), the advantages of the GMOU models includes; oil companies are able to maintain control over memorandum's decision making, plans and the outcomes of the CCP projects. One of the disadvantage of this model are that; it does not allow for effective community engagement. This is because, the model is still subject to the influence of the local elites and company staff. (Idemudia 2014, p. 159).

Power Relations:
Power is a broad, complex and multi-faceted theory that lacks a universally accepted definition. Scholars like Dahl (1961), Lukes (1974), Foucault (1980), etc have different views about whether power is conflictual or consensual and about how power is shaped (Csaszar 2004, p. 137). Hence, the different views on the theory of power cannot be fully discussed in this research. Nevertheless, this research will focus on relational power as it relates to corporate social responsibility. This is important to help guide the understanding of the power relations evident in Bonny Kingdom vis-a-vis NLNG's CSR and the bid to achieve community development.
The concept of power as it concerns governance mechanisms, state, society and businesses buoys down to the relationship between these actors. Relational power exists largely in the relationship between actors or between their positions in a social setting. This means that in order to understand the relationship between people in a social setting, we have to understand how a person, or group of persons, come to have power to control and power over others or each other (Reed 2013, p. 199, 200). Reed (2013), defined relational power as;

> *"the degree to which the structure of relations or ties between actors (where relations or ties can be variously constituted, and actors can be individual or collective) determines the ability of some actors to control or limit the actions of others, achieve their intentions over against the will of others, and generally possess the ability to direct social life, often to their advantage"* (p. 203).

Relational power is derived from positionality e.g. race, gender, class and other aspects of human identity that mark relational positions rather than important characteristics in the structure of social relations (Reed 2013, p. 203; Maher & Tetreault 1993, p.118). On the part of the communities, internal power relations is based on the shared values and objectives of a community. The people in trust and confidence, define certain positions of leadership, legitimize the occupants of such positions and also grant them the right to issue commands and make policies in line with these shared values and objectives. Hence, these leaders are empowered by the people to act in the name of and on behalf of the entire community (Scott 2006, p. 10). However, these leaders sometimes utilize these powers to produce their personal intensions or desired outcomes irrespective of the impact it might have on their subjects. This happens when the leader is able to limit the choices of the people. More so, the greater the restrictions on the choices of the people, the greater the powers of the leaders. Nonetheless, the possibility of conflicts and opposition abound as the people tend to react based on the limited choices and restrictions put on them by their leaders (Scott 2006, p. 2, 3).

According to Scott (1995), resistance strategies put up by the people are often caused by their loss of access to the means of production, marginalization, loss of work, income and status (p. 241). Resistance oftentimes conjure images of use of deadly weapons, strife and war in opposition to unfavourable choices imposed by community leaders. Nonetheless, to Scott, the 'oppressed' have other weapons of liberation which may not necessarily be aggressive. Sometimes people combine active and passive means of resistance that are creative and potentially liberating e.g. murmurs, gossip, etc. However, the community people may lack any realistic possibility to change their situation, so they find ways to adjust to their

unfavourable situation. Furthermore, Community people may resent their leaders, they however have to tread cautiously in order to grasp whatever benefit these elites can offer. This is why they often resort to these silent and indirect resistance (Scott 1995, p. 246).
The idea of a good corporate citizenship and neighbour can be realized through adequate engagement and dialogue with stakeholders in order to build a positive relationships with them (Waddock, 2001, p. 35). On one side, oil and gas companies often want to show that they are good corporate citizenship because if a company is a bad citizen, then its licence to operate will be withdrawn by the society. Yet, they are responsible for some of the worst environmental damages and negative social impacts in developing countries. Instead of losing their social licence to operate, these companies remain stronger and more powerful using such means as persistent public relations campaigns, restructuring, etc. (Banerjee 2008, p. 62) This has created some power imbalance in favour of business, based on wealth and access to other resources that makes the partnerships between host communities and such company faulty (Hamann & Acutt, 2003, p. 263). This is because 'consultations and engagement' take place under unequal power relations. Members of local communities instead of being duly consulted are informed of the decisions made concerning their social and economic environment. This has made the stakeholders who are supposedly 'empowered' by these companies to have opposing agendas and objectives to that of the company. This can be seen in the current conflict situations between oil and gas companies and their host communities across the Niger Delta. Hence, these companies use strategies like the promise of royalties, jobs creation, empowerment programs, and pitting one group in the community against another to retain their power to and power over their host communities as stakeholders (Banerjee 2008, p. 64).

Nevertheless, power relations in CSR can have positive influence over a range of stakeholder groups in that it might lead to an increase in bargaining and negotiating power (Hamann & Acutt, 2003, p. 260). This is especially useful for host communities as it can help them work together and better towards meeting their own development needs. This is because it creates opportunities for the community to work with the company to mitigate the impacts of business operations and also attend to their development needs in partnership with the company (Bondy 2008, p. 308). Power relations continues to be important in the discourse of CSR and its possibility of providing a win-win situation for both company and community. According to Utting, CSR 'is not simply a technical issue of know-how, resource availability, "win-win" situations or even greater environmental awareness on the part of key decision makers', rather it is a political process 'involving power struggles between the different actors and stakeholders' (Utting 2002, p. 277). Though CSR can be a source of power struggle, focus has been placed on negotiation, joint agenda setting, and partnership that will be reflective of all stakeholders' interest. This has the potential of providing local community with the capacity and confidence to participate effectively while encouraging business success and achievement of corporate objectives (Garvey & Newell 2007, p. 392).

Part 3:

Conflicting Perceptions on Corporate Social Responsibility:
Corporate Social Responsibility (CSR) is yet to get a generally accepted definition. This is because the perception of NLNG about its CSR policies and strategies is different from how Bonny Kingdom perceived it. Armstrong and Green (2012) have argued that the difficulties of establishing a common definition stems from the different perception of CSR among stakeholders. In this case, the Nigeria Liquefied Natural Gas Limited (NLNG) and Bonny Kingdom has defined it differently. The NLNG believes that CSR is the voluntary decisions

and actions they have undertaken to give back to the society. The NLNG believes its CSR activities have granted it a positive corporate reputation, social licence to operate and competitive advantage. The community on the other hand define CSR based on their experiences. The community perceive CSR as mandatory and as a way the NLNG pays for the negative social, economic and environmental externalities from its operations. In Bonny Kingdom especially the Finima community, the people believe CSR is their right because, they had to vacate their ancestral land for NLNG to carry out its business operations. In Nigeria, CSR is often viewed in terms of project intervention which companies undertake in local communities. These projects encompass social and infrastructural amenities, creation of job opportunities, human development and environmental protection. The communities in the Niger Delta are looking for a trickle-down effect from the vast oil wealth being generated from their environment.

Conflicting Perceptions on Community Development:
From an environmental standpoint on sustainable development of host communities, Bridger and Luloff (1999), stated that communities differ in terms of environmental challenges, natural resources, human resources, economic and social development level, etc. Development strategies which are developed and utilized by global or national bodies or corporations tend to prevent meaningful and concerted community action (p.380). Theodori (2008), has defined community development as a process that depends largely on the intentional actions of people in a locality who come together and interact with the intent of solving their local problems, improving their quality of life, and shaping their future wellbeing (p.64). The NLNG's perception of community development falls in line with this definition. The company stated that part of its sustainability vision for undertaking CSR in their host community is that the community should champion their own development. The company expects Bonny Kingdom to identify their needs as a group, identify projects that will meet the needs and also head such project implementation. The company plays a supporting role in the process of community development in Bonny Kingdom.

The local people on the other hand, expects NLNG or the government to take over community development. Local people believe they are helpless and incapable of meeting their community challenges and become consumers of services rather than producers. Rather than developing their social networks, local people tend to rely on external institutions to meet their socio-economic challenges. The ideology is that of dependency that entails it is 'only outside experts can provide real help' to development challenges (Orubu et al., 2004 p.210; Mathie & Cunningham, 2003 p. 476). Evidence of this is reflected in the data from Bonny Kingdom where the people expressed their feeling of inadequacy and dependence on external agents of development for the development of their community. The belief is that government or the company ought to empower them by providing funds and training in small business ventures or vocations, provide necessary infrastructures and other social goods. This is due to the seemingly lack of capability and resources to champion the development process.

There is a challenge of leadership in terms of coordination and cooperation across local communities in Niger Delta which has been identified as one of the reasons for the dependency on external help. Bridger and Luloff (1999), posit that leaders of local communities tend to paint issues of sustainability and environmental problems in apocalyptic terms using extensive technocratic language of planning and administration. Thus, creating the necessity for external development agencies to work compulsorily with political or local elites. This leaves the multinational and national corporate leaders especially of oil and gas

companies to resolve these environmental and developmental challenges (Bridger & Luloff, 1999, p.381). This kind of leadership scenario belittles the community members as their leaders have discovered that the best way to attract institutional resources is to embellish the seriousness of their community problems (Mathie & Cunningham, 2003 p. 476). Many of the oil and gas companies in the Niger Delta are relating to their host communities through the paramount rulers and councils of chiefs and other local elites. This was due to the traditional in-house and global memorandum of understanding CCP models adopted by the oil and gas companies which seems to be favourable to them. This led to the feeling of alienation and marginalization by such groups, for example, the youth and women groups. This is because they were not part of the CSR negotiation, discussions and community development process. According to a Nigerian proverb, "when two elephants fight, the grass beneath suffers" hence it is the ordinary people that bear the brunt of the power relations between their leaders and these development agents. The ordinary people are at the receiving end of the negative externalities of oil production, they have been neglected for so long, and it has led to the feeling of marginalisation (Orubu et al., 2004 p.210).

In general, local people are excluded from participating in decision-making processes due to structural and institutional factors within the Nigerian setting. There is no co-management arrangement of CCP project as modelled in figure 5.This has resulted in the inability of the oil companies or the government to consider the local communities as stakeholders of the oil industry. As noted above, local people do not count themselves worthy of participating in or ensuring the sustainability of any development projects the oil companies embark on in their communities. Such company or government projects are often labelled as, 'government hospital', or 'NLNG sports facility', etc. Hence, this has made local communities to see the government and oil companies as 'partners in crime' and the enemy. CSR has the potential to restore the company reputation, legitimacy and secure their license to operate through corporate-community partnership and effective participation. This is because, making the host community a stakeholder and a partner will eliminate the sense of alienation which has etched its hold on the Niger Delta people (Idemudia & Ite, 2006 p.200).

Power Relations:

Oil and gas companies have recognized the potentials of CSR as a community development agent and as a means of achieving their corporate objectives of profitability, social licence to operate and competitive advantage. NLNG has adopted the voluntary CSR style to solve the socioeconomic challenges of their host communities. The challenge of community development in the Niger Delta has resulted in the different corporate-community partnerships, adopted by the oil and gas companies that are working in the region. These partnership styles were necessary as these companies tried to engage their host communities as partners in their development process. It was also necessary to reduce the dependence and feeling of alienation which host communities felt and possibly build a positive relationships with them as stakeholders.

Through the data analysis, it was observed that the NLNG- Bonny partnership shows the prominent features of a combination of the traditional in-house and the global memorandum of understanding models. This is because of the prominent role the traditional rulers play in the partnership. The traditional authority has a significant impact on the relationship and partnership between NLNG and the community on one hand and between the community members and their rulers on the other. The NLNG has stated that it recognizes and respects the traditional institution in Bonny Kingdom. Therefore, the hierarchical structure in Bonny Kingdom puts the traditional rulers in the place of facilitating the community development

processes as representatives of the people. The Bonny Kingdom Master plan was aimed at community development. It stipulated that it would maintain the traditional governance structures. The company also stated that its relationship with other groups is based on the already established hierarchical structure in the kingdom. This proved to have both positive and negative effects on the Bonny- NLNG relationship and partnership. The experience is positive in the sense that the hierarchical structure and the power patterns and relations in the community has been a determinant to building a trusting relationship with the community and securing a social license to operate. This is because the traditional authority maintains a conducive environment for the actualization of NLNG's business objectives. Hence, both NLNG and the traditional institution have become powerful by strengthening each other. This is because, the relationship between the monarchy and the oil companies is mutually beneficial to them but disadvantageous to the rest of the community (Barnerjee 2008 p. 62; Hamann & Acutt, 2003 p. 263). This relationship has eroded the trust factor which should make CSR a vehicle for attainment of community development.

There must be an objective channel for direct benefits to the rest of Bonny Kingdom. The question here is that, is there an objective channel for CSR benefits to be equitably distributed? The traditional channel tends to favour certain segments of the population and disfavours the others. The ordinary people are not saying NLNG should go away (a form of social licence to operate) but what comes from NLNG to Bonny kingdom in form of CSR benefits are disproportionally distributed. People that belong to or are connected to the traditional authority tend to benefit more than those who are not. Hence, CSR is a political struggle of the strong and powerful and not for the marginalized. This is where the negative aspect lies as reflected in the disadvantages of the corporate-community partnership adopted by the NLNG. The traditional in-house and the global memorandum of understanding models hinder effective community engagement and participation as they are subject influence of both the local elites and NLNG. The global memorandum of understanding model is said to lead to community dependency instead community empowerment.

Consequently the Bonny people continuously and increasingly demand more development efforts from the NLNG. These situations has also been confirmed by this research. The research also found that there is incompatibility between NLNG- Bonny partnership objectives and the priority needs of the community. This is because the local elites often push their selfish interest as against the wider community interests as pointed out by most respondents from the community. The NLNG complained about the lack of sense of ownership and unsustainability of community development on the part of the community people. Lastly, it hampers the possibility of a long-term positive relationship between NLNG and Bonny Kingdom even though it seems that if NLNG maintains the status quo, there might be a long relationship between the company, community representatives and the community by extension.

Power relations in the community is such that, the traditional authority in Bonny Kingdom has played and continue to play a vital role in the development of its communities both historically and contemporarily. The throne and community elites have been strong and continues to wield power and control over the subjects and NLNG by extension. The theory of relational power posited that control is a function of positionality and influence the actors have over each other in their relationship. More so, much like in a social contract, it is the people who choose their leaders, empower them by legitimizing their positions and handing them the right to represent their common interest and pursue their shared values and objectives. These representatives therefore make policies in line with these shared values and

objectives (Scott 2006, p. 10). The Bonny Kingdom has this characteristics. As mentioned in the history of the Kingdom, their defeat in their war with Andoni tribe in 1869 led to the installation of a viable kingship dynasty that still rules Bonny Kingdom today. The people have given the throne and its officials the right and power to make policies on their behalf and also represent them in matters like CSR. Consequently, the people are supportive and loyal to the policies and decisions made by their leaders and accept same as binding.

Across the Niger Delta inclusive of Bonny Kingdom, the traditional authority has acted as representatives of the people in the relationship between company and community. However, holders of traditional chieftaincies and monarchs have often used their position as a way of gaining and retaining control over compensation payments, and diverting development funds for personal gains (UNDP 2006, p. 352). This has resulted in mistrust which make the community people to constantly suspect and blame the traditional authority for the under-development experienced in the local communities. As Scott (1995) posits, people utilize their 'weapons of the weak' i.e. grumbling, blame game, suspicion and gossip, etc to resist their leaders due to the limited choices provided them by their leaders. The Niger Delta wide revolt by the youths against the traditional institution is a consequence of this situation. The revolt was able to restructure the traditional system and water down the powers of the traditional rulers in some Niger Delta communities. Many communities reorganised their youth bodies and set up an independent body Community Development Committee (CDC). In Bonny Kingdom, this body is the Bonny Kingdom Development Committee (BKDC). The CDC was established for managing CSR benefits and working towards community development and is usually comprised of persons elected by the chiefs (Akpan, 2006 p.232). In the case of Bonny Kingdom the youths did not succeed to water down the powers of the traditional institution. Findings from this research, show that community people are left with little or no choice on the decisions made by their leaders on matters of CSR and community development. The powers and influence of the traditional rulers have thus expanded, leading to the people utilizing their 'weapons of the weak' i.e. grumbling, blame game, suspicion and gossip, etc to resist their leaders.

The impact of Social Capital and Cohesion on Community Development:
The erosion of trust has increasingly become a challenge to the stability of the local social order within the Bonny Kingdom. Given that conflict management is one of the customary responsibilities of traditional leaders, coupled with the eroding trust and impartiality of traditional authorities, the communities' ability to manage and resolve internal conflict has weakened considerably. This has led to each person and groups placing themselves in advantageous position above the community good (i.e. corruption and selfishness). Findings show that for trust to be or not to be is a perception of how much one is benefitting. The higher the criticism of this system, the lower the degree of trust. Criticism or lack of it is based on the material returns for any individual or group gained from any particular source be it the government, NLNG or the traditional authority. Hence, if one is advantageously placed and reaping benefits then the level of trust is high, but if not then the trust will be low. This spells an erosion of social capital and cohesion. Social capital entails network, rules, and trust that enable members of the community to work together to pursue their shared objectives.

Fukuyama (2001) defined social capital as shared norms within a community, and the willingness for members of the community to sacrifice their individual interests and benefits for collective community interests (in Rochelle, 2015 p. 439). Social cohesion on the other hand is characterised by a set of outlooks and norms that includes trust, a sense of belonging and the willingness to participate in and support community development initiatives. Both

concepts consists of vertical and the horizontal interactions among members of the community as members of the group strengthen each other's identity and helps build self-esteem in individuals and social cohesion in groups. Social capital and social cohesion play a vital part in community development (Rochelle, 2014 p. 439).

Balance of Power through Participation and Effective Engagement:

A viable corporate-community relationship should integrate adequate stakeholder engagement and should also address the inherent power relations that affects NLNG's CSR strategies and projects. Based on the relational power theory, Barnerjee (2008) believes that there is an unequal power balance that tends to favour the company but has negative implications for both NLNG and Bonny Kingdom. This hinders the opportunity for equal representation of all interests and actors involved in the NLNG- Bonny partnership. As empirical evidence suggests, community people are marginalised, they lack the confidence and ability to air their views, expectations, grievances and concerns (Garvey & Newell, 2005).

Scholars of community development proposed participation and community engagement, not just consultation with the community people but allowing them to be involved in the community decision making. Participation should enable all people to have their interests represented. If all community members have equal opportunity to voice their concerns and be included, there is the possibility that sustainable community development can be achieved. In Nigeria, the position of the host communities as a stakeholder in the oil industry is a fairly new concept. Host communities are mostly relegated to the background especially in the area of decision making processes within the oil industry (Idemudia & Ite 2006, p 197). The promotion of accountable government boosts the capabilities of people who were formerly excluded from participating in decision making to be involved by constructing the institutional mechanisms for their voices to be heard. (Bridger & Luloff, 1999, p.381).

Community Development: Government or Corporate Function:

In Nigeria, the socio-economic challenges of the Niger Delta has influenced oil and gas companies to play an expanded role in the area of CSR like investing in social amenities, job creation, stimulating the growth of the local economy, and also contributing to the national economy through payment of royalties and taxes. Given the influence of the 'western' trends in CSR theoretical debates on other geographical regions, it becomes pertinent to ask the question: who has the responsibility of developing the rural communities of the Niger Delta in general and Bonny Island in Particular? Is it companies or the function of the government?

The citizens of a nation - state expects their government to provide their basic needs like education, health care, infrastructures, security, etc in exchange for support and loyalty. Every member of society and constituent groups (community) envisions that the government's activity towards development should be equitable as it will motivate them to support their government and also want to contribute to implementation of such development actions. However, when this is lacking, the idea of 'corporations as government' becomes the case. This refers to the means by which businesses are currently taking up the functions and responsibility previously undertaken only by governments (Idemudia, 2014b p. 178). Moon (2007) in support of this stand point have argued that governments especially in democratic, capitalist, welfare systems are falling short of societal expectations (p.302). For example; the Niger Delta Development Commission recognizes that generally, there is an eroded faith in the reliability, intents and capability of governments among the Niger Delta people. This is because, the Nigerian government is accused of neglecting its primary function and even her efforts have not yielded any real benefit for local communities (NDDC, 2004 p. 93; Idemudia 2014b, p. 179).

Idemudia (2010), argued that the Nigerian state failed due to several reasons. First of all, being a creation of colonialism, Nigeria is a state-nation, rather than a nation state (p.135). This means that Nigeria is a product of several ethnic elements joined together in a process of social mobilization, who still retain their sense of individuality but still attempt to preserve and enhance the status and interests of the collectivity (Rejai & Enloe 1969, p.141). Consequently, Nigeria suffers a legitimacy crisis. The vast heterogeneity in terms of ethnic religious differences coupled with different administrative styles the colonialists adopted in the different regions (i.e. different regions had colonial experiences) still plays out in Nigeria's political scene (Idemudia 2010, p. 135).
Furthermore, the dependence on oil in the economy means that Nigeria is 'a mono-commodity rentier state'. Hence not only is the country dependent on oil rents, most of the population are involved in the distribution and consumption of petroleum rather than production. It is only a few (about 2% - 3%) of the Nigerian population that are involved in the oil rent production (Idemudia 2010, p. 136; Ite, 2005, p. 915). More so, Nigeria is caught up in the 'resource curse'. This has informed the marginalisation of the Niger Delta, informed injustice in resource distribution, caused armed social conflicts, hindered democracy, resulted in poor governance and also slow economic development (Osaghae, 2015 p.1-2; Ite, 2004 p. 9; Ite 2005 p. 916).

Finally, the failure and lack of continuity of government institutions (like the NDDB, OMPADEC, etc), corruption, inadequate planning, and poor governmental funding has contributed to the poor state of community development in the Niger Delta (Idemudia 2010 p. 136). This is contrary to the supposed ideology of the picture of 'the Nigerian state' presented in the model in figure 5. By implication, the failure of the Nigerian government in relation to the development of the Niger Delta has resulted in severe outcomes for CSR systems. One of which is the absence of an enabling environment for CSR systems to thrive. Fox, Ward and Howard (2002) described this in four ways; "Mandating role", where the government sets a minimum requirements for business operations and ensure compliance by entrenching it within a legal framework. (p.3). However, institutional and technical capacity of governmental regulatory agencies, such as the Department of Petroleum Resources and the federal and state ministries of environment are weak. This has made them unable to effectively monitor and ensure oil and gas companies comply with regulatory policies. These agencies more or less allow the oil and gas companies to monitor themselves. Hence, the continuous rise in oil spills in the Niger Delta due to lack of transparency in environmental reporting (Idemudia 2010, p. 140). That aside, the Nigerian government's failure is not actually based only on inadequate policies, but also on government institutions especially the Nigerian National Petroleum Corporation (NNPC). The NNPC has not exhibited exemplary character as the most senior partner in a joint venture partnerships with the various multinational oil and gas firms exploring and producing crude oil in the country. Just like the NDDC, the NNPC is mostly politicized and weak institutionally characterized by unnecessary bureaucratic delays in its daily activities (Ite 2004, p. 9).

Secondly, it reflects a "facilitating" role, where government acts as a catalyst by creating incentives and support for social and environmental development of CSR strategies of oil and gas companies (Fox, et.al 2002 p.3). For example, Niger Delta is a volatile region. Government has been blamed for its inability to provide avenues for local communities to adequately seek redress in the courts. Instead of the government to deactivate the tension by encouraging stakeholder engagement and reconciling opposing stakeholder interests, the Nigerian government has always resorted to the use of force on agitating communities who

are perceived as separatist that cannot be tolerated. A case in point is the Odi Genocide of 1999 where the Odi village in Bayelsa State was levelled out and over 200 people were slaughtered under the instruction of the Obasanjo administration (Idemudia 2010, p. 144).

Thirdly, becoming a partner, in order to enhance and harness the complementarity embedded in a collective effort with private sector and civil society in tackling complex social and environmental problems (Fox, et.al 2002 p.5). The Nigerian state especially at the local government level through the NDDC involves in a partnership with oil and gas companies operating in the Niger Delta. However, there is a consensus among scholars of Niger Delta discourse that there is poor coordination between the government and the companies on government-company development partnerships. The NDDC is blamed partly for host community development challenges largely due to the replication of development projects done by these companies and the ineffective use of scarce resources (Idemudia 2010, p. 145). Lastly, endorsing CSR efforts of companies like recognizing the CSR efforts oil and gas companies operating in the nation through award schemes (Fox, et.al 2002 p.6).

The politics of development borders on the blame game as each tier of government blames each other for the development woes in the Niger Delta. The oil companies are also not left out of the blame game as government accuses them for their role in the Niger Delta situation. The Niger Delta states were agitating for resource control asking for a 50% of national oil revenues as against the 15% derivation funds already being allocated to the Niger Delta states. The belief was that more funds will lead to more development in the region. The Federal government however only pays about 10-12% of the expected funds. In its defence, the Federal government claims that the state governments have little to show for the already allocated funds much more when it is allocated 50% of national revenue (Idemudia, 2010 p. 146). This blame game buoys down to corruption. For example, the current Emir of Kano and the former Governor of the Central Bank of Nigeria, Emir Muhammadu Sanusi II in 2014 had alerted the country and the international community that Nigeria is missing $20bn. According to his interview in the Punch Newspaper, (March 19, 2015), he stated that;

> *"My position in the Central Bank was that there was always this gap of $20bn after reconciliation between what the NNPC exported and what it deposited into the Federation Account". "...It could be $20bn at the end of the day. After reconciliation it could amount to $14(bn) or $12(bn) and I think these issues reflect unconstitutional and illegal withholding of revenues from the Federation Account.... It must stop. I think those issues need to be addressed and until we address them and begin to close all the loopholes in government revenues, we are going to continue to create opportunity for the destruction of the economy"* (Akinkuotu, 2015).

Government's failure in terms of curbing corruption (closing all loopholes in government revenue) as the Emir stated, is an opportunity to destroy the economy of Nigeria. Corruption demoralizes the ethical case for oil companies to engage in CSR practices. This is because, the government cannot successfully point out corrupt practices on the part of the companies as regards their CSR obligations. More so, government loses its integrity as a regulator of companies' operations or CSR activities. If the Nigerian government cannot regulate itself against corruption, neither can it regulate companies' inability to meet local community expectations especially when these functions are the primary duty of government that it failed to meet. (Ite, 2004, p, 8; Idemudia 2010, p. 147; Idemudia & Ite, 2006 p. 203). Because, Nigeria suffers legitimacy issues, and is wanting in its facilitating, mandating, partnering and endorsing functions in supporting CSR. Therefore, the focus shifts from government to the oil companies because, they are more visible and accessible to the host communities in that

the office complexes and workers co-exists in the communities. More so, the substantial efforts of oil and gas companies towards community development through their CSR initiatives fall short of the peoples' expectations. This has led to their over-dependence on these companies for their development needs (Ite, 2004 p. 7).
The oil and gas companies also refute the concept that it is their responsibility to develop their host communities. They maintain that community development is the primary function of the Nigerian state (Ite 2005, p.923). Business objectives are designed by neoliberalism and a 'market mind-set'. It is guided by profitability and the assumption that all sectors of the nation would benefit from their oil exploration activities. This is because, companies pay rents and royalties to Nigerian government and it is their expectation and dilemma that it is the government's primary responsible to distribution the oil wealth maximally and equitably for community development (Idemudia 2007 p. 20).

Conclusion: CSR for Community Development: an Icing on the Cake:
Several oil and gas companies especially those that have embraced the sustainable development paradigm have become aware and embraced their role as development actors and partners in the development of their host communities. This is because, they also aspire to achieve their triple-bottom line of profitability, social licence to operate and competitive advantage. This is evident in the various projects they have embarked on in their various communities. Some of which are; provision of infrastructure facilities and other services like healthcare and education, etc. Others include, improving economic opportunities through payment of compensation for environmental damage and remediation, payments of rents and royalties, direct or indirect employment as well as capacity building and economic empowerment initiatives aimed at community development (Kemp 2010 p. 2).

Therefore, the issue of the Niger Delta is not the issue of CSR, the situation is too desperate to be handled entirely by CSR. It is not that CSR cannot be used as means of community development, but it should be redefined in context. The kind of intervention that is needed in the Niger Delta can only be afforded by the state because, only the state can mobilize the necessary resources and capacity needed to handle the development challenge in the Niger Delta. The oil and gas companies have some responsibility but not as much responsibility as is assigned to them. There is a challenge of co-ordination and distribution of whatever public good comes into the community either from the state or the companies. The question should be how do development actors ensure that benefits are evenly distributed. What channels are available to encourage the different groups in the host communities to have a voice in the decision making process. Another problem is the lack of helplessness and lack of information about happenings in the community and what is available and provided for the people. Proper communication channels and the answers to this question would lower the degree of alienation felt by the marginalized groups in Bonny Kingdom while the degree of trust will improve.

This research indicates that the Niger Delta people lack the patience and the willingness to invest time to organize themselves into a cohesive and strong unit with the power to bargain and negotiate. As Scott (1995) proposed, the 'oppressed' have other weapons of liberation which may not necessarily be aggressive. Sometimes, people combine active and passive means of resistance that are creative and potentially liberating. A united and cohesive group armed with resolve and persistence can be powerful enough to ensure bargains and negotiations to bring the expected objectives which the group aspires to achieve in relation to CSR benefits. For instance, the situation where the youths successfully challenged the

traditional authority was the opportunity they had to achieve this but they were too dispersed and unorganized to take advantage of this new opportunity. The situation in the Niger Delta communities is not so different from what is obtainable in other rural areas across Nigeria. However, the region receives the attention of CSR discourse because the region generates the national wealth therefore it deserves both CSR and state interventions.
Multi-sector partnership have been proposed by scholars of Niger Delta discourse. Business and government should share the responsibility of community socio- economic development (Ojo, 2012 p. 20).

Partnership is believed to be an innovative instrument for solving complex social problems. The Local governments, responsible for directing the formation of such partnerships should be actively involved, thus promoting the notion of social co-responsibility between the government, companies, social organizations and host communities (Albareda, Lozano & Ysa, 2007 p. 401). Other factors are also necessary like 'creating an enabling environment' for CSR to thrive, good governance structures in all tiers of government and institutions (i.e. effective democratic institutions, rule of law, transparency and accountability, and participatory decision making). This should also include, quality policies geared towards environmental protection and poverty-reduction. Corporate social responsibility is therefore the 'icing on the cake' as the primary obligation, for businesses still remains productivity, profitability and wealth creation, while the government's primary function to equitably distribute the wealth among the various sector of the society (Ite, 20004 p. 9).

Recommendation:
As a recommendation, the research would echo the propositions made by the scholars of the Niger Delta challenge, CSR and community development which is a multi-sector partnership. The NLNG, Bonny Kingdom and government should be co-responsible for the socio-economic development of the Bonny Kingdom. Adequate engagement and representation of all interests and stakeholders groups in the kingdom should be adapted by both the NLNG and the traditional authority. This research would also like to push forward the recommendations of the local people in Bonny Kingdom who bear the brunt of NLNG business operation. CSR intervention in form of projects especially infrastructure and job opportunities should be directly managed and supervised by the company. This is because the use of contractors have led to abandonment or improper execution of much needed CSR projects and it has negative effects on the local people. Democratic principles of rule of law, accountability, effective representation for the marginalized and transparency should be adopted by the government, NLNG and the traditional rulers and people of Bonny Kingdom. The implication is that community development is a collective effort that would thrive on unity, trust and commitment to shared values and objectives.

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References:

Akinkuotu, E. (March 15, 2015): Missing 20bn issue not adequately addressed- Sanusi. *Punch Newspaper.* Accessed at: *http://www.punchng.com/news/missing-20bn-issue-not-adequately-addressed-sanusi/* on 16/4/2015

Akpan, W. (2006): The Theory and Practice of Corporate Citizenship in Nigeria: A Petroleum Industry Beneficiary Analysis. Paper presented at the International Research Symposium on Corporate Citizenship, "Is Corporate Citizenship Making a Difference?" 2006. GIMPA, Accra, Ghana. Accessed at http://www.unisa.ac.za/contents/colleges/col_econ_man_science/ccc/docs/akpan.pdf on 17/4/2015

Akume, A. T (2013): Egalitarianism, Traditional Authority and Local Governance in Nigeria: A Reflection*, International Journal of African and Asian Studies.* (Vol.2 pp. 28-37) Accessed at: http://www.iiste.org/Journals/index.php/JAAS/article/download/9112/9331 on 07/03/2015

Alagoa E. J. and Fombo A. (1972): *A Chronicle of Grand Bonny*. Ibadan University Press in Orji, K. E (2011): The Place of Bonny in Niger Delta History, *African Research Review*. Vol. 5 (Iss. 5 No. 22), pp. 36-45. Accessed at http://www.ajol.info/index.php/afrrev/article/view/72292 on 06/03/2015

Albareda, L., Lozano, J. M and Ysa, T. (2007): Public Policies on Corporate Social Responsibility: The Role of Governments in Europe. *Journal of Business Ethics.* Vol. 74, (Iss. 4), pp 391-407. Accessed at: *http://link.springer.com/article/10.1007%2Fs10551-007-9514-1* on 14/04/2015

Antwi-Boasiako and Bonna, (2009): *Traditional Institutions and Public Administration in Democratic Africa.* Xlibris Corporation, USA. Accessed at https://books.google.com/books?id=OXepyfLYDIcC on 11/03/2015

Armstrong, J. S and Green K. C (2012): Effects of Corporate Social Responsibility and Irresponsibility Policies. *Journal of Business Research,* (MPRA Paper No. 43007) pp. 1-27 Accessed at: *http://mpra.ub.uni-muenchen.de/43007/1/MPRA_paper_43007.pdf* on 23/03/2015

Azzopardi, A. (2011): Conceptualising discursive communities: developing community in contemporary society. *International Journal of Inclusive Education.* Vol. 15, (Iss.1), pp. 179-192. Accessed at: *http://www.tandfonline.com/doi/pdf/10.1080/13603116.2010.496215* on 13/4/2015

Banerjee, B., (2007): *Corporate social responsibility: the good, the bad and the ugly*. USA. Edward Elgar Publishing Limited.

Banerjee, S. B (2008): Corporate Social Responsibility: The Good, the Bad and the Ugly. *Critical Sociology* Vol. 34, (Iss.1), pp. 51-79. Accessed at http://crs.sagepub.com/content/34/1/51 on 12/5/2015

Baumgartner, R. J (2014): Managing Corporate Sustainability and CSR: A Conceptual Framework Combining Values, Strategies and Instruments Contributing to Sustainable Development. *Corporate Social Responsibility and Environmental*

Management. Vol 21 (Iss. 5) pp. 258-271 Accessed at http://onlinelibrary.wiley.com/doi/10.1002/csr.1336/epdf on 29/3/2015

Bondy, K. (2008): The Paradox of Power in CSR: A Case Study on Implementation. *Journal of Business Ethics.* Volume 82, (Iss. 2), pp. 307-323. Accessed at http://link.springer.com/article/10.1007%2Fs10551-008-9889-7 on 7/5/2015

Bowen, G. A (2005): Local-Level Stakeholder Collaboration: A Substantive Theory of Community-Driven Development. *Community Development*, (Vol.36 Iss.2), pp.73-88 Accessed at *http://www.tandfonline.com/doi/pdf/10.1080/15575330509490176* on 9/4/2015

Bridger, J. C and Luloff, A. E. (1999): Toward an interactional approach to sustainable community development. *Journal of Rural Studies*. Vol. 15, (Iss. 4), pp. 377‑387. Accessed at: *http://www.sciencedirect.com/science/article/pii/S074301679800076X* on 12/4/2015

Brundtland, G., (1987): *Our Common Future,* Oxford. Oxford University Press,

Carroll, A. B. (1979). A three-dimensional conceptual model of corporate social performance. *Academy of Management Review*, Vol. 4, 497-505.

Carroll, A. B. 1999. Corporate social responsibility: Evolution of a definitional construct. *Business and Society,* Vol. 38 (Iss. 3), pp. 268-295. Accessed at http://bas.sagepub.com/content/38/3/268 on 5/5/2015

Carroll, A. B. and Shabana, K. M (2010): The Business Case for Corporate Social Responsibility: A Review of Concepts, Research and Practice. *International Journal of Management Reviews.* Vol. 12 (Iss. 1) pp. 85-105 Accessed at http://onlinelibrary.wiley.com/doi/10.1111/j.1468-2370.2009.00275.x/pdf on 11/04/2015

CIA (Central Intelligence Agency) (2015): *The World Fact Book: Nigeria*. [Online]: https://www.cia.gov/library/publications/the-world-factbook/geos/ni.html Accessed on 22/4/2015

Csaszar, F. (2004): Understanding the Concept of Power in Alsop, R (ed.): *Power, Rights, and Poverty: Concepts and Connections.* A working meeting sponsored by DFID and the World Bank pp. 137 – 146. Accessed at http://siteresources.worldbank.org/INTEMPOWERMENT/Resources/PPFinalText.pdf on 13/5/2015.

Davis, K. (1973): The Case for and Against Business Assumption of Social Responsibilities. *Academy of Management Journal* (Vol.16 Iss. 2), pp. 312–322. Accessed at: *http://amj.aom.org/content/16/2/312.full.pdf+html* on 8/7/2015

Donaldson, T., & Preston L. (1995). The stakeholder theory of the corporation: Concepts, evidence and implications. *Academy of Management Review*. Vol. 20, pp. 65-91 Accessed at: *http://www.jstor.org/stable/pdf/258887.pdf* on 7/4/2015

Dyllick, T and Hockerts, K. (2002): Beyond the business case for corporate sustainability. *Business Strategy and the Environment.* Vol. 11, pp. 130 -141 Accessed at: http://onlinelibrary.wiley.com/doi/10.1002/bse.323/epdf on 1/4/2015

Emordi, E.C. and O.M. Osiki, (2010): Traditional Rulers under Military Rule in Nigeria, 1966-1999. In Amusa S.B. and Ofuafor M.O. (2012): Resilience of Traditions in Contemporary Politics: A Historical Study of the Political Influence of Traditional Rulers in Nigeria. *Current Research Journal of Social Sciences* Vol. 4 (Iss. 6) pp. 407-414)

Esteves, A. and Barclay, M. (2011): New Approaches to Evaluating the Performance of Corporate–Community Partnerships: A Case Study from the Minerals Sector. *Journal of Business Ethics.* Vol. 103, (Iss. 2), pp 189-202. Accessed at: *http://link.springer.com/article/10.1007/s10551-011-0860-7* on 8/4/2015

Eweje, G (2006): The Role of MNEs in Community Development Initiatives in Developing Countries Corporate Social Responsibility at Work in Nigeria and South Africa. *Business & Society.* Vol. 45 (No. 2) pp. 93-129. Accessed at http://bas.sagepub.com/content/45/2/93 on 24/8/2014

Eweje, G (2014) (Ed): *Corporate Social Responsibility and Sustainability: Emerging Trends in Developing Economies. Critical Studies on Corporate Responsibility, Governance and Sustainability,* Vol. 8, United Kingdom, Emerald Group Publishing Limited.

Eweje, G. (2011): A Shift in Corporate Practice? Facilitating Sustainability Strategy in Companies. *Corporate Social Responsibility and Environmental Management*. Vol. 18, pp. 125–136 Accessed at http://onlinelibrary.wiley.com/doi/10.1002/csr.268/epdf on 30/3/2015

Fentiman, A (1996): The Anthropology of Oil: The Impact of the Oil Industry on a Fishing Community in the Niger Delta. Social Justice, Vol. 23, No. 4 (Iss. 66), *Environmental Victims.* pp. 87-99. Accessed at http://www.jstor.org/stable/29766976 on 19/03/2015

Fox, T., Ward, H and Howard, H. (2002): *Public Sector Roles in Strengthening Corporate Social Responsibility: A Baseline Study*. Accessed at: *http://pubs.iied.org/pdfs/16017IIED.pdf* on 13/4/2015.

Fukuyama, F. (2001). Social capital, civil society, and development. *Third World Quarterly*. Vol. 22, pp. 7–20. Accessed at http://www.tandfonline.com/doi/pdf/10.1080/713701144 on 18/3/2015

Garvey, N. and P. Newell. (2005): Corporate accountability to the poor? Assessing the effectiveness of community-based strategies. *Development in Practice*, Vol. 15, (Iss. 3&4), pp. 389-404. Accessed at http://www.tandfonline.com/doi/abs/10.1080/09614520500075763 on 12/5/2015

Golder B. (2005): *Cross-cutting tool Stakeholder analysis.* Accessed at: *www.panda.org/standards/1_4_stakeholder_analysis* on 2/4/2015

Hah and Freeman (2014): Multinational Enterprise Subsidiaries and their CSR: A Conceptual Framework of the Management of CSR in Smaller Emerging Economies. *Journal of Business Ethics.* Vol. 122, (Iss.1) pp 125-136 Accessed at: http://link.springer.com/article/10.1007%2Fs10551-013-1753-8 on 9/04/2015

Hamann, R. & Acutt, N. (2003): How should civil society (and the government) respond to "corporate social responsibility? A critique of business motivations and the potential

for partnerships. *Development Southern Africa,* Vol. 20 (Iss. 2), pp. 255-270. Accessed at http://www.tandfonline.com/doi/abs/10.1080/03768350302956 on 13/5/2015

Hameit-Sievers, A (1998): Igbo 'Traditional Rulers': Chieftaincy and the State in South-eastern Nigeria. Afrika Spectrum Vol. 33. (No. 1) pp. 57- 79. Accessed at: http://www.gigahamburg.de/sites/default/files/openaccess/afrikaspectrum/1998_1/giga_as_1998_1_harneit.pdf on 11/03/2015

Hoben, M., Kovick D., Plumb D. and Wright, J (2012): *Corporate and Community Engagement in the Niger Delta: Lessons Learned from Chevron Nigeria Limited's GMOU Process*. (pp. 1-19) Accessed at: *http://www.cbuilding.org/sites/default/files/Corporate%20and%20Community%20Engagement%20in%20the%20Niger%20Delta_Lessons%20Learned.pdf* on 9/10/2015)

Idemudia, U. (2007): Corporate partnerships and community development in the Nigerian oil industry: Strengths and limitations. Markets, Business and Regulation Programme paper. No. 2, (2007), UNRISD, Geneva

Idemudia, U. (2010): Corporate Social Responsibility and the Rentier Nigerian State: Rethinking the Role of Government and the Possibility of Corporate Social Development in the Niger Delta, *Canadian Journal of Development Studies*. Vol. 30, (Iss. 1-2), pp.131-151. Accessed at: *http://www.tandfonline.com/doi/pdf/10.1080/02255189.2010.9669285* on 14/4/2015

Idemudia, U. (2014): Corporate-Community engagement strategies in the Niger Delta: Some critical reflections. *The Extractive Industries and Society.* Vol. 1. pp. 1-9. Accessed at *http://www.sciencedirect.com/science/article/pii/S2214790X14000525* on 25/3/2015

Idemudia, U. (2014b): Oil Companies and Sustainable Community Development in the Niger Delta, Nigeria: the Issue of Reciprocal Responsibility and its Implications for Corporate Citizenship Theory and Practice. *Sustainable Development*. Vol. 22, (Iss. 3), pp. 177–187. Accessed at: *http://onlinelibrary.wiley.com/doi/10.1002/sd.538/epdf* on 12/4/2015

Idemudia, U. and Ite, U. E. (2006): Corporate–Community Relations in Nigeria's Oil Industry: Challenges and Imperatives. *Corporate Social Responsibility and Environmental Management.* Vol. 13, (Iss. 4), pp. 194–206 Accessed at: *http://onlinelibrary.wiley.com/doi/10.1002/csr.101/epdf* on 10/24/2015

Ite, U. E. (2007): Partnering with the state for sustainable development: Shell's experience in the Niger Delta, Nigeria. *Sustainable Development*. Vol. 15, (Iss. 4), pp. 216–228. Assessed at: http://onlinelibrary.wiley.com/doi/10.1002/sd.312/epdf on 14/04/2015.

Ite, U.E. (2004), "Multinationals and corporate social responsibility in developing countries: a case study of Nigeria", *Corporate Social Responsibility and Environmental Management,* Vol. 11 (No. 1), pp. 1-11. Accessed at: *http://onlinelibrary.wiley.com/doi/10.1002/csr.49/pdf* on 27/3/2015

Ite, U.E. (2005). Poverty reduction in resource-rich developing countries: What have multinational corporations got to do with it? *Journal of International Development*.

Vol. 17, (Iss. 7), pp. 913-929. Accessed at: *http://onlinelibrary.wiley.com/doi/10.1002/jid.1177/epdf* on 15/4/2015

Jamali, D. and Mirshak, R. (2007): Corporate Social Responsibility (CSR): Theory and Practice in a Developing Country Context. Journal of Business Ethics. Vol. 72, (No. 3), pp. 243-262. Accessed at http://www.jstor.org/stable/25075377?seq=1#page_scan_tab_contents on 7/5/2015

Kemp, D. (2010) Mining and community development: problems and possibilities of local-level practice. *Community Development Journal*. Vol.45 (Iss. 2), pp. 198 - 218. Accessed at http://cdj.oxfordjournals.org/content/45/2/198 on 20/3/2015

Lemos, M.C. and Agrawal, A. (2006): Environmental governance. *Annual Review of Environment and Resources* Vol. 31, pp. 297–325. Accessed at: *http://www-personal.umich.edu/~arunagra/papers/publications/2006.%20Maria%20Carmen%20Lemos%20and%20Arun%20Agrawal.%20%20Environmental%20Governance.pdf* on 15/4/2015

Loza, J. (2004): Business–Community Partnerships: The Case for Community Organization Capacity Building. *Journal of Business Ethics* Vol. 53, pp. 297–311. Accessed at: *http://link.springer.com/article/10.1023%2FB%3ABUSI.0000039415.90007.56* on 7/4/2015

Maher, F.A., & Tetreault, M.K. (1993): Frames of positionality: Constructing meaningful dialogues about gender and race. *Anthropological Quarterly*, Vol. 66 (Iss. 3), pp. 118- 126. Accessed at http://www.jstor.org/stable/pdf/3317515.pdf on 12/5/2015

Matarrita-Cascantea, D and Brennan, M. A (2012): Conceptualizing community development in the twenty-first century, *Community Development*, (Vol.43 Iss. 3), pp.293-305 Accessed at: *http://www.tandfonline.com/doi/pdf/10.1080/15575330.2011.593267* on 13/4/2015

Mathie, A and Cunningham, G (2003): From clients to citizens: Asset-based Community Development as a strategy for community-driven development. *Development in Practice*, Vol. 13, (Iss.5), pp. 474-486. Accessed at *http://www.tandfonline.com/doi/pdf/10.1080/0961452032000125857 on 13/4/2015*

Moon, J. (2004): *Government as a driver of corporate social responsibility. ICCSR Research paper* series No. 20, International Centre for Corporate Social Responsibility, Nottingham University.

Moon, J. (2007): The contribution of corporate social responsibility to sustainable development. *Sustainable Development.* Vol. 15, (Iss. 5), pp. 296–306. Accessed at: *http://onlinelibrary.wiley.com/doi/10.1002/sd.346/epdf*

Moura-Leite, R. C., Padgett, R. C, and Galán, J. I (2014): Stakeholder Management and Nonparticipation in Controversial Business. Business & Society, Vo. 53 (Iss.1) pp. 45–70 Accessed at: *http://bas.sagepub.com/content/53/1/45.full.pdf+html* on 7 /4/2015

NLNG (2007): *A Kingdom, Bonny and Rare.* Accessed at http://www.nigerialng.com/publications/bonny%20book.pdf on 15/3/2015

NLNG (2010): *For the NLNG Host Communities*. Accessed at http://www.nigerialng.com/publications/host_new_2010_ed_1_web.pdf on 17/3/2015

Ojo, G. U. (2012): Community Perception and Oil Companies Corporate Social Responsibility Initiative in the Niger Delta. *Studies in Sociology of Science,* Vol. 3, (Iss.4), pp. 11-21. Accessed at: *http://www.cscanada.net/index.php/sss/article/view/j.sss.1923018420120304.600* on 14/4/2015

Okolo, P.O. (2014): NDDC, Conflict, Peace-Building and Community Development, in the Niger Delta Region. Global Journal of Political Science and Administration. Vol.2, (No.1), pp.36-54. Accessed at: http://www.eajournals.org/wp-content/uploads/NDDC-Conflict-Peace-Building-and-Community-Development-In-the-Niger-Delta-Region.pdf on 14/4/2015.

Olowu, D. and Erero, J. (1995): *Governance of Nigeria's Villages and Cities through Indigenous Institution.* Ile-Ife, Obafemi Awolowo University. Accessed at: http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/4145/DOGO95AA.pdf?sequence=1 on 09/03/2015.

Olusola, O and Aisha, A (2013): Traditional Rulers and Conflict Resolution: An Evaluation of Pre and Post-Colonial Nigeria. *Research on Humanities and Social Sciences*. Vol.3, (No.21) pp. 12-127 Accessed at: http://www.iiste.org/Journals/index.php/RHSS/article/view/9541/9863 on 10/03/2015

Omotola, J. S. (2007): From the OMPADEC to the NDDC: An Assessment of State Responses to Environmental Insecurity in the Niger Delta, Nigeria. *Africa Today*, Vol. 54, (No. 1), pp. 73-89. Accessed at: http://muse.jhu.edu/journals/africa_today/v054/54.1omotola.pdf on 10/4/2015.

Orubu, C. O., Odusola, A. and Ehwarieme, W. (2004): The Nigerian Oil Industry: Environmental Diseconomies, Management Strategies and the Need for Community Involvement. Journal of Human Ecology. (Vol. 16, Iss.3), pp. 203-214. Accessed at: http://www.krepublishers.com/02-journals/jhe/jhe-16-0-000-000-2004-web/jhe-16-3-151-226-2004-abst-pdf/jhe-16-3-203-214-2004-1168-orubu-c-o/jhe-16-3-203-214-2004-orubu-c-o.pdf on 11/4/2015

Osaghae, E. E. (2015): Resource Curse or Resource Blessing: The Case of the Niger Delta 'Oil Republic' in Nigeria. (pp. 1-21) Commonwealth & Comparative Politics. Accessed at: http://www.tandfonline.com/doi/pdf/10.1080/14662043.2015.1013297 on 15/4/2015.

Oviasuyi, P. O. and Uwadiae, J. (2010): The Dilemma of Niger-Delta Region as Oil Producing States of Nigeria. *Journal of Peace, Conflict and Development*. (Iss. 16), pp. 110-126. Accessed http://www.bradford.ac.uk/ssis/peace-conflict-and-development/issue-16/dilemanigerdelta.pdf on 10/4/2015

Peter, I. (2014): Reconsidering Place of Traditional Institutions under the Nigerian Constitution: A Comparative Analysis. *Journal of Law, Policy and Globalization*. Vol.31. pp. 135-148) Accessed at http://www.iiste.org/Journals/index.php/JLPG/article/view/17675 on 09/3/2015

Porter, M.E. & Kramer, M. R. (2006): Strategy & society: The link between competitive advantage and corporate social responsibility. *Harvard Business Review*, 01.12.2006. Accessed at http://f2.washington.edu/fm/sites/default/files/Porter%20Business%20Case%20for%20CSR.pdf on 12/5/2015

Prno, J. and Slocombe, D. S. (2012): Exploring the Origins of 'Social License to Operate' in the Mining Sector: Perspectives from Governance and Sustainability Theories. *Resources Policy*. Vol. 37, (Iss. 3) pp. 346–357. Accessed at: http://www.sciencedirect.com/science/article/pii/S0301420712000311 on 15/4/2015

Ralston, E. S (2010): Deviance or norm? Exploring corporate social responsibility. *European Business Review,* (Vol. 22 Iss. 4) pp. 397 – 410 Accessed at http://www.emeraldinsight.com/doi/pdfplus/10.1108/09555341011056177 on 23/3/2015

Reed (2013): Power: Relational, Discursive, and Performative Dimensions. *Sociological Theory.* Vol. 31, (Iss. 3), pp.193–218. Accessed at *http://stx.sagepub.com/content/31/3/193.full.pdf on 13/5/2013*

Rejai, M. and Enloe, C. H. (1969): Nation-States and State-Nations. *International Studies Quarterly* Vol. 13, (No. 2), pp. 140-158. Accessed at http://www.jstor.org/stable/pdf/3013942.pdf on 12/5/2015

Richards, L. and Dalbey, M. (2006): Creating Great Places: The Role of Citizen Participation. *Community Development*, Vol. 37, (Iss. 4), pp.18-32. Accessed at: *http://www.tandfonline.com/doi/pdf/10.1080/15575330609490193* on 13/04/2015

Rochelle, T. L. (2015): Diversity and Trust in Hong Kong: An Examination of Tin Shui Wai, Hong Kong's 'City of Sadness'. *Social Indicators Research*. Vol. 120, (Iss. 2), pp 437-454. Accessed at: *http://link.springer.com/article/10.1007/s11205-014-0592-z#page-1* on 13/04/2015

Roseland, M (2000): Sustainable community development: integrating environmental, economic, and social objectives. *Progress in Planning.* Vol. 54, pp. 73-132. Accessed at: *http://socialeconomyhub.ca/sites/socialeconomyhub.ca/files/Sustainable%20Community%20Development%20%20integrating%20environmental,%20economic%20and%20social%20objectives_0.pdf* on 14/4/2015

Russo, A and Perrini, F (2010): Investigating Stakeholder Theory and Social Capital: CSR in Large Firms and SMEs. *Journal of Business Ethics* Vol. 91, (Iss.2), pp 207-221. Accessed at: *http://link.springer.com/article/10.1007/s10551-009-0079-z* on 5/4/2015

Scott, J (2006): *Power*. Cambridge. Polity Press.

Scott, J. C. (1995): *Weapons of the Weak: Everyday Forms of Peasant Resistance*. New Haven, Yale University Press. Accessed at http://site.ebrary.com/lib/agder/reader.action?docID=10579301&ppg=274 on 12/5/2015

Székely, F and Knirsch, M. (2005): Responsible Leadership and Corporate Social Responsibility: Metrics for Sustainable Performance. *European Management Journal.* Vol.23, (Iss. 6), pp. 628-647. Accessed at http://www.sciencedirect.com/science/article/pii/S0263237305001131 on 2/4/2015

Taylor, G.S. (2007): *What is community development? Brazos Agricultural Communications*. Texas. A&M University System.

Theodori, G. L. (2008): Constraints to the Development of Community. *Community Development,* Vol. 39, (Iss. 1), pp. 63-81. Accessed at: *http://www.tandfonline.com/doi/pdf/10.1080/15575330809489742* on 12/04/2015

UNDP (2006): *"Niger Delta Human Development Report"*. Accessed at http://web.ng.undp.org/reports/nigeria_hdr_report.pdf on 25/3/2015

Utting, P. (2002): Corporate environmentalism in the South: Assessing the limits and prospect. In Utting, P. (ed), *the greening of business in developing countries: Rhetoric, reality and prospect.* Zed Books and UNRISD, pp. 135–58.

Waddock, S. (2001): Integrity and Mindfulness: Foundations of Corporate Citizenship. *Journal of Corporate Citizenship,* Vol. 1, (No. 1), pp. 25-37. Accessed at *http://hdl.handle.net/2345/2664* on 5/5/2015

Wariboko, N (1998): Capability Distribution and Onset of the 1869 Bonny War. *Nordic Journal of African Studies*. Vol. 7 (Iss.2) pp. 1-26 Accessed at http://www.njas.helsinki.fi/pdf-files/vol7num2/wariboko.pdf on 23/03/2015

Watts, M. (2004): Resource curse? Governmentality, oil and power in the Niger Delta. *Geopolitics.* Vol. 9, (Iss.14), pp. 50-80. Accessed at http://www.tandfonline.com/doi/abs/10.1080/14650040412331307832 on 15/4/2015

World Bank (2015): Nigeria. http://data.worldbank.org/country/nigeria Accessed on 22/4/2015

Economic and Social Causes for a Lack of Sustainable Development: a Comparison Between India and Ethiopia

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Abstract

Understanding the issues of a country is often a requirement for the full understanding of the feasible solutions. The aim of this paper is to study, to analyze and to identify the multiple reasons for a lack of development in two very different areas of the world: Tamil Nadu, in India and Ethiopia, in Africa. Most of the literature shows that the causes of underdevelopment in developing countries may be related to many different issues: a lack of technology, social and cultural issues, environment, the availability of natural resources, among the others. Examining all aspects of the issue, this is the reason why different solutions should be provided.

Both Tamil Nadu and Ethiopia are growing economies where there are huge differentials in economic development and growth within the country. Moreover, both countries could be growing more and faster than what they are actually doing.
Tamil Nadu is a State located in the South-Eastern part of the Indian peninsula. It is a very populous State, with 67.86 millions of inhabitants, it covers an area of 130,058 km2 and its GDP is $145,868 millions. Since 2012, Tamil Nadu is the second richest State in India, with $160 billions in GDP. It also has the highest number of business enterprises and it is one of the first States in India in total employement. Despite Tamil Nadu is one of the most advanced States of India, its rural areas are among the poorest of the whole Indian peninsula.

Ethiopia is located in the Centre-Eastern part of Africa, it has 94,1 millions of inhabitants, it covers an area of 1,127,127 km2 and its GDP is $47.53 billions. From 2004 to the financial crisis in 2009, Ethiopia was one of the fastest growing economies in the world. In spite of this growth, GDP per capita is very low: civil wars and recurrent drought made Ethiopia one of the poorest countries in the world (about 40% of population lives below the international poverty line $1.25).

The aim of the paper is to highlight the reasons why some resource-abundant countries, that could be rich and advanced countries, experience an high percentage of poor population and are not completely able to pursue a development path.
The paper will present a work in progress based on the analogies and the differences in the development path in Tamil Nadu and Ethiopia. This will also be an open work, on which we will ask for the contribution from our international colleagues.

Keywords: Growth, Development Path, India, Ethiopia.

Summary: Introduction; 1. India and Ethiopia: an economic outlook, *1.2 International trade data; 2.* International ranking, *2.1 Index of Economic Freedom, 2.2 Doing Business Index, 2.3 Social Progress Index, 2.4 Human Development Index;* 3. Health in India and Ethiopia, *3.1. Health Economic and Human Resources; 4*. Education in India and Ethiopia, 4.*1 Literacy, 4.2 School participation, 4.3 Education Economic and Human Resources; 4*. Feasible solutions.

Introduction

Poverty is a wide and complex mechanism that can hardly be defined within very strict boundaries. First theories on poverty were essentially connected to a lack of income that didn't allow people to be physically efficient (Rowntree, 1901), even if also morality rate was used in order to measure the well-being of individuals. Since then, many theories suggested that poverty conditions of individuals and populations need a various set of indicators in order to be understood. One of the most relevant theories (on which even many international studies are based) is the capabilities theory developed by Sen (1980): well-being of a country really increases when also increase the chances for individuals of achieving their personal and professional goals. Nowadays, the approach developed by the United Nations Development Program (UNDP) is widespread, since it captures the nature itself of poverty, that is a multidimensional issue which is not determined only by a lack of income, but also by one social and cultural issues, like health, education, representation.

The development differentials between advanced countries and emerging ones also highlighted the need for a double definition of poverty: absolute poverty and relative poverty. People in absolute poverty are in acute deprivation, not having the minimum income needed to meet the basic requirements, neither the access to many basic services, like health or education. World Bank set this threshold at 1.25$ a day. Life of people living in relative poverty conditions are quite different, since their income is higher than 1.25$ a day (so they are not poor in absolute terms), but their income and their living standards are much worse than the average levels of the place they live in. One of the consequences of poverty lies in exclusion, the impossibility for poor people of being involved in social, economic, cultural life of their society. Due to this lack of integration, poor people are not able to get an education, to find a good job, to receive adequate health care services for themselves and for their children. This mechanism, also known as the poverty trap, connects enduring poverty to the variables and the conditions that cause the lack of income. Poverty trap may affect not only individuals, but also countries.

In our paper, we tried to highlight that the income differentials are just one of the variable that can explain the development of a country and that there are other variables, such as basic health and education services, that could really help the development of countries that have the potential for growing and for increasing the well-being of their population.

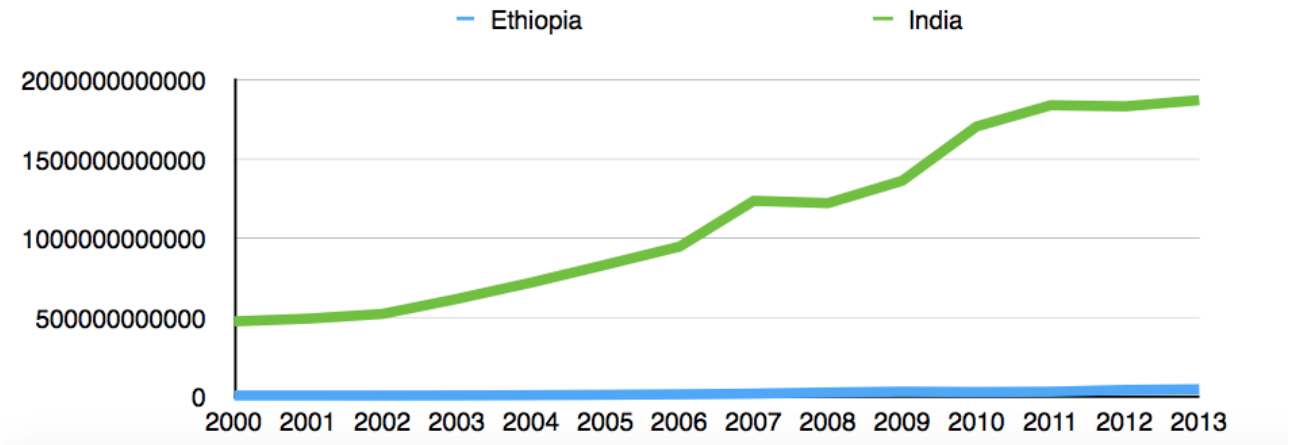
1. India and Ethiopia: an economic outlook[1]

1.1 Production data

[1] All data in this chapter are taken from the World Bank Databases.

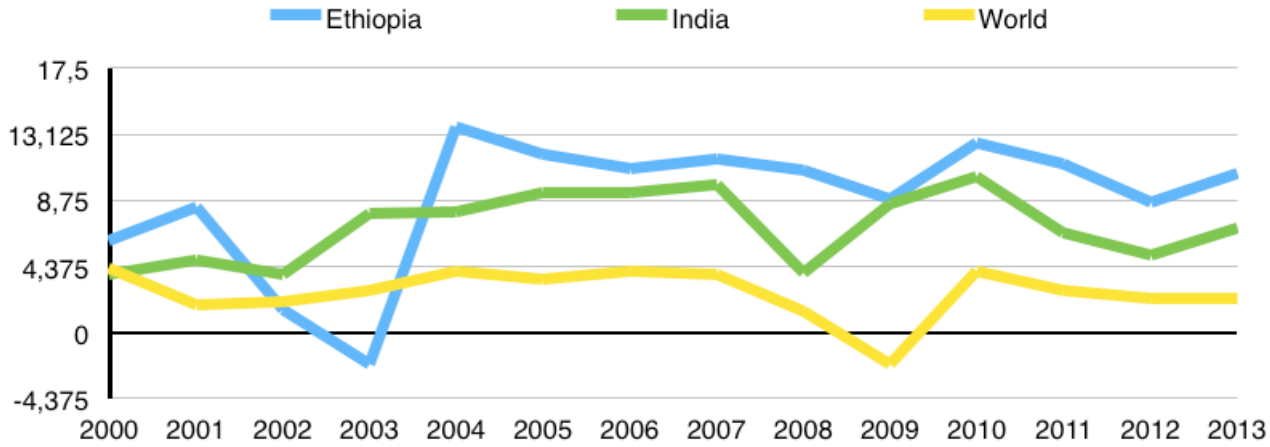
India and Ethiopia are both emerging countries, but they show very different paths of development. Indeed, India ranks 10th in the World Bank 2013 GDP ranking, while Ethiopia ranks 84th and, during the last 15 years, India's GDP in current US$ rapidly and constantly grew, while Ethiopia's growth is much lower and slower (Figure 1).

Figure 1 - GDP (current US$) in India and Ethiopia, 2000-2013



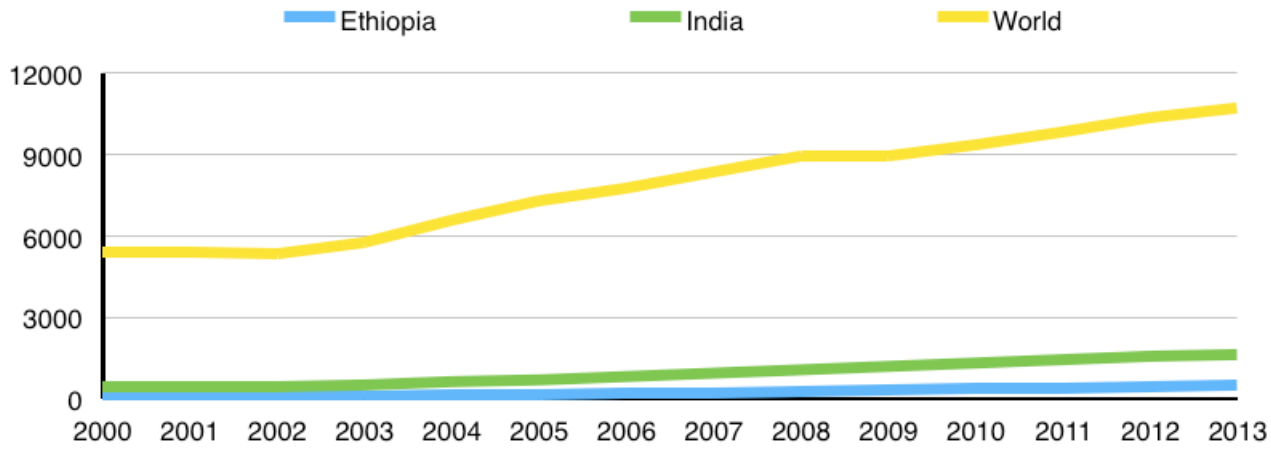
As well as many emerging economies, both countries are growing by an higher rate with respect to the world as a whole. India's GDP growth rate (that, in 2000, was slightly lower than the world average, since then always remained higher than the world value and is 6.9% in 2013). GDP growth for Ethiopia is even higher, since it is 10,5% (Figure 2).

Figure 2 - GDP growth in the World, India and Ethiopia, 2000-2013



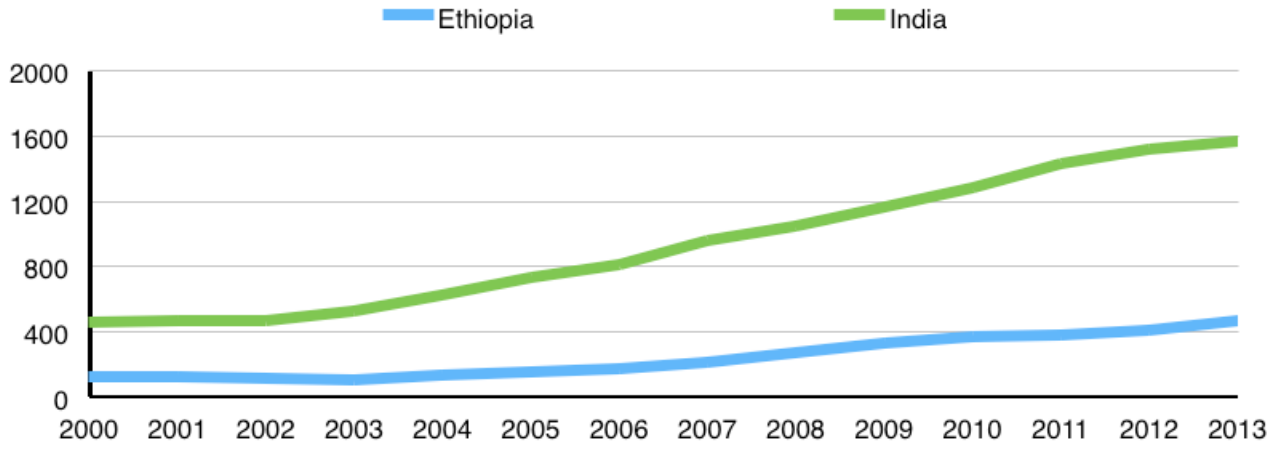
Even though current GDP's values are very dissimilar, GDP growth data seem to be quite encouraging, since both countries show a very dynamic trend. But literature shows that GDP growth doesn't mean higher living standards for the population. A very preliminary attempt to measure wellness of the population is GNI per capita PPP, an indicator that is based on the conversion of GNI to international dollars using purchasing power parity rates.
If compared to the world average, GNI per capita PPP in India and in Ethiopia are enormously lower (Figure 3).

Figure 3 - GNI per capita PPP in the World, India and Ethiopia, 2000-2013



In Figure 4 we decided to compare only India and Ethiopia and this way we may see that, even though they both are growing, India is performing much better. In 2000, GNI per capita PPP in India was 460$. In 2013, it is 1,570$. In Ethiopia, while it was 130$ in 2000, it is now 470$ (Figure 4).

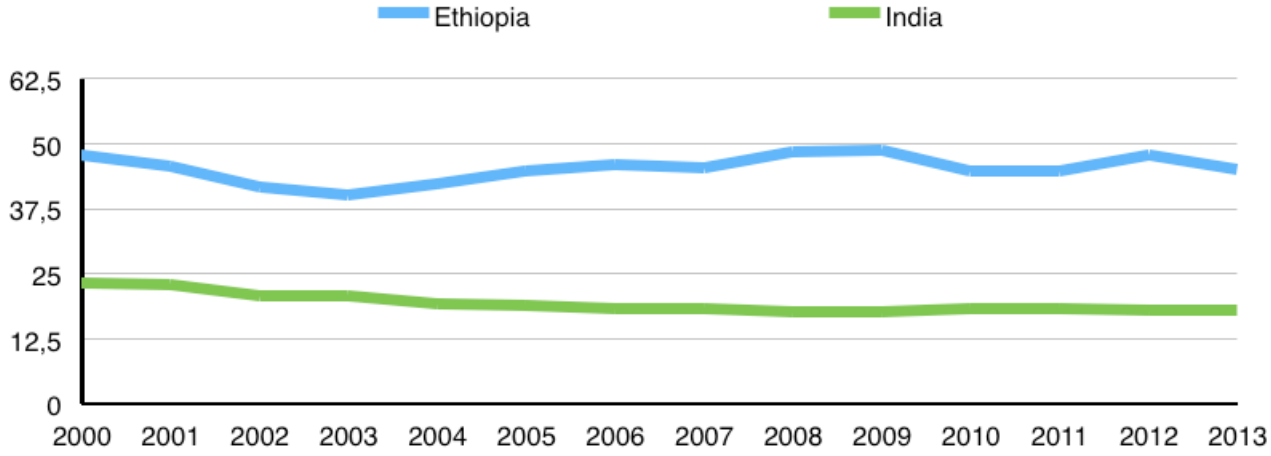
Figure 4 - GNI per capita PPP in India and Ethiopia, 2000-2013



As for the productive structure of the countries, the development of the service industry hypothesis provides that development is usually accompanied by an higher percentage of services as a share of GDP and the progressive substitution of agricultural productive activities with industry and, most of all, services. Since Rostow, theories elaborated in advanced countries have often been based on the idea that the development path of emerging countries should follow consecutive stages. In many cases, the first stage was based on the prevalence of agriculture, the second stage on industry and finally the third stage on services.
This is the reason why we often use the value added of agriculture as a percentage of GDP like a proxy for assessing the low level of development of a country.

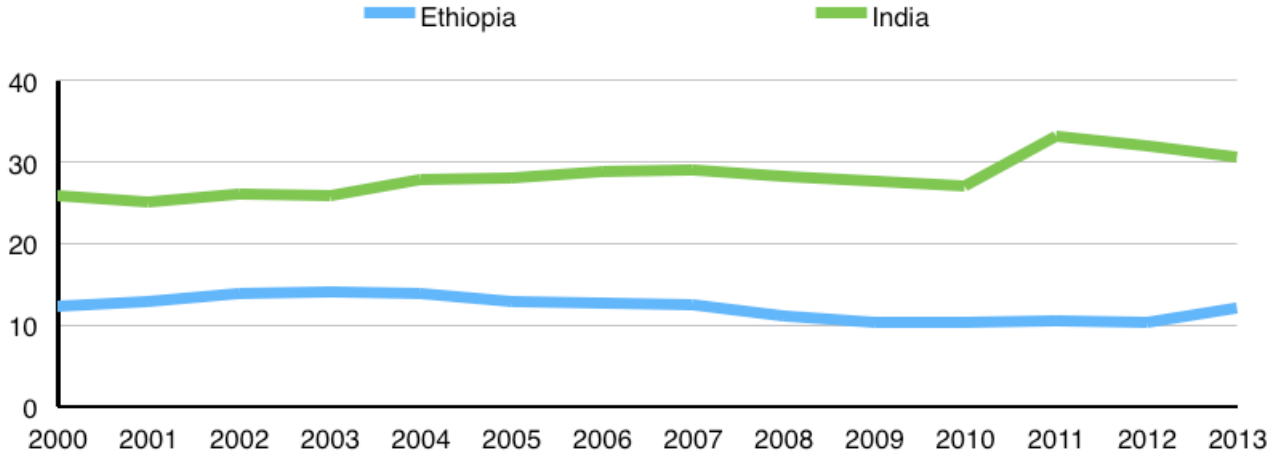
In order to analyze the development stage of India and Ethiopia, we used data on GDP composition (agriculture, industry, services), starting from agriculture (Figure 5).
Agriculture contribution to GDP in Ethiopia is twice the value in India and, even if it slightly decreased since 2000 (when it was 47%), it still is 45% in 2013. Also for India there has been a decreasing trend: agriculture value added as a share of GDP was 23% in 2000 and is 18% in 2013.

Figure 5 - Agriculture, value added (% of GDP) in India and Ethiopia, 2000-2013



Just to confirm the hypothesis, we may see some data about some advanced countries: in the United States, agriculture contribution to GDP is around 1.3%, in Ireland 1.55%, in Singapore 0,03%, while it is 59,5% in Sierra Leone, 37,2% in Niger, 35,1% in Nepal. In theory, agriculture as a share of GDP value added should then make way for industry and, finally, to services.
While agriculture value added was higher in Ethiopia, industry value added is much higher in India. Furthermore, in Ethiopia it remained steadily around 12% during the last years, while it grew in India from 26% to 31% (Figure 6).

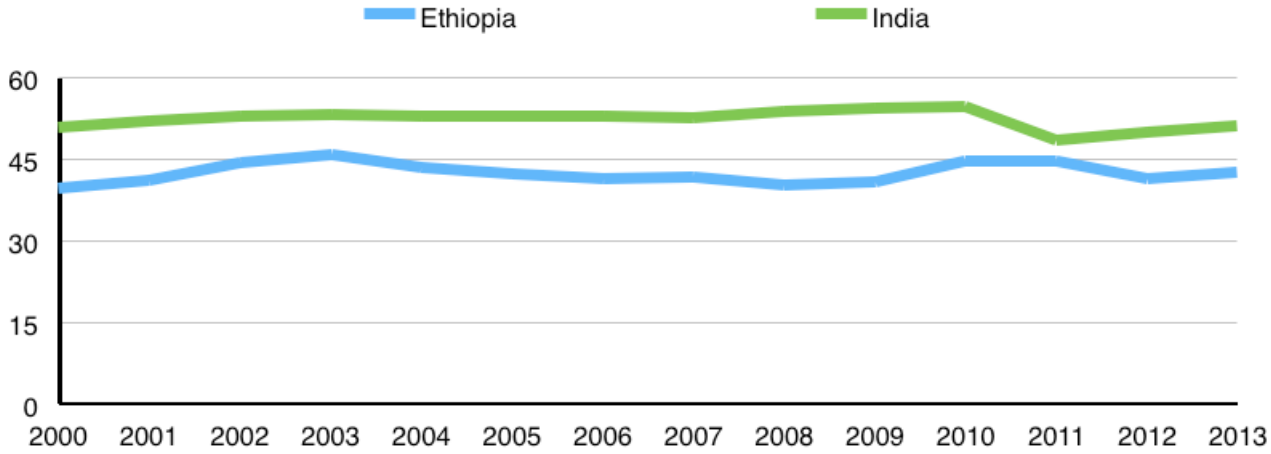
Figure 6 - Industry, value added (% of GDP) in India and Ethiopia, 2000-2013



Anyway, the real innovation comes with services. Theory suggests that advanced countries tend to produce an higher share of services. Figure 7 shows that India has the highest percentage of services

as a value added of GDP. Also, both countries' trend is quite stable: percentage of services in India was 50% in 2000 and is 51% in 2013; in Ethiopia, it was 40% in 2000 and it is 43% in 2013.

Figure 7 - Services, value added (% of GDP) in India and Ethiopia, 2000-2013

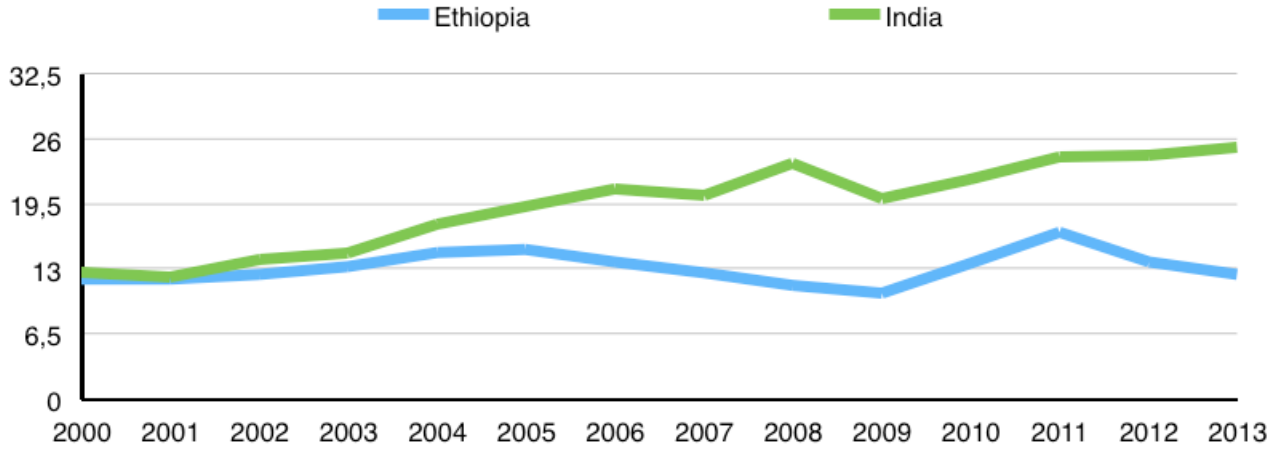


1.2 International trade data

The data we used in the previous part of the research provided a framework for a better understanding of the national paths of development of both countries and they showed that India is performing better than Ethiopia both for GDP and for GDP composition: GDP and GDP per capita PPP are higher in India and they are also increasing; in Ethiopia, economic development is still very slow and trends are quite steady. Even GDP composition by sector shows an higher share of agriculture and a lower percentage of services in Ethiopia with respect to India. These data picture the performance of a country under the production point of view. To analyze the robustness of a country within the international markets, data on international exchanges are needed, starting from exports and imports of goods and services. We used both indicators as a percentage on GDP to assess the importance of exports and imports on national production.

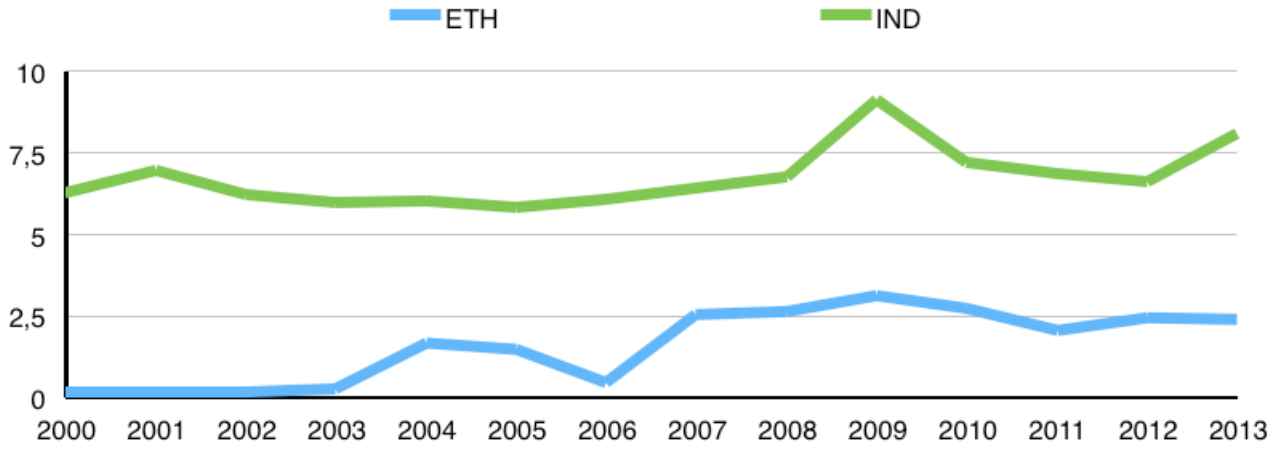
Data on exports of goods and services as a share of GDP are quite interesting, since they highlight two opposite trends in India and in Ethiopia. Indeed, while both countries' exports were around 12% of GDP in 2000, in 2013 they account for 25% in India and remained the same in Ethiopia (Figure 8).

Figure 8 - Exports of goods and services (% GDP) in India and Ethiopia, 2000-2013



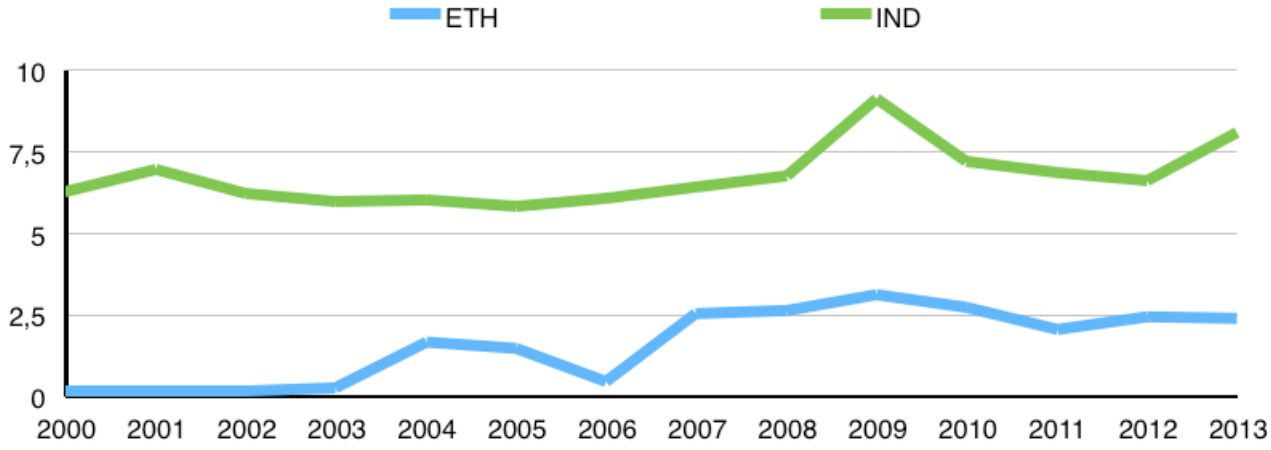
As for the imports of goods and services as a percentage of GDP, they are growing in both countries. In Ethiopia, they accounted for 23% of GDP in 2000 and they are 20% of GDP in 2013; in India, they grew faster and almost doubled, from almost 14% of GDP in 2000 to more than 28% in 2013 (Figure 9).

Figure 9 - Imports of goods and services (% GDP) in India and Ethiopia, 2000-2013



India's development path seems so to be based also on an higher integration on the international markets, since both exports and imports grew during the last years. We know that India is a country whose growth has been very fast and has been supported by the delocalization of production that has been made by many advanced countries. In these cases, both imports and exports tend to rise. Since the country became one important production centre in the world, their exports are rising. But we also saw that India's GDP and GDP per capita are rapidly growing and both indicators portend that a middle class is also growing and that, this way, even national demand for international goods is rising.

Figure 10 - High-technology exports (% of manufactured exports) in India and Ethiopia, 2000-2013

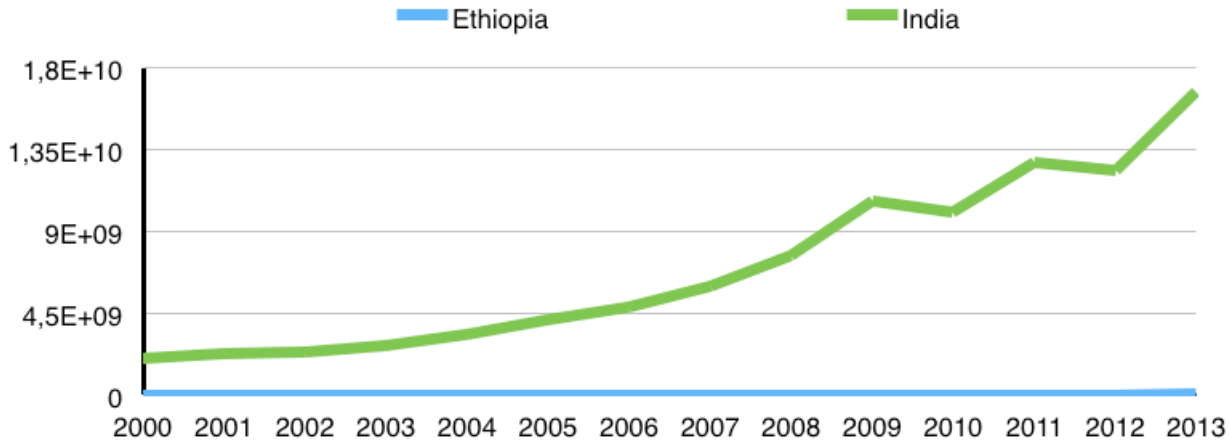


In the literature, the dependency theories assess that if the economic growth of an emerging economy is based on exports growth, a vicious cycle could arise since emerging countries often export raw materials to advanced countries. Then, rich countries manufacture products out of those

commodities. It may also happen that they sell back these commodities to the emerging countries. So, the dynamic relations between advanced and emerging countries do intensify inequalities. This is the reason why, in order to understand if the growth of exports is due to an increase of dependency or rather to a real economic development of the country, it may be useful to analyze the composition of exports and, even more, the share of high-technology exports on the whole of manufactured exports of the country.
During the last years, India and Ethiopia show similar trends but different values: they both are growing, but India steadily shows higher levels of the impact of high-technology exports on manufactured exports (Figure 10).

When considering high-technology exports in current US$, differences between India and Ethiopia are even higher. Since 2000, they rapidly grew in India, while they are still very low in Ethiopia (Figure 11).

Figure 11 - High-technology exports (current US$) in India and Ethiopia, 2000-2013



2. International ranking[2]

Relying on GDP as the unique measure of development provides an incomplete and misleading picture of countries, because it doesn't capture factors like education, health, property rights, freedom. This is why many international institutions and think thanks started elaborating new kind of indicators for development, efficiency and well-being. For our purposes, we used the following: the Index of Economic Freedom, the Doing Business Index, the Social Progress Index and the Human Development Index.

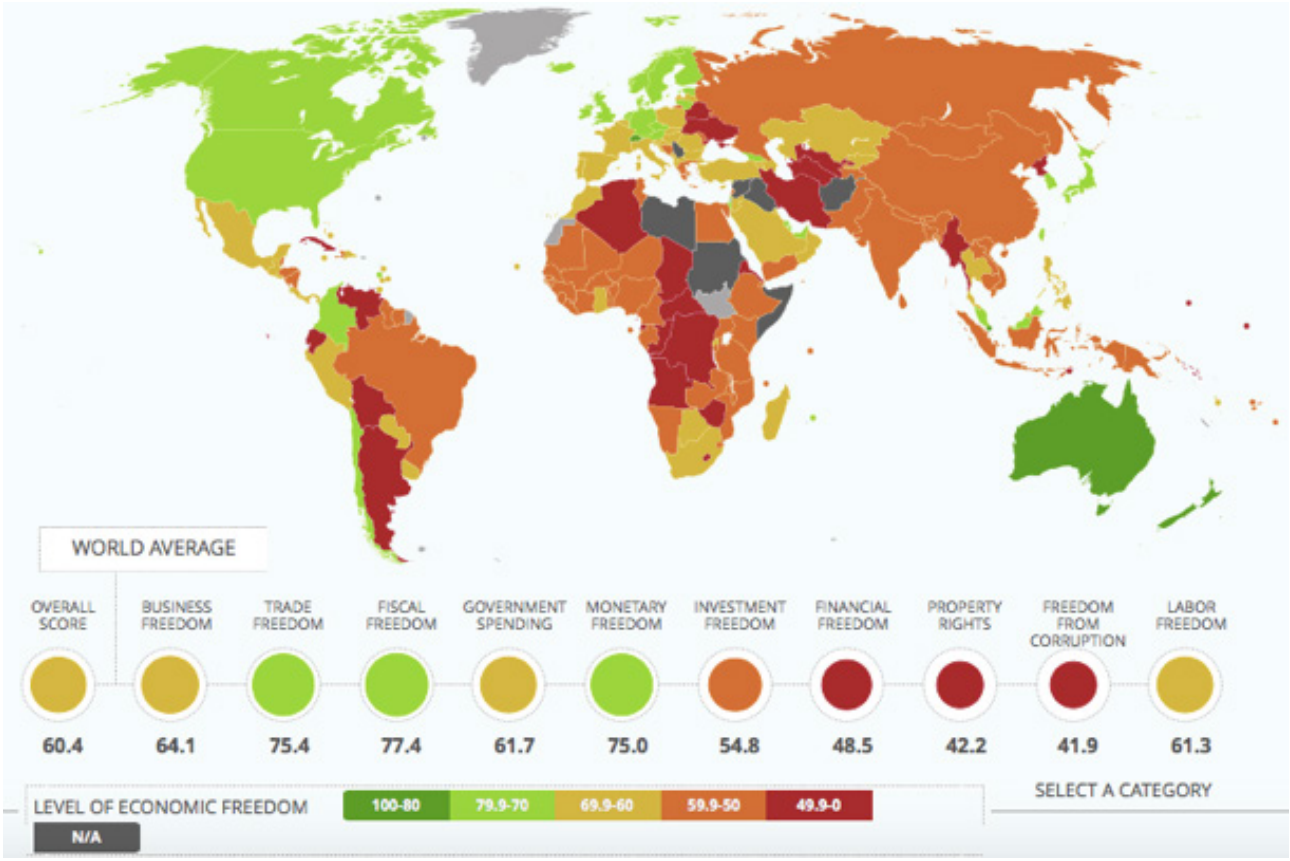
2.1 Index of Economic Freedom
The Heritage Foundation's Center for Trade and Economics leads each year the publication of the Economic Freedom Report. The Index of Economic Freedom is based on 10 dimensions of economic freedom that are grouped in 4 areas:

- Rule of law (property rights, freedom from corruption);
- Government size (fiscal freedom, government spending);

[2] All data in this chapter are taken from the World Bank Databases.

- Regulatory efficiency (business freedom, labor freedom, monetary freedom); and
- Market openness (trade freedom, investment freedom, financial freedom).

Figure 12 - Index of Economic Freedom 2015



India

In the 2015 Economic Freedom Report, India is a “mostly unfree” economy, since it ranks 128th with an economic freedom score of 54.6. From 2014, India’s economic freedom score decreased by 1.1 points. Some of the index dimensions increased, like business freedom, property rights, and freedom from corruption, but other dimensions declined (labor freedom and trade freedom). Within the Asia–Pacific region, India ranks 26th out of 41 countries and its economic freedom score still is below the regional and world averages.

Main obstacles to economic growth are corruption, lack of infrastructure and fiscal deficits. Furthermore, the state still owns enterprises and banks, legal and regulatory framework aren’t perfectly working and high corruption affects many economic sectors.

The highest individual income tax rate is 30.9%, while the highest corporate tax rate is 32.4%. Despite that, during the last years, business registration fees have been widely reduced and the government is favoring foreign investments. Public finance has been bettered and the investment environment has been improved and supported.

Ethiopia

With a score of 51.5, Ethiopia ranks 149th in the 2015 Economic Freedom Index. Important improvements in monetary freedom, freedom from corruption and labor freedom made the score

increase 1.5 points with respect to the previous year. Within the Sub-Saharan Africa region, Ethiopia ranks 37th out of 46 countries and its score (like India) still is below the regional and the world average.
State intervention is still high and corruption remains widespread. The right to own the land is not established by law, some relevant sectors of the economy are closed to investment and global trade. A very weak enforcement of regulations discourages business activity. Indeed, foreign investments remain very low.
Still, even national business is hard to be started: minimum capital requirement for launching a business is higher than the average annual income.
The highest individual income tax rate is 35% and the highest corporate tax rate is 30%.
Despite the steady economic growth Ethiopia experienced during last 10 years and the fact that poverty declined from 44% of population in 2000 to 30% in 2011, the country's per capita income remains among the lowest in the world.
Nevertheless, government made big investments in some development projects, and, thanks to a large domestic market, Ethiopia has a great potential.

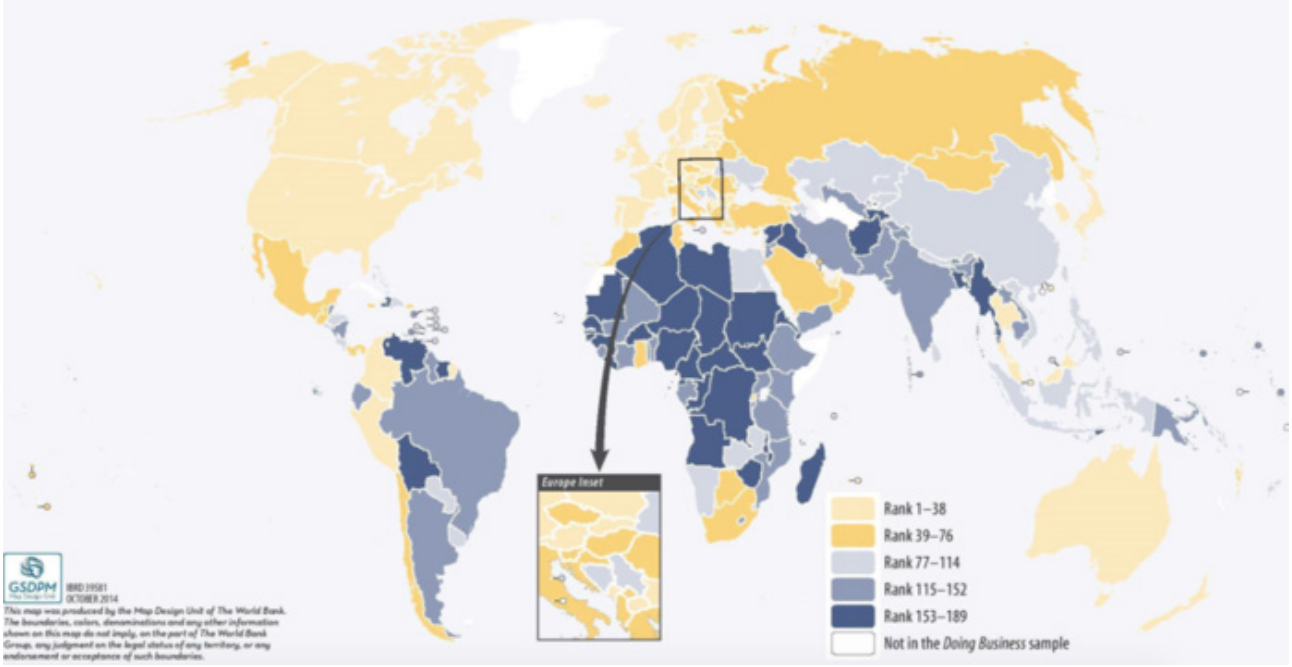
2.2 Doing Business Index

Doing Business Report is released each year by the World Bank. Its main tool is the Doing Business Index, that covers the following areas:

- Procedures, time, cost and paid-in minimum capital to start a business
- Procedures, time and cost to complete all formalities to build a warehouse
- Procedures, time and cost to get connected to the electrical grid
- Procedures, time and cost to transfer a property
- Movable collateral laws and credit information systems
- Minority shareholders' rights in related-party transactions
- Payments, time and total tax rate for a firm to comply with all tax regulations
- Documents, time and cost to export and import by seaport
- Procedures, time and cost to resolve a commercial dispute
- Time, cost, outcome and recovery rate for a commercial insolvency.

Doing Business Report 2015 highlights that, once more, the easiest country for doing business is Singapore. The map shown in Figure shows the gap between advanced and emerging countries: yellow colored countries are the easiest places where to do a business, while the blue ones are the most problematic. Among the easiest places, we find North America, Northern Europe, Australia. Almost all the countries in Africa, South America and South Asia are mostly difficult places where doing business.

Figure 13 - Doing Business Index 2015



India

In 2015 Doing Business Report, India ranks 142nd out of 189 economies, losing 2 positions in comparison with the 2014 ranking.

Figure 14 - Doing Business in India 2015



In 2015, India recorded the better performances in the following dimensions:

- protecting minority investors (7th): the country globally ranks very high thanks to its performances in the issues related to disclosure requirements, the liability regime for directors, the access to internal corporate documents, the shareholder rights, the governance structure and the corporate transparency. Furthermore, the country strengthened minority investor protections by requiring higher disclosure of conflicts of interest by board members, by increasing the remedies available in case of prejudicial related-party transactions and by providing additional safeguards for shareholders of privately held companies.

- getting credit (36th): in India legal rights for borrowers and lenders and sharing of credit information are particularly high.

In the Doing Business Report 2015, India showed the worst performances in the following dimensions:
- enforcing contracts (the country ranks 186th): according to data collected by Doing Business, contract enforcement takes 1420 days, costs 39.6% of the value of the claim and requires 46.procedures;
- dealing with construction permits (184th): it requires 25.4 procedures, takes 185.9 days and costs 28.2% of the warehouse value, even if India reduced the time required to obtain a building permit by setting strict time limits for preconstruction approvals;
- starting a business (158th): starting a business in India requires: 11.9 procedures, 28.4 days, 12.2% of income per capita and a minimum capital of 111.2% of income per capita, and, during the last years, India made it easier by reducing the registration fees, but also made it more difficult by introducing a requirement to file a declaration before the beginning of business operations.
- paying taxes (156th): on average, firms make 33 tax payments a year, spend 243 hours a year filing, preparing and paying taxes and pay 61.7% of profits as a total taxes amount, but India improved electronic payment and abolished the fringe benefit tax and eased the administrative burden of paying taxes for firms by introducing mandatory electronic filing and payment for value added tax.

Ethiopia
In 2015 Doing Business Report, Ethiopia ranks 132nd out of 189 economies, losing 3 positions in comparison with the 2014 ranking.

Figure 15 - Doing Business in Ethiopia 2015



According to the last report, Ethiopia performed better in the following dimensions:
- dealing with construction permits (the country ranks 28th): in Ethiopia, it requires 7 procedures, takes 125 days and costs 3.2% of the warehouse value;
- enforcing contracts (50th): it takes 530 days, costs 15.2% of the value of the claim and requires 38 procedures. During the last year, case management improved and the role for the enforcement judge expanded;
- resolving insolvency (74th): on average, procedures take 1.8 years and cost 14.5% of the debtor's estate, the average recovery rate is 38.3 cents on one dollar.

The weakness points are related to the following issues:
- starting a business (168th): requires 9 procedures, takes 15 days, costs 89.3% of income per capita and requires paid-in minimum capital of 164.4% of income per capita. Starting a business is now easier thanks to the streamlining registration procedures.
- trading across borders (168th): exporting a standard container of goods requires 8 documents, 44 days and an amount of $2380, while importing the same container requires 11 documents, 44 days and an amount of $2960. Internal bureaucratic inefficiencies have been addressed and this is making trading easier;
- getting credit: Ethiopia established an online platform for sharing information on credit and by guaranteed borrowers' right to inspect their personal data.

2.3 Social Progress Index

The Non-Profit organization Social Progress Imperative started publishing the Social Progress Index three years ago, moved by the awareness that GDP, as well as the other traditional indicators of economic growth, cannot be anymore the exclusive measures of development and wellbeing. The Social Progress Index uses a set of social and environmental indicators for measuring social progress: Basic Human Needs, Foundations of Wellbeing, and Opportunity. Each of these dimensions comprises 4 indicators.

Basic Human needs is measured by: Nutrition and Basic Medical Care, Water and Sanitation, Shelter, Personal Safety. The indicators of Foundations of Wellbeing dimension are: Access to Basic Knowledge, Access to Information and Communications Health and Wellness, Ecosystem Sustainability. Finally, the Opportunity dimension is measured by Personal Rights, Personal Freedom and Choice, Tolerance and Inclusion, Access to Advanced Education.

In 2015, social progress is higher in North America, Australia, Northern Europe, while the worst performing countries are mostly located in Africa.

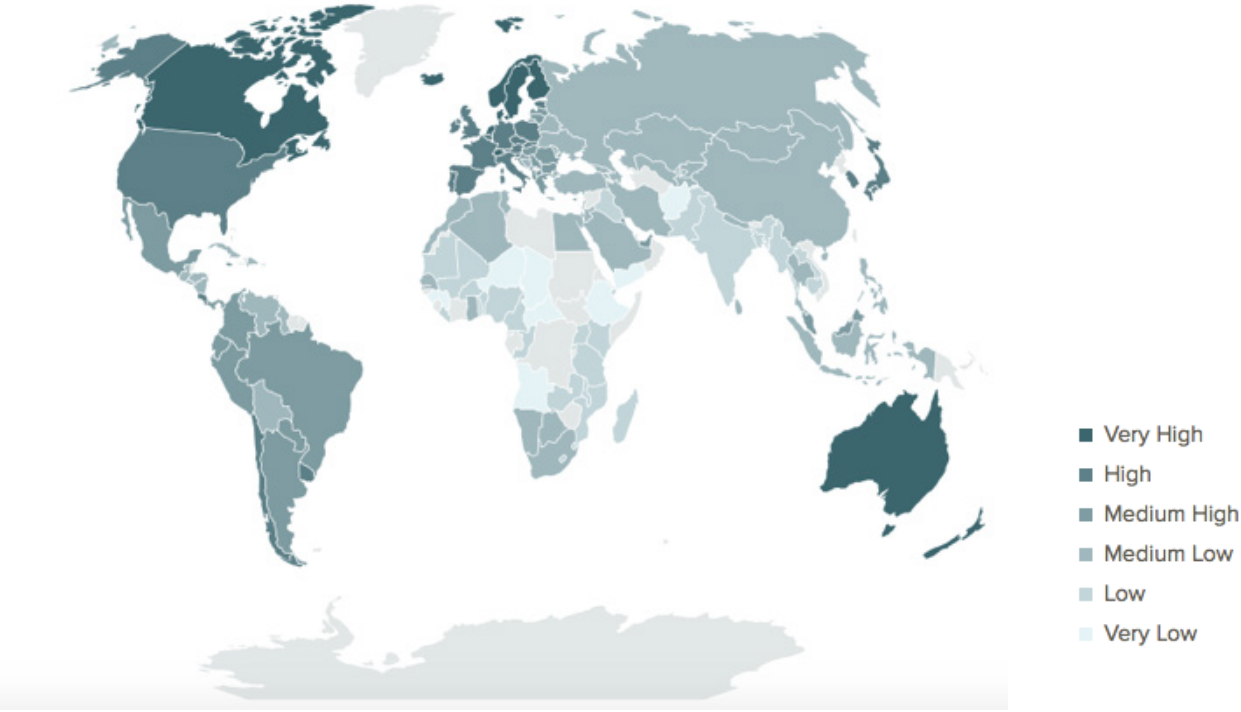
India

As for the Social Progress Index, in 2015 India ranks 101st. Its performance is better in the Opportunity dimension (91st), while it is weaker both in the Basic Human Needs (101st) and in the Foundations of Well Being (113) dimensions.

The relative strengths of the country are related to:
- a good higher education
- low homicide rate
- low obesity rate
- good enforcement of private property rights.

The relative weaknesses of India are:
- bad household air pollution
- high perceived criminality and political terror
- low adult literacy rate
- high premature deaths and suicide
- scarce freedom of assembly and religion
- early marriages
- very low tolerance (for immigrants, religious)
- education (few women's average years in school, high inequality in attaining education).

Figure 16 - Social Progress Index 2015



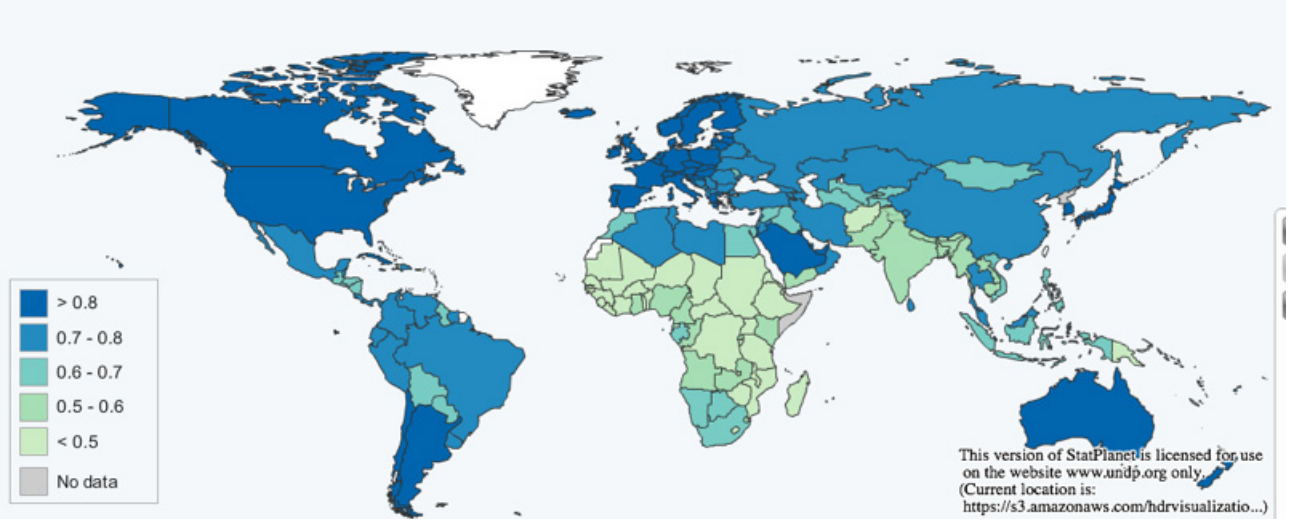
Ethiopia
In the Social Business Index 2015, Ethiopia ranks 126th, with bad performances in the Opportunity and Foundation of Wellbeing dimensions (both 126th) and a slightly better performance in the Basic Human Needs dimension (120th).
Relative strengths of the country are:
- good access to electricity
- good life expectancy rate
- low obesity rate
- high satisfied demand for contraception.

Relative weaknesses of Ethiopia are:
- undernourishment
- high food deficit
- bad rural access to improved water source
- high homicide rate
- weak upper secondary enrollment
- low access to ICTs (mobile telephone subscriptions, internet users)
- very weak personal rights (political rights, freedom of speech, freedom of assembly, freedom of religion)
- inequality in the attainment of education.

2.4 Human Development Index
Development of a country has been measured for a long time only by GDP and GDP growth. Nevertheless, in many cases, GDP growth has not resulted in socioeconomic development. This is why, in the last decades, more emphasis has been laid on a wider approach to development that also

includes some basic social development factors.
The Human Development Index is the expression of a new vision on social and economic development that is based on the actual growth of wellness of a population, rather than on the GDP growth alone. To assess the development of a country, the HDI uses three dimensions of human development: health, education, economic development, that are measured by life expectancy rate at birth, a basic literacy among the population (mean of years of schooling for adults aged 25 years and expected years of schooling for children of school entering age) and GDP per capita PPP. Even if HDI is a very useful tool in order to understand the development path of a country as a whole, it still doesn't give information on some important issues such as inequalities, poverty or empowerment, even if a deep understanding of a country's development would require it.

Figure 17 - Human Development Index 2014



India
United Nations Human Development Report 2014 shows that India is a medium human development country, since it ranks 135th, while India's HDI value in 2013 is 0.586 (slightly growing on the previous year), life expectancy is 66.4 and GDP per capita PPP is five times more than Ethiopia. Mean years of schooling in India are very low (4.4) Looking at the last decades, we may see that India started to grow during the 1980s and that its growth has been stable and continuos, except for a slowdown from 2011 to 2013.

Ethiopia
Ethiopia still is a low human development country and ranks 173rd. Ethiopia's HDI value is 0.435 (even in this case, showing a scarce growth on 2012) and life expectancy is 63.6, mean years of schooling are 2.4. During the last decades, Ethiopia has steadily grown on an average rate of 3.35%. From 2000 to 2013, Ethiopia shows an higher growth with respect to India and from 2008 to 2013 it gained two positions in the HDI global ranking.

3. Health in India and Ethiopia

How we have seen Health is a fundamental element of poverty and development for a country. India and Ethiopia have signed the Millennium Development Goals (MDG). Both countries are specially committed to reaching the goals with respect to maternal and child survival.

The MDG target for **Maternal Mortality Ratio** (MMR) is 140 per 100,000 live births. From a baseline of 560 in 1990, India had achieved 220 in 2010 and 190 in 2013, and at this rate of decline is estimated by Indian government to reach an MMR of 141 by 2015.
In Ethiopia MMR is 420 in 2013. This rate is very high considering that the target of MDG is 140, but the trend is positive. In fact Ethiopian MMR in 2010 was 500. (Tab.1)

Tab.1 - Maternal Mortality Ratio (MMR)

Maternal mortality ratio (modeled estimate, per 100,000 live births)		
Country	**2010**	**2013**
Ethiopia	500	420
India	220	190

Source: World Bank data

For **under-5mortality rate** (U5MR), the MDG target is 42. From a baseline of 126 in 1990, in 2013 India has an U5MR of 53 and an extrapolation of this rate would bring it to 42 by 2015. This is particularly creditable on a global scale where in 1990 India's MMR and U5MR were 47% and 40% above the international average respectively. (Tab. 2)
In Ethiopia we observe a very interesting positive trend. The U5MR is decreased by 16% from 2010 to 2013, even a better performance if compared to India (where is also decreased, but only 12%).
In both countries, data show that mortality rate under 5 among children whose mothers are uneducated is twice the rate of mortality among children whose mothers had a basic education.

Tab.2 - Mortality Rate Under-5 (U5MR)

Mortality rate, under-5 (per 1.000 live births)				
Country	**2010**	**2011**	**2012**	**2013**
Ethiopia	76	71	68	64
India	60	58	55	53

Source: World Bank data

With a current population of about 1.2 billion people and continued population growth, India is expected to surpass China by 2030 and become the world's most populous nation[3].
India has shown consistent improvement in population stabilization, with a decrease in decadal growth rates, both as a percentage and in absolute numbers. Twelve of the 21 large States for which recent **Total Fertility Rates** (TFR) is available, have achieved a TFR of at or below the

[3] http://www.healthpolicyproject.com/index.cfm?id=country-india

replacement rate of 2.1[4] and three are likely to reach this soon. The challenge is now in the remaining six states, but even here rates are declining. However these six States between them account for 42 % of the national population and 56 % of the annual population increase. (Tab. 3) In the remaining small States and Union Territories except Meghalaya, the **Crude Birth Rate** (CBR), is less than 20 per 1000. The national TFR has declined from 2.6 to 2.5 (2010/2013). The persistent challenge on this front is the declining sex ratio. In India the rate of decline of still-births and neonatal mortality has been lower than the child mortality on the whole[5].
Ethiopia has also seen a little reduction in the CBR from 35 in 2013 to 33 in 2013. Concerning the Total Fertility Rate in the African country we observe a slight decrease of 8%, but the absolute value remains very high, in comparison to the world average. (Tab. 4)

Tab. 3 - Total Fertility Rate (TFR)

Total fertility rate				
Country	**2010**	**2011**	**2012**	**2013**
Ethiopia	4.9	4.8	4.6	4.5
India	2.6	2.5	2.5	2.5

Source: World Bank data

Tab. 4 - Birth Rate

Birth rate, crude (per 1,000 people)				
Country	**2010**	**2011**	**2012**	**2013**
Ethiopia	35	34	34	33
India	21	21	21	20

Source: World Bank data

In India life expectancy at birth (Tab. 5), that is stable since from 2010, is 66 years, with significant differences between different states (in Kerala life expectation is 74 years, in Madhya Pradesh it is 58 years). In Ethiopia, instead, we record a small increase from 2010 (61 years): in 2013, life expectancy at birth is 64 years.

Tab.5 - Life Expectancy

Life expectancy at birth, total (years)

[4] Ministry of Health & Family Welfare (MHFV) of India, National Health Policy 2015 Draft, http://www.thehinducentre.com/multimedia/archive/02263/Draft_National_Hea_2263179a.pdf

[5] MHFW, 2014.

Country	2010	2011	2012	2013
Ethiopia	61	62	63	64
India	66	66	66	66

Source: World Bank data

The vaccination rate in India is 61%[6], rising to 72% (Tab. 6) if we consider access to some kind of vaccination. In India **vaccination** rate is higher in urban areas (58%) than in rural areas (39%)[7]. With respect to immunization, in Ethiopia in 2013 72% of children have been immunized (+ 18% in three years).
Health indicators in Ethiopia are among the worst in Africa (newborn mortality rate is 6.8% and mortality rate for children under 5 is 10.6%). Only 17% of women delivers in an hospital (African percentage is 46%)[8]. Ethiopian Demographic and Health Survey (Edhs) highlights that very few women are assisted during delivery by health professional. Customer satisfaction rate for health services is the lowest in the world (19%)[9], even if the diffusion of health services generally improved thanks to the Health Sector Development Program started in 1998. Since then, there have been many improvements (for example, vaccination rate increased); nevertheless, health system as a whole is still very weak.

Tab. 6 - Immunization

Immunization, DPT (% of children ages 12-23 months)				
Country	**2010**	**2011**	**2012**	**2013**
Ethiopia	61	65	69	72
India	72	72	72	72

Source: World Bank data

India's progress on communicable disease control is mixed. The most acclaimed success of this period is the complete elimination of polio. In Leprosy too there have been significant reductions, but after a reduction of an annual incidence of 120,000 cases, there is stagnation, with new infective cases and disabilities being reported. In AIDS control, progress has been good with a decline from a 0.41 % prevalence rate in 2001 to 0.27% in 2011, but this still leaves about 2.100.000 persons living with HIV, with about 116.000 new cases and 148.000 deaths in 2011. Performance in disease control programmes is largely a function and reflection of the strengths of the public health systems. Where there are sub-critical human resource deployment, weak logistics and inadequate

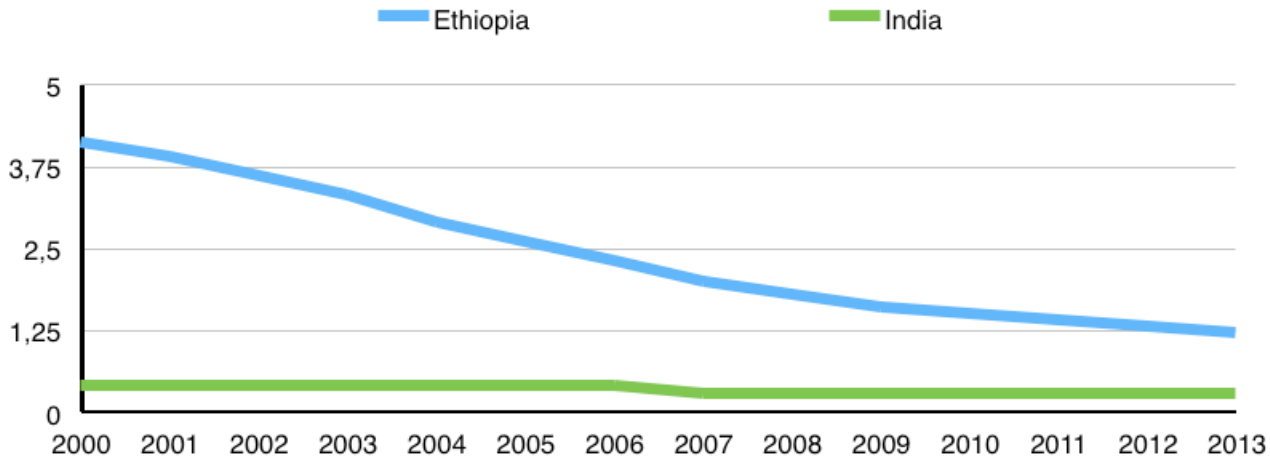
[6] Only 61% of children (12 -23 months) in 2012 have been fully immunized.
[7] MHFW, 2014.
[8] United Nations. The Millennium Development Goals Report 2011. New York: United Nations, 2011.
[9] Central Statistic Authority. Ethiopia Demographic and Health Survey 2011. Calverton: ORC Macro, 2011.

infrastructure, all national health programmes do badly. This was one of the important reasons of the launch of the National Rural Health Mission[10], which was geared to strengthen health systems. National Health Programmes for chronic diseases are very limited in coverage and scope, except perhaps in the case of the Blindness control programme.

Over the last two decades Ethiopia has taken strong measures to address the epidemic, as a result of which HIV incidence has declined by 90 per cent (Fig.18).
Following the approval of the declaration on HIV/AIDS known as Resolution 60/262 in June 2006 during the United Nations General Assembly, Ethiopia accepted the Resolution. A 'Multi-sectoral Plan of Action for Universal Access to HIV Prevention, Treatment, Care and Support in Ethiopia, 2007–2010' has been developed and implemented.
The responses to the HIV/AIDS epidemic showed considerable progress and achieved encouraging results.
The adult prevalence rate, in fact, has also declined from 2.4 per cent in 2009/10 to 1.3 per cent in 2012/13 .

However, the nature of the epidemic and its fuelling factors creates a complex challenge to the ability of health and other sectors to meet the targets for HIV/AIDS control in Ethiopia.
The prevalence rate is 1.7% for males and 2.6% for females.

Figure 18 - percentage of people ages 15-49 who are infected with HIV



This creates additional problems because With 90.000 HIV-positive pregnant women, there are an estimated 14.000 HIV-positive births and a total of 28.000 AIDS death and an estimated 800.000

[10] The National Rural Health Mission (NRHM), launched in April 2005, led to a significant strengthening of public health systems. It brought in a workforce of close to 900,000 community health volunteers, the ASHAs, who brought the community closer to public services, improving utilization of services and health behaviors. The NRHM deployed over 18,000 ambulances for free emergency response and patient transport services to over a million patients monthly, added over 178,000 health workers to a public system that had depleted its workforce to sub-critical levels over a long period of neglect. Across States, there were major increases in outpatient attendance, bed occupancy and institutional delivery. However these developments were uneven and more than 80% of the increase in services is likely to have been contributed by less than 20% of the public health facilities.
Inefficiencies in fund utilization, poor governance and leakages have been a greater problem in some of the weaker states. Much of the increase in service delivery was related to select reproductive and child health services and to the national disease control programmes, and not to the wider range of health care services that were needed.

AIDS orphans annually.
Today, based on a single point estimate of Health Policy Project, there are nearly 1.2 million people living with HIV/AIDS in Ethiopia.

The conditions of the health system both in India and in Ethiopia show great differences between urban and rural areas.
With 17% of the world's population, India accounts for 20% of the diseases on a global basis, for 20% of maternal mortality and for 25% of child mortality under 5 years. Among equally developed countries in the same area, health indicators in India are much worse and even higher inequalities may be seen within the country.
There are urban-rural inequities and there are inequities across states and regions. A number of districts, many in tribal areas, perform poorly even in those states where overall averages are improving. Marginalized communities and poorer economic quintiles of the population continue to fare poorly.
In both countries, Rapid and unplanned urbanization has led to massive growth in the number of the urban poor population, especially those living in slums. This section of the population has poorer health outcomes due to adverse social determinants and poor access to health care facilities, despite living in close proximity to many hospitals - public and private. There is almost no arrangement for primary care in many cities and towns. A technical resource group has examined the urban health situation at length and suggested measures needed to address the most vulnerable and marginalized sections of the urban poor and the way forward in convergence, but now the problem is not solved.

The Indian government shows its full awareness of the inadequacy of the country's health system and its desire to adapt it in the National Health Policy 2015.
In fact, The National Health Policy 2015 is a declaration of the determination of the Government to leverage economic growth to achieve health outcomes and an explicit acknowledgement that better health contributes immensely to improved productivity as well as to equity.
The primary aim of the National Health Policy, 2015, is to inform, clarify, strengthen and prioritize the role of the Government in shaping health systems in all its dimensions- investment in health, organization and financing of healthcare services, prevention of diseases and promotion of good health through cross sectoral action, access to technologies, developing human resources, encouraging medical pluralism, building the knowledge base required for better health, financial protection strategies and regulation and legislation for health.
The National Health Policy of 1983 and the National Health Policy of 2002 have guided the approach for the health sector in the Five-Year Plans and for different schemes, Now 13 years after the last health policy, the context has changed in four major ways. Firstly- Health Priorities are changing. As a result of focused action over the last decade we are projected to attain Millennium Development Goals with respect to maternal and child mortality.
The second important change in context is the emergence of a robust health care industry growing at 15% compound annual growth rate (CAGR). This represents twice the rate of growth in all services and thrice the national economic growth rate.
Thirdly, incidence of catastrophic expenditure due to health care costs is growing and is now being estimated to be one of the major contributors to poverty. The drain on family incomes due to health care costs can neutralize the gains of income increases and every Government scheme aimed to reduce poverty.

The fourth and final change in context is that economic growth has increased the fiscal capacity available.

3.1. Health Economic and Human Resources

Yearly health expenses per person (Tab. 7) in Ethiopia amounts to 25 $, that is much lower with respect to the minimum health expense recommended by the World Health Organization for the developing countries. In India it amounts to 61$ in 2013, that, despite being more than twice the Ethiopian per capita expenditure, is always much lower than the minimum health expense recommended by the WHO (in the United States, health expenditure per capita is $ 9,146).

Tab.7 - Health Expenditure per capita

Health expenditure per capita (current US$)				
Country	**2010**	**2011**	**2012**	**2013**
Ethiopia	15	18	22	25
India	54	61	58	61

Source: World Bank data

In Ethiopia and even more in India the failure of public investment in health to cover the entire spectrum of health care needs is reflected best in the worsening situation in terms of costs of care and impoverishment due to health care costs. All services available under national programs are free to all and accessed with fairly good rates of coverage. India has one of the largest programs of publicly financed ART drugs for HIV anywhere in the world. All drugs and diagnostics in all vector borne disease programs are free. This is also true for all of immunization and much of the pregnancy related care. Also due to the selective approach, several essential services especially for chronic illness is not easily obtainable resulting in physical and financial hardship and poor quality of care.

Yet if health care costs in India are more impoverishing than ever before, almost all hospitalization even in public hospitals leads to catastrophic health expenditures, and over 63 million persons are faced with poverty every year due to health care costs alone, it is because there is no financial protection for the vast majority of health care needs. In 2011-12, in India, the share of out of pocket expenditure on health care as a proportion of total household monthly per capita expenditure was 6.9% in rural areas and 5.5% in urban areas. This led to an increasing number of households facing catastrophic expenditures due to health costs (18% of all households in 2011-12 as compared to 15% in 2004-05). In Ethiopia long-term trends in health access and health gains show dramatic improvements in the past 10 years. The Government has shown the political commitment and leadership, which has resulted enhanced responsiveness to community health needs. As a result, Ethiopia has achieved multi-front health gains including the achievement of the MDG 4 on child mortality three years ahead of the target date. The overall gain has led to increased life expectancy for both men and women, which is a key component of the human development index.

Tab.8 - Number of Health Facilities in Ethiopia

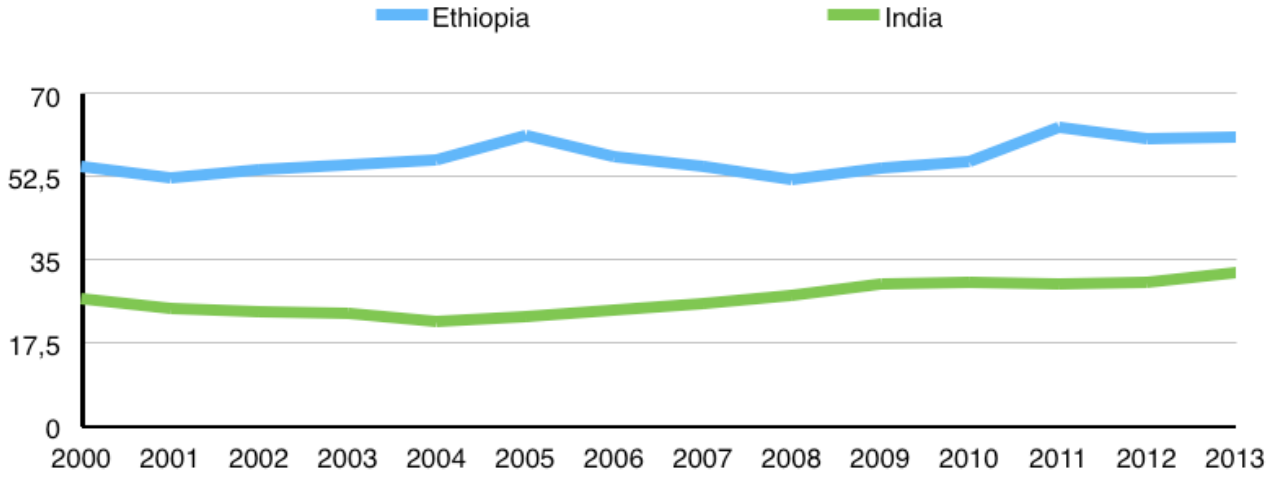
Number of Health Facilities in Ethiopia		
Facilities	**2004/2005**	**2012/2013**

Public Hospitals	11	127
Health Centres	519	3.100
Health Posts	4.211	16.048

Source: MoFED data

The basis for accelerated improvement in health has been the rapid growth in the construction of health facilities, the training of health professionals and the budgetary resources allocated to the sector. The Government has been making strong efforts to expand and provide health services at all levels. Between 2005 and 2013, the number of health centres increased from 519 to 3,100, and public hospitals rose from 11 to 127. The number of medical schools increased from 5 to 25 in the same period.
Despite everything that we said, public health expenditure (%) of both countries, however, has remained essentially unchanged over time.

Figure 19 - Health expenditure, public (% of total health expenditure)



In connection with the economic impact of health expenditure of which it has been discussed previously, in India a number of publicly financed health insurance schemes were introduced to improve access to hospitalization services and to protect households from high medical expenses[11]. The Indian health Private Sector, engaging and supporting the growth of the health care industry, is an important element of public policy. The private health care industry is valued at $40 billion and is projected to grow to $ 280 billion by 2020 as per market sources. The private health care industry is complex and differentiated. It includes insurance and equipment, which accounts for about 15%, pharmaceuticals which accounts for over 25%, about 10% on diagnostics and about 50% is

[11] The Central Government under the Ministry of Labour & Employment, launched the Rashtriya Swasthya Bima Yojana (RSBY) in 2008. The population coverage under these various schemes increased from almost 55 million people in 2003-04 to about 370 million in 2014 (almost one-fourth of the population). Nearly two thirds (180 million) of this population are those in the Below Poverty Line (BPL) category. Evaluations show that schemes such as the RSBY, have improved utilization of hospital services, especially in private sector and among the poorest 20% of households. However there are other problems. One problem is low awareness among the beneficiaries about the entitlement and how and when to use the RSBY card. Another is related to denial of services by private hospitals for many categories of illnesses, and over supply of some services.

hospitals and clinical care. The Government has had an active policy in the last 25 years of building a positive economic climate for the health care industry.
In any case, today, only 10% of Indian population has an health insurance and health services are commonly paid out-of-pocket (India 58%).
The population of Ethiopia will appeal more to public health than Indian population, paying health expenditure out of pocket just for the 35%.

World Health Organization set the medical standards that require 25.4 health workers each 10.000 inhabitants; in India there are 11,9 health workers each 10.000 inhabitants and there are huge differences among states and between urban and rural areas.
Indian government tried to intervene, especially in the rural areas, by training women from 25 to 45 who received at last 8 years of education. Each of them serves as community health worker by providing basic health services to about 1.000 people.
In Ethiopia is been made a Health Development Army (HAD). A Health Development Army has also been formed as a means to meet priorities set in the Health Sector Development Program and Growth and Transformation Plan. The Army consists of 2,026,474 one-to five peer networks that have been established nationwide. Priority is given to mass mobilization in pastoral areas.
During last ten years, medical, nursing and technical education increased. Currently most have little orientation to rural service or any public services, and the teaching standards are very varied with sub-optimal skill sets requiring extensive in-service training subsequently. The challenge for future Indian health program is to guide the expansion of educational institutions to provide skilled health workers to where they are needed most, and with the necessary skills.
In Ethiopia the number of health posts rapidly increased to reach 16,048 in 2013, up from 4,211 in 2005 and 6,191 in 2006. At present, the Government is planning to expand the health service system further through constructing more than 15,000 health posts, 3,056 health centres, and 800 new primary hospitals[12].

Tab. 9 - Healthcare Workforce Standards in Ethiopia

Healthcare Workforce Standards			
Indicators	**Status 2009**	**Status 2013**	**International Benchmarks**
Health Workforce Density	0,7 per 1.000	1,3 per 1.000	2,3 per 1.000 (WHO recommended)
Physicians	1 per 42.706	1 per 23.700	1 per 10.000
Nurses	1 per 5.000	1 per 1.890	1 per 5.000
Midwives	1 per 57.000	1 per 14.894	1 per 1.000

Source: MoFED data

[12] MoFED

The Indian Department of Health Research was established in 2006 to strengthen Indian efforts in health research.
Much of its results are delivered though the research institutions that come under the Indian Council of Medical Research. Simultaneously research support to medical colleges across the country is being strengthened to ensure their engagement in research. There have been significant contributions made by the Department, but modest funding of less than 1 % of all public health expenditure has resulted in limited progress.

Despite years of strong economic growth in India and increased Government health spending in the 11th Five Year plan period, the total spending on healthcare in 2011 in the country is about 4.0% of GDP, lower than percentage Ethiopian equal to 5.1%.

Tab. 10 - Health Expenditure

Health expenditure, total (% of GDP)				
Country	**2010**	**2011**	**2012**	**2013**
Ethiopia	4.9	5.2	4.9	5.1
India	3.8	3.8	3.8	4.0

Source: World Bank data

Global evidence on health spending shows that unless a country spends at least 5–6% of its GDP on health and the major part of it is from Government expenditure, basic health care needs are seldom met. While it is important to recognize the growth and potential of a rapidly expanding private sector, international experience (as evidenced from the table 11) shows that health outcomes and financial protection are closely related to absolute and relative levels of public health expenditure.

Tab.11 - Health Indicators

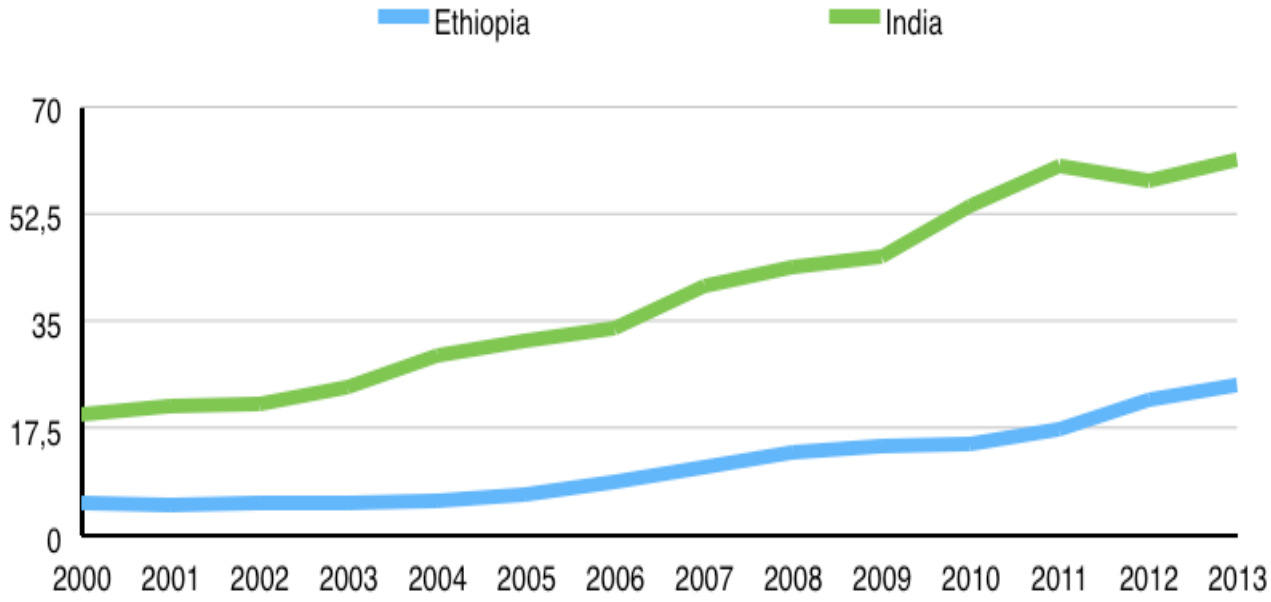
Health Indicators 2013				
Country	**Health Exp. Per Capita**	**Health Exp. % GDP**	**Govt. Health Exp (% of total H. Exp)**	**Life Expect. At birth**
Ethiopia	25	5.1	61	64
India	61	4.0	32.2	66
Thailand	264	4.6	80.1	74
BRICS Country				
Brazil	1,083	9.7	48.2	74

OECD Countries				
Italia	3,155	9.1	78	82
Japan	3,966	10.3	82.1	83
USA	9,146	17.1	47.1	79

Source: World Bank data

Out of the developing countries in Table 11, two countries (Brazil and Thailand) are considered to have almost achieved universal health coverage. Thailand has almost the same total health expenditure as India but its proportion of public health expenditure is 77.7% of total health expenditures (which is 3.2 % of the GDP) and this is spent through a form of strategic purchasing in which about 95% is purchased from public health care facilities which is what gives it such a high efficiency. Brazil spends 9% of its GDP on health but of this public health expenditure constitutes 4.1 % of the GDP (which is 45.7% of total health expenditure).
With respect to the health budget in Ethiopia, the Health expenditures per capita (Fig. 20) have been rising for a longer period, but especially rapidly since the mid-2000s, reaching in 2013 the 25$. Total health expenditures on GDP are 5.1%, of which 61% are public health expenditure, against 32.2% of India.

Figure 20 - Health expenditure per capita (current US$)



National health policies, as you can see from the table 11, appear to have significant repercussions on the life expectancy of the populations.
India is the world's third largest economy in terms of its Gross National Income (in PPP terms) and has the potential to grow larger and more equitably, and to be considered as one of the developed countries of the world. India today possesses as never before, a sophisticated arsenal of interventions, technologies and knowledge required for providing health care to its

people. Yet the gaps in health outcomes continue to widen. On the face of it, much of the ill health, disease, premature death, and suffering we see on such a large scale is needless, given the availability of effective and affordable interventions for prevention and treatment. "The reality is straightforward. The power of existing interventions is not matched by the power of health systems to deliver them to those in greatest need, in a comprehensive way, and on an adequate scale".[13]

4. Education in India and Ethiopia

Education of human resources and their management is a fundamental tool of development.
Long-term trends indicate that encouraging progress in educational attainment has been made in Ethiopia and in India. In particular, the expansion of education in the last 10 years has been fairly good.
While the recent expansion of education has taken place at all levels, the Governments have made particular efforts towards universal primary education.
There are unfortunately no substantial time series in order to better evaluate the increase, but even the existence of the data today has great significance.
Anyway, the situation of the two countries analyzed, in absolute value, is still hard for the Education, just look at the Years of schooling of 2012 amounted to 4.4 for India and 2.4 for Ethiopia, against 11.7 of Indians expected years of schooling and 8.5 Ethiopians (Tab.12)

Tab. 12 - HDI Ethiopia - India

HDI rank	Country	Human Development Index (HDI) Value, 2013	Life expectancy at birth (years), 2013	Mean years of schooling (years), 2012	Expected years of schooling (years), 2012
173	**Ethiopia**	0.435	63.6	2.4	8.5
135	**India**	0.586	66.4	4.4	11.7

Source: World Bank data

4.1 Literacy

Literacy rate in Ethiopia is better than the average of African countries, but it still remains at a very low level. Even though the government's education strategy set the objective of spreading an universal primary education in the country before 2015, the target is still very far. Primary school is free, but it is not compulsory, so the decisions about children's education is completely left to the families, that often prefer children to come and help in their working activities. In case of baby girls, they are often forced to get married even if they are very young.

[13] MHFW, 2014.

So, even if Ethiopian government seems to be aware of the importance of education in the development process of the country, times for implementing its programs (also due to the bureaucracy) are often too slow and this requires some kind of support.
Definitely more Ethiopians are attending school, especially in rural areas. As revealed in the 2011 Welfare Monitoring Survey (WMS)[14], literacy rates have risen since 2004 from 37.9 per cent to 46.7 per cent in 2011. Literacy rates in Ethiopia are on target for males but lower than expected for females, even when taking into account levels of income. This is occurring despite major improvements in literacy for both sexes since the mid-2000s. Overall, the female literacy rate has increased from 27 to 47 per cent between 2004 and 2012, and male literacy from 49 to 63 per cent[15]. (Tab. 13)

In India, the Ministry of Human Resource Development and its Department of School Education and Literacy is starting to improve education in rural areas, by building new schools and paying adequate salaries to the teachers, but corruption affecting the country makes these initiatives often worthless, since teachers don't go to the forest schools and children cannot undergo an adequate education process.
The Youth literacy rate – Percentage of population aged 15–24 years who can both read and write with understanding a short simple -, is between 2008 and 2012 88 for male and 74 for female. Indeed, education index in India grew during the last 12 years, but its average value is still 4.4 years.
Even though Indian government is committed in improving the education system, its strategy is not perfectly working and this makes individuals and associations essential for implementing education programs. Education for disabled children is also a big issue: public schools are very crowded and disabled children cannot receive a proper education. Furthermore, religious and cultural beliefs make disabled children's access to education even more difficult[16].

Tab. 13 - Youth Literacy Rate

Youth (15–24 years) literacy rate (%)			
Country	**male**	**female**	
Ethiopia	63	47	2008-2012
India	88	74	2008-2012

Source: Unicef statistical data

4.2 School participation

As part of expanding educational opportunities over the past two decades, net enrollments in primary school have almost tripled since monitoring began in the 90s. Currently, in Ethiopia about 65 per cent of female primary age children are attending primary school and 64% of male, while in

[14] Central Statistical Agency - Ministry of Finance and Economic Development (MoFED) (2011), *Welfare Monitoring Survey (WMS) 2011-2012*, Ethiopia.

[15] Unicef Data.

[16] Rinaldi A., Sciarelli F. (2015), *Economic and social causes for a late development: a comparison between India and Ethiopia*, SIBR 2015 Osaka Conference, Osaka.

India are 85% of male and 82% of female (Tab. 14). Large variations were observed at the regional level, with some regions or states at or above the national average, while others lagged behind.

Tab. 14 - Primary School Partecipation

Primary school participation – Net attendance ratio (%)			
Country	**male**	**female**	
Ethiopia	64	65	2008-2013
India	85	82	2008-2013

Source: Unicef statistical data

Secondary school enrollment has risen too, but it remains quite low, especially in rural areas, and among the poorest groups. Only in the last five years did the gender gap start decreasing at this level of education.
Secondary school net attendance ratio is the number of children attending secondary or tertiary[17] school who are of official secondary school age, expressed as a percentage of the total number of children of official secondary school age.
This ratio confirms that the participation to secondary school is very low mostly for Ethiopians people. In fact, in Ethiopia, only 16% of children attend school. In India this share is higher, but for females it does not exceed 50% (Tab. 15).

Tab. 15 - Secondary School Partecipation

Secondary school participation – Net attendance ratio (%)			
Country	**male**	**female**	
Ethiopia	16	16	2008-2013
India	59	49	2008-2013

Source: Unicef statistical data

In India and in Ethiopia, encouraging progress in educational attainment has been made and the expansion of education in the last 10 years has been impressive and it has taken place at all levels. Ethiopian Government started trying to improve the quality of education through the School Improvement Program launched under the General Education Quality Improvement Program (GEQUIP). This program intends to improve students' performance by creating a conducive school environment, improving the school facilities, using tutorial classes and so on.

[17] Because of the inclusion of secondary-school-aged children attending tertiary school, this indicator can also be referred to as a secondary adjusted net attendance ratio.

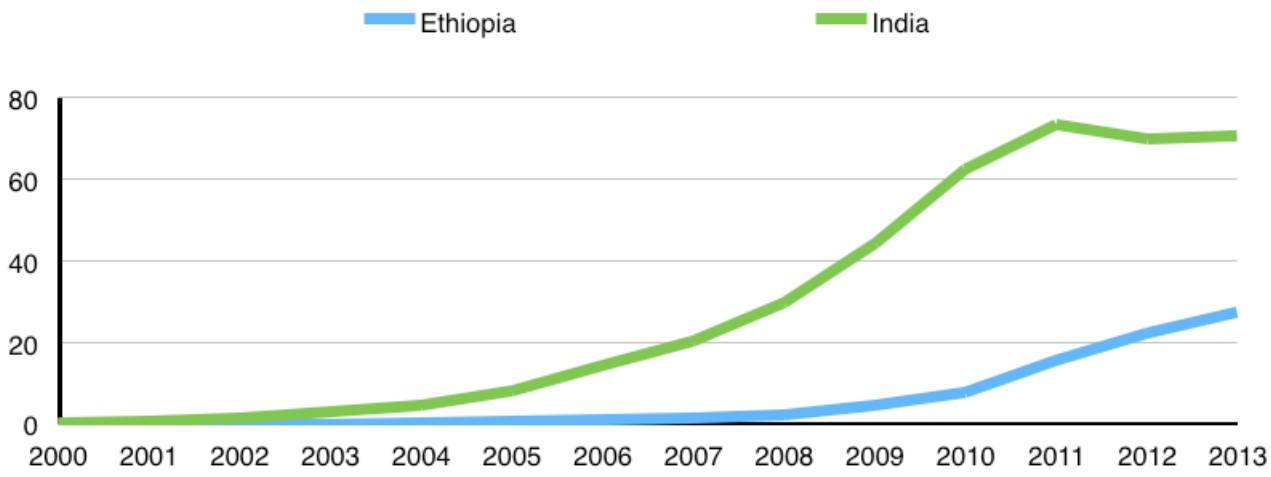
The issues related to literacy of the population also emerge from other data, such as possession of the mobile phone and internet usage.
India, today new and great technological power, shows a large gap between the percentage of phone users (71%) and the percentage of Internet users (15%), which suggests that the word is still the first element of communication (Tab. 16 – 17).
In Ethiopia the two values are very low, but this is caused not only by the lack of literacy, even by the weak technological development, the lack of telephone and internet network in most of the territory.

Tab. 16 - Mobile phone users

Mobile phones per 100	
Country	**2013**
Ethiopia	27
India	71

Source: Unicef statistical data

Figure 21 - Mobile cellular subscriptions (per 100 people)

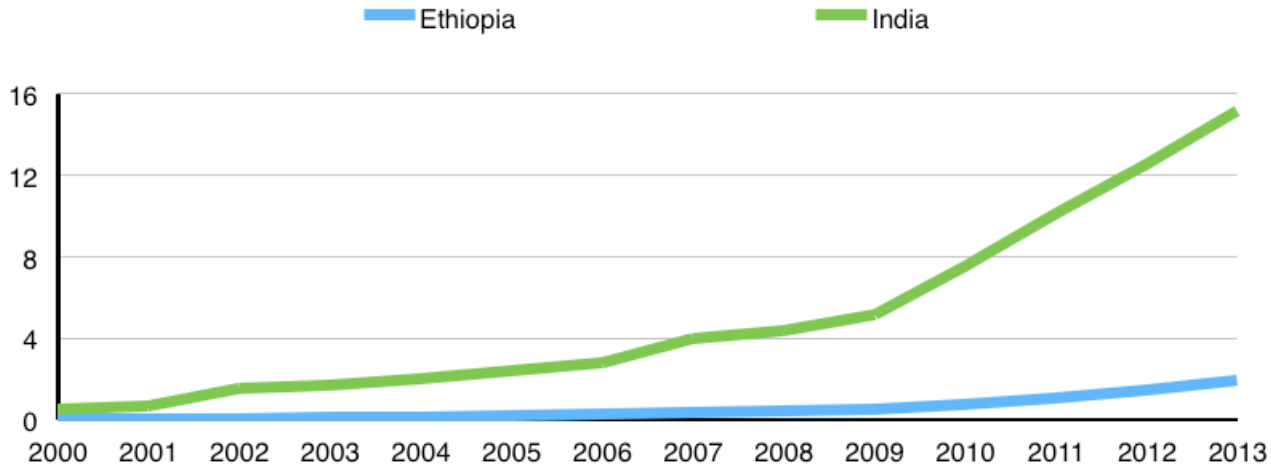


Tab. 17 - Internet users

Internet users per 100	
Country	**2013**
Ethiopia	2
India	15

Source: Unicef statistical data

Figure 22 - Internet users (per 100 people)



Many Ethiopians and Indians are at least getting basic education, which, by itself, is a significant achievement. However, it should be noted that there is still a very high level of illiteracy, over 37 million Ethiopians and 250 million di Indians cannot read and write, and the most of them are adults.
Multi-sector collaboration is needed for curriculum development for promoting adult education. The Ethiopian Government, for example, provided educational instruction to 3.5 million adults in 2012/13 and planned to double that number in 2013/14.

1.3.Education Economic and Human Resources
Anyhow, the expansion in access to and enrollment in education is a necessary but not a sufficient condition to ensure the knowledge and skills that will enable this countries to create more productive employment. There are multiple factors that come into play in this, including quality of education, employment opportunities, and the necessary environment in order to create or expand productive employment.
The Governments, primarily wanting to push the economic development of countries, are trying to improve the quality of education.
With this objective, the Ethiopian government launched the School Improvement Program Financed under the General Education Quality Improvement Program (GEQUIP). This program lays the ground-work for improvements in student performance. Examples include the creation of a conducive school environment, the improvement of school facilities, the use of cluster resource centers, tutorial classes, student peer networking, and greater participation via student parliaments/ councils.

Both states have increased the government expenditures to improve the education and its quality. Examples include the mass hiring of new teachers that has led to the reduction in pupil-teacher ratios from 66:1 in 2004/05 to 49:1 in 2012/13 for primary education, and from 51:1 to 29:1 for secondary education In Ethiopia[18].

[18] MoFED Data.

In the same period, In India and In Ethiopia, the proportion of qualified primary school teachers increased with qualified women.
The Ethiopian government expenditure per student (Tab. 18) is in 2010 equal to 19.2% of GDP per capita, while Indian government spends per student in 2010 7.2%, value increased in 2011 to 9%.

Tab. 18 - Government Expenditure per capita

Gov. expenditure per student, primary (% of GDP per capita)		
Country	**2010**	**2011**
Ethiopia	19.2	
India	7.2	9.0

Source: World Bank data

The government expenditure on total education (Tab. 19) decrease slightly in 2012, rising from 3.3% in 2010, to 3.9% in 2011 and 3.8% of GDP in 2012. This expenditure is greater in Ethiopia (4.7%)[19].

Tab. 19 - Government Total Expenditure on Education (% of GDP)

Government expenditure on education, total (% of GDP)			
Country	**2010**	**2011**	**2012**
Ethiopia	4.7		
India	3.3	3.9	3.8

Source: World Bank data

The total government expenditure on education in percentage of government expenditure (Tab. 20), in Ethiopia, has a very significant value. In fact the 24.4% of total government expenditure is dedicated to education system. This value shows clearly the commitment that the government of Ethiopia has chosen to have regard to the education of its population. The same thing can not be said for the Indian government, which spending in education is consistently low (12.9 in 2012 and 2013).

Tab. 20 - Government Total Expenditure on Education

[19] World Bank Data.

Government expenditure on education, total (% of government expenditure)			
Country	**2010**	**2011**	**2012**
Ethiopia	24.4		
India	10.5	12.9	12.9

Source: World Bank data

Both India and Ethiopia lack a wide education strategy and territorial inequalities in education are still evident between rural and urban areas and between male and female.
By and large, however, the main determinants of inequity and exclusion from education lie outside the classroom: poverty and food insecurity; child labour both at home and commercially; long distances to schools (especially to secondary schools); gender disparities and in particular early marriage; and the lack of continuous access for children from pastoralist families.
The recent narrowing of the education gap, as we have seen before, has contributed to the observed narrowing in the gender wage gap. On average, differences in education explain a significant fraction of the variation in productivity, wages and incomes among adults. Moreover, in their roles as mothers, educated women pass on the benefits of higher education to their children. A World Bank study (World Bank, 2012a) states that education has a big and good influence on human development and health, in fact children born to more educated mothers are less likely to die in infancy and more likely to have higher birth weights and be fully immunized.

5. Feasible solutions

From vicious circle of poverty to virtuous circle of development
In economics, the cycle of poverty is the "set of factors or events by which poverty, once started, is likely to continue unless there is outside intervention." The cycle of poverty has been defined as a phenomenon where poor families become trapped in poverty for at least three generations. These families have either limited or no resources[20].
There are many disadvantages that collectively work in a circular process making it virtually impossible for individuals to break the cycle. This occurs when poor people do not have the resources necessary to get out of poverty, such as financial capital, education, or health.
In other words, poverty-stricken individuals experience disadvantages as a result of their poverty, which in turn increases their poverty.
The great risk is that the poor remain poor throughout their lives.
This cycle has also been referred to as a "pattern" of behaviors and situations which cannot easily be changed. The poverty cycle is usually called "development trap" when it is applied to countries.
Economic growth is been seen by some researcher as the virtuous circle, but in our opinion this is

[20] Bura R., *What is the meaning of 'vicious circle of poverty'?,* http://www.preservearticles.com/2012042631242/what-is-the-meaning-of-vicious-circle-of-poverty.html

not correct, because economic development is necessary but not sufficient.
Our virtuous circle of sustainable human development is composed from the following factors: living standard, education, health, quality and persistence. The last two factors are indispensable to complete the development circle, because they introduce the right way to drive the development. Quality is an important factor on which development must rely and it has to permeate the entire development strategy of countries.
Persistence is a fundamental factor in every development process to achieve long-time sustainability.
These two factors are positive objectives of a country's development strategy, as well as good living standards, good health and good education.
Moreover, to follow a sustainable and balanced development path, it is necessary to implement a strategy that allows the coexistence of all the virtuous circle's factors.
The lack of just one of these factors, as shown by history, causes the circle to become vicious, ignoring the problems more than solving them.
The development model to which a government must necessarily aim is, therefore, a complex, complete, balanced and sustainable development model.
We have two fundamental actors for sustainable human development: Sustainable Development State and Civil Society.

Sustainable Development State
Although the term "Developmental State" has been used to refer to state-led economic planning as experienced in some of the countries of East Asia and elsewhere since the 1970s, serious attempts at conceptualizing it are said to have begun with the work of Chalmers Johnson in the 1980s. The Developmental State model is defined as an ideological orientation that promotes the ideal agenda of development and its institutional arrangements in the formulation and implementation of policies and programs.
A Sustainable Developmental State, in simple terms, must be a state that tends to be a strong player in the three dimensions of economy, health and education of a nation, trying to put together economic, social and human development.
The Ethiopian State, in the past decade, and the Indian State, in the past twenty years have given high priority to achieving specific goals that directly promote human development and inclusive growth; they also enhanced primary health and education access and services, gender equality, job creation and provision of basic economic and social infrastructure, such as electricity, roads, telecommunications and potable water. Furthermore, governments have been investing in economic and social infrastructure, streamlining the public service, revamping the tax collection system, and supporting small and medium enterprises.

All of these policy and institutional frameworks determined very small gains in HDI rank: Ethiopia gained 1 position and India gained 2 positions. Surely, both countries need more time. Development policies require long time perspectives and great synergies between states and civil society.
It needs a strategy that will see the government works on national policies with a top down system and civil society works on the territories, in coordination with state, with a bottom-up system.
The 'Sustainable Development State', that is a Sustainable Human Development State, still needs to be theoretically defined and has to find an adequate application in the poorest countries.

Civil Society
In order to support governments in the development strategy, civil society can play a fundamental role.

Civil society should not take the place of governments, but it must support governments so that national policies may also reach the most far areas, by combining a traditional top down approach to development to a new one bottom up.
Social, human and economic growth may arise from the involvement of civil society, particularly in the most marginalized areas of the country, since one of the main issues in the analyzed countries is related to the lack of professionals.
In our opinion, if the planning of a development process governments were able to include individuals from civil society, represented in different ways, and foreign capital and innovative knowledge to the start-up phase, would be able to achieve at the same time results in the short term. Civil society could also be an important instrument to train the new skills, through foreign professionals supported by foreign capitals, in many essential services (community health workers, community education worker, community worker architecture, community planning worker, etc). This way, local manpower could be trained to manage international tools for development benefitting new capabilities and the knowledge on international tools[21].

India and Ethiopia are caught up in vicious cycle of poverty, because they lack the coexistence of growth of the three factors of the poverty cycle.
Lack of education does not allow the increase in income that does not help in the protection of the health especially in those countries where the government does not ensure free health care.
Overcoming the barriers of poverty in these countries certainly requires a concentrated effort on many fronts and a 'big-push' is required to transform the 'poverty vicious cycle' into a 'development virtuous circle'.

[21] Sciarelli F. (2015), Human Resource Management for Sustainable Development, Sustainable Development Conference 2015 Proceeding, Bangkok, July 2015.

References

Aghion, P., Bolton, P. (1997). A trickle-down theory of growth and development. *Review of Economic Studies*, 64, 151-172.

Atkinson A. B., Cantillon B., Marlier E., Nolan B. 2002, *Social Indicators. The EU and Social Inclusion*, Oxford: Oxford University Press.

Bourguignon, F., Morrison, C. (2002). Inequality among world citizens: 1820-1992. *American Economic Review*, 92 (3), 727-744.

Bura R., *What is the meaning of 'vicious circle of poverty'?,* http://www.preservearticles.com/2012042631242/what-is-the-meaning-of-vicious-circle-of-poverty.html

Callan T., Nolan B. (1991). Concepts of Poverty and the Poverty Line, *Journal of Economic Surveys*, n. 5.

Central Statistic Authority (2011). *Ethiopia Demographic and Health Survey 2011*. Calverton: ORC Macro, 2011.

Desai M., Shah A. (1988) An Econometric Approach to the Measurement of Poverty, *Oxford Economic Papers*, n. 40, 505-522.

Domar E.D.(1957). *Essays in the Theory of Economic Growth*, Oxford: Oxford University Press.

Fisher G. R. (1992). The Development and History of the Poverty Thresholds. *Social Security Bulletin*, 55, 3-14.

Fukuyama, F. (1995). *Trust: the Social Virtues and the Creation of Prosperity*, New York, Free Press, trad. it. Fiducia, Milano: Rizzoli.

Gillie A. (1996). The Origin of the Poverty Line, *Economic History Review*, n. 49, 715-730.

Helliwel. (2002). How's life? Combining individual and national variables to explain subjective well-being in *NBER Working Paper* No. 9065.

Hirshman A. (1958). The Strategy of Economic Development, Yale UP, New Haven and London.

Khan A., Riskin C. (2000), Inequality and Poverty in China in the Age of Globalization, New York: Oxford University Press.

Kuznets, S. (1955). Economic growth and income inequality. *American Economic Review*, 45 (1), 1-28.

Lewis, W.A. (1954). Economic Development with Unlimited Supplies of Labour. *Manchester School*, 22, 139-191.

Lorentzen, P., McMillan, J., Wacziarg, R. (2008). Death and development. *Journal of Economic Growth*, 13 (2), 81-124.

Lucas R. (1988). On the Mechanism of Economic Development. *Journal of Monetary Economics,* 22,pp.3 - 42.

Milanovic, B. (2012). Global inequality recalculated and updated: the effect of new PPP estimates on global inequality and 2005 estimates. *Journal of Economic Inequality*, 10 (1), 1-18.

Ministry of Health & Family Welfare (MHFV) of India, *National Health Policy 2015 Draft*, http://www.thehinducentre.com/multimedia/archive/02263/Draft_National_Hea_2263179a.pdf

Persson, T., Tabellini, G. (1994). Is inequality harmful for growth?. *American Economic Review*, 84 (3), 600-621.

Prebisch R. (1959). Commercial Policy in the Underdeveloped Countries. *American Economic Review*, Papers and Proceedings, p. 256.

Quah D. (2003), *One Third of the World's Growth and Inequality* , in T. S. Eicher, S. J. Turnovsky (eds.), *Inequality and Growth. Theory and Policy Implications*, Mit Press, Cambridge (Mass.).

Rinaldi A., Sciarelli F. (2015), Economic and social causes for a late development: a comparison between India and Ethiopia, SIBR 2015 Osaka Conference, Osaka, July 2015.

Rostow W.H. (1961). *The Stages of Economics Growth*. Cambridge: Cambridge Univeristy Press.

Rowntree B. S. (1901), *Poverty: A Study of Town Life*, Macmillan, London.

Rowntree B.S. ,1941, *Poverty and Progress: A Second Social Survey of York*, Londra: Longmans.

Sala-i-Martin, X., Doppelhofer, G., Miller, R. (2004). Determinants of long-term growth: a Bayesian averaging of the classical estimates (BACE) approach. *American Economic Review*, 94 (4), 813-835.

Sciarelli F. (2015), Human Resource Management for Sustainable Development, Sustainable Development Conference 2015 Proceeding, Bangkok, July 2015.

Sen A. K. (1997b), *Inequality Re -Examined*, (1a ed. 1992), Clarendon Press, Oxford (trad. it. La disuguaglianza. Un riesame critico, il Mulino, Bologna, 1994).

Sen A. K. (1987), *On Ethics and Economics*, Blackwell, Oxford (trad. it. Etica ed economia, Laterza, Roma-Bari, 1988).

Sen A. K., (1979). Issues in the Measurement of Poverty, *Scandinavian Journal of Economics*, 81, , 285-307.

United Nations (2011). *The Millennium Development Goals Report 2011.* New York: United Nations, 2011.

Williamson, J. D. (1985). *Did british capitalism breed inequality?*. Boston, MA: Allen & Unwin.

World Bank. (2000). *World Development Report: Attacking Poverty*. Oxford: Oxford University Press.

World Bank. (2001). *The Concept of Poverty and Well-Being*, in Poverty Manual, chapter 1, Washington D.C.

Zhang, J., Zhang, J. (2005). The effect of life expectancy on fertility, saving, schooling and economic growth: theory and evidence. *Scandinavian Journal of Economics*, 107 (1), 45-66.

Effect of salinity on the toxicity of single-walled carbon nanotubes in marine microalgae

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Abstract

Nanotechnology has grown rapidly for the past 20 years, with nanomaterials at the leading edge of this technology. Single-walled carbon nanotubes (SWCNT) are one of the most widely used nanomaterials, especially in electronic devices, paints and medical materials. Release of nano-wastes into the environment has raised the alarm due to their toxicity effect to the biota, especially the marine ecosystem. The toxicity of nanowastes to marine ecosystem may be affected by several physiochemical factors such as salinity. The salinity of seawater changes can be due to several factors such as melting of sea ice on a regional scale. The objective of this study was to investigate the effect of SWCNT in marine microalgae *Dunaliella tertiolecta* and *Isochryis* sp. at different salinity levels. The toxicity effects of SWCNT, SWCNT-OH and SWCNT-COOH (0-100 mg/L) on marine microalgal cells in different salinity (30, 15 and 7.5 ppt) levels were studied based on concentration of algal photosynthetic pigments, cell morphology, level of reactive oxygen species (ROS) and lipid peroxidaion. The results showed that the presence of hydroxyl group caused greater toxicity to microalgae compared to pristine SWCNT and SWCNT-COOH by displaying lowest half maximal effective concentration (EC_{50}) values <15 mg/L. On the other hand, salinity was found to affect the toxicity of SWCNT-COOH but not pristine SWCNT and SWCNT-OH. The toxicity effect of SWCNT-COOH decreased as the amount of salt concentration decreased. In general, *D. tertiolecta* was more sensitive to all nanoparticles studied compared to *Isochrysis sp*. This may be due to the formation of reactive oxygen species (ROS) and lipid peroxidation in *D. tertiolecta*. In conclusion, SWCNT nanoparticles exert toxic effects in marine microalgae and salinity may affect the toxicity of SWCNT in marine microalgae.

How do we set an appropriate policy target of new ODA ?
- The origin of the 0.7% target and post-2015 targets -

○Hamana Hiroaki[1] (Japan International Cooperation Agency)

1 Introduction —Development Finance and International Circumstances—

2015 is an important year for development as it is a target year for Millennium Development Goals (MDGs), which were set in 2001 based on the Millennium Declaration of the United Nations. At the moment, the international community -- not only international organizations and donors, but also researchers, CSOs, and recipient countries -- are actively arguing post-2015 Development Goals, referred to as Sustainable Development Goals (SDGs). The Open Working Group (OWG) was created for the purpose of defining SDGs and published its proposal in July 2014. The SDGs proposal, citing 17 goals and 169 targets, is far a more ambitious proposal than the MDGs proposal, which consists of only 8 goals and 21 targets.

When it comes to the financial sources for development, the United Nations General Assembly (UNGA) is renewing its development finance category i.e., Financing for Development (FfD), as a financial framework to achieve SDGs, which would potentially include the domestic financial resources of developing countries, e.g., tax revenues and private finance such as Foreign Direct Investment (FDI) or remittances, as well as official finance flows from donors like Official Development Assistance (ODA) or officially supported export credits (Figure 1). The third International Conference on Financing for Development (FfD 3) is planned for July 2015, to be held in Addis Ababa, Ethiopia. It is anticipated that estimates of required financial resources for SDGs, financial sources and its quantitative policy target will be discussed at FfD 3. While the FfD will contain a wider variety of resources than its previous rubric, as stated above, it is assumed that ODA will be an important part of Ffd in the post-2015 period.

The concept of ODA and its means of measurement is defined by the Organization of Economic Cooperation for Development /Development Assistance Committee (OED / DAC). In order to maintain its credibility, DAC publishes annual statistics and sets a number of rules and objectives, such as disengaging recommendation or minimum grant elements. Frankly, however, the current approach is out of date since it was set in 1969 and has never been updated after the idea of concessionality[2] was added in 1972, although proposals to modernize the resolution to reflect the drastic changes international circumstances have had on ODA methods have been made several times. Hence, the modernization of the ODA approach and its means of measurement has been urgent work for OECD/DAC even before 2015, if it is to keep its position as the standard-setter for development and have ODA contribute to the FfD. This is a probable reason why OECD/DAC reached a consensus and published its Communiqué in December 2014, stating the new basic approach of ODA and its measurement parameters, as well as introducing a new development financial category, i.e., the Total Official Support for Sustainable Development (TOSSD). Currently, OECD/DAC is drafting a new reporting directive to reflect the agreements set forth in the Communiqué; and when it is endorsed by DAC High Level Meeting (HLM) in February 2016, a new ODA definition and measurements will be officially introduced. The next step will be discussion of the quantitative target of ODA, based on the new definition and approach, possibly to take place at FfD 3.

The quantitative target of ODA was originally introduced in the International Development

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This Paper should not be reported as representing the views of JICA. The views expressed in this paper are those of the author and do not represent those of JICA.
[2] Concessionality suggests how agreeable the terms of an ODA loan are to a borrower.

Strategy for the Second United Nations Development Decade in 1970, stating "Each economically advanced country will progressively increase its official development assistance to developing countries and will exert its best effort to reach a minimum net amount of 0.7% of its gross national product at market prices by the middle of the decade." Since then, the ODA target of 0.7% (hereafter "0.7% target") has been taken as an key target by some donors. It was reiterated during the Second International Conference on Financing for Development, wherein the EU committed to the target again in 2012 [OECD/DAC 2012, p.18), the UK especially passing the bill in order to pledge the target[3], and even the 2014 HLM communique, in its draft zero of the outcome document for FfD 3, emphasizes it. Considering the documents prepared for the post-2015 development agenda and development finance cite the 0.7% target, it is expected that the 0.7% target will be adopted as the post-2015 target if there no strong opposition to it. However, the history that defines the figure and the theory backing it are not well known. This means that the target is again being adopted with no critical revision, even though it may also be out of date under the current approach of ODA, as it stands. (Figure 2).

The first objective of this paper is to review the origin and the background theory of the 0.7% target, then to analyze its meaning under the current economic situation, and to explore how the international community can set an appropriate policy target for ODA post-2015 when a number of new development agenda will be introduced.

Section 2 will review points of the SDGs proposal in line with the historical changes in the development agenda of the United Nations. Sections 3 (1) will explore the original discussion of 0.7% target and theory behind it; Section 3 (2) will reexamine its meaning by applying the theory and empirical data, as well as its modern implication, under the current economic situation. Section 4 will then propose how we can consider a new target in 2015.

Figure 1 Classification of Development Finance

[3] http://www.theguardian.com/global-development/2015/mar/09/uk-passes-bill-law-aid-target-percentage-income

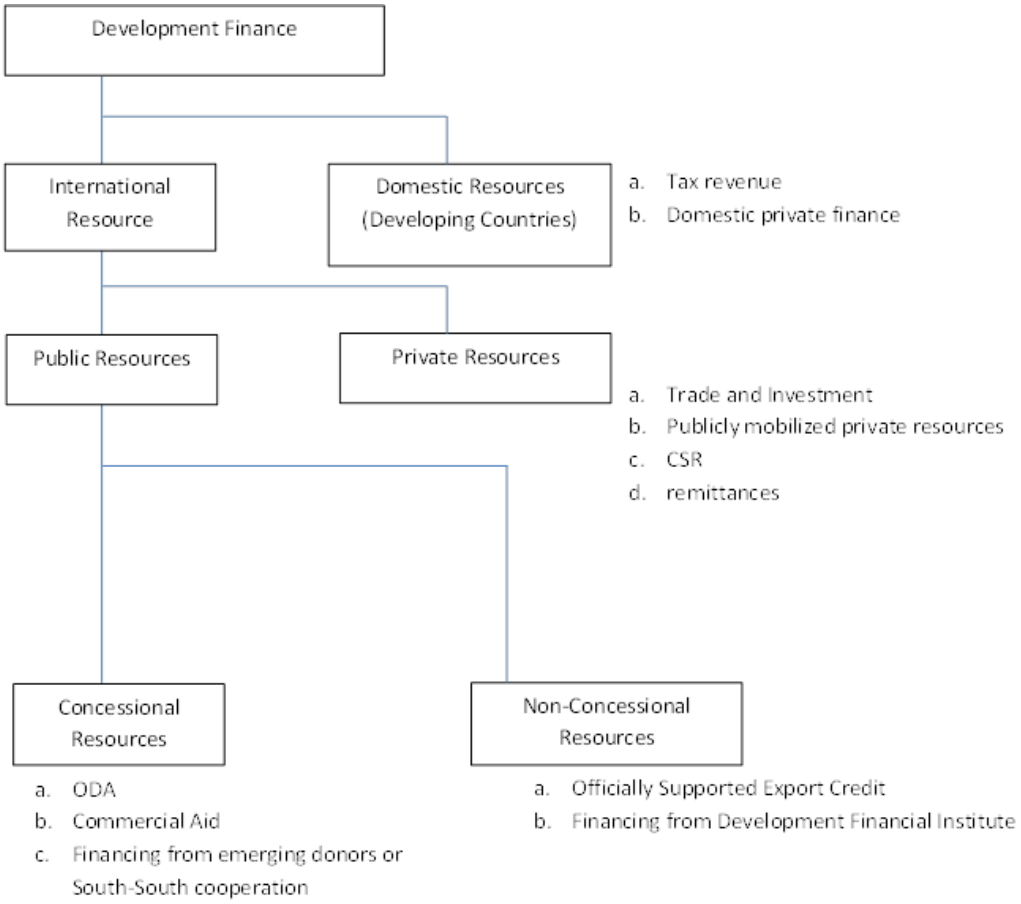
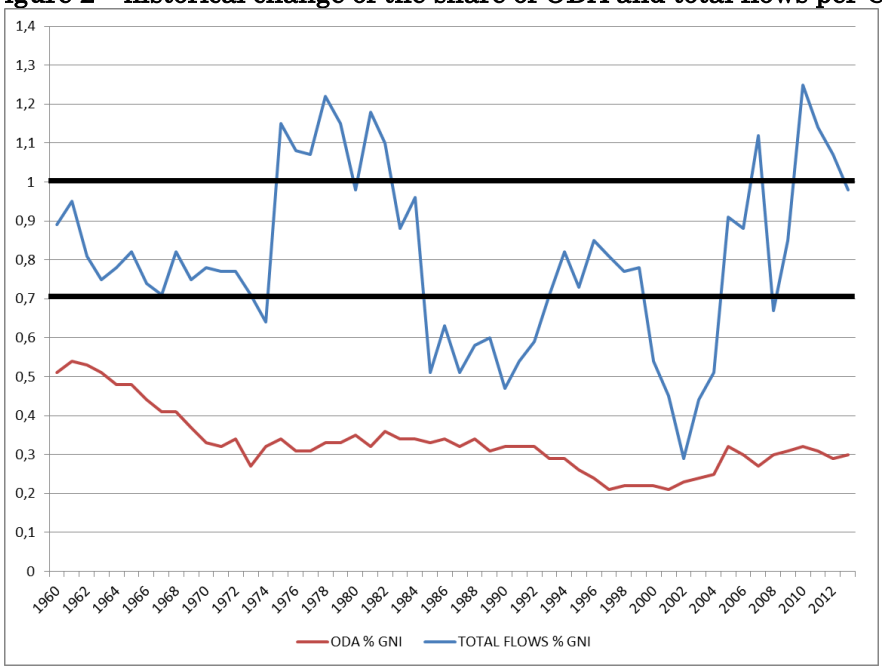


Figure 2 historical change of the share of ODA and total flows per GNI



Notes : Net Disbursement

Source : Author based on OECD.STAT DAC1

2 History of the Rhetoric of the Development Agenda and SDGs

The development agenda varies as international circumstances change. Of course, developing countries have at times contributed to shaping the agenda, but it has been limited; it is mainly donor countries that have taken the initiative in forging the development agenda, as well as the means to achieving it. It would be fair to say that the first internationally accepted modern development agenda is the *United Nations Development Decade: A program for international economic cooperation* (hereafter "First Development Decade"), which was introduced under the initiative of late U.S. President, John F. Kennedy, and was adopted by UNGA in 1961. Since the First Development Decade, UNGA adopted development agendas every 10 years until 2000, when it endorsed the Millennium Development Declaration. Those agendas diversified their goals and objectives accordingly, but their main focus was always on economic growth -- which we can assume was affected by the "trickle-down" theory, that economic benefits provided to businesses and upper income levels will indirectly benefit poorer members of society when the resources inevitably "trickle down" to them (though this idea is often criticized). It is interesting to note that the MDGs proposal does not have overall economic growth as its goal, but that the SDGs proposal does. The history of changes to those agenda and the international circumstances affecting them will be reviewed below.

(1) Development Decades : Agendas in 1960－2000

The First Development Decade set as its main goal for development cooperation annual economic growth[4] of 5% of all developing countries. It was therefore only natural that, during this period, ODA was mainly focused on economic infrastructures and production sectors that promoted national economic growth such as transportation, electric power plant etc. It can be concluded that its assistance led South Korea and other NIEs with solid basic education systems, to "take off". On the other hand, some researchers, such as economist Raul Prebisch, pointed out the challenges of the trickle-down approach, stating that the terms of trade for developing countries relative to developed countries had deteriorated over time: the underdeveloped countries were able to purchase fewer and fewer manufactured goods from the developed countries in exchange for a given quantity of their raw materials. In 1964, the United Nations Conference on Trade and Development (UNCTAD) held a General Assembly, chaired by Prebisch, and agreed to establish a special fund for stabilizing the price of raw materials.

In 1970, the International Development Strategy for the Second United Nations Development Decade (hereafter "Second Development Decade") was adopted in UNGA, which set economic growth[5] goals at 6% and 3.5% per capita. The Second Development Decade assumed that an increase of net financial flow automatically leads to short-term economic growth, based on the economic growth theory that was prevalent at that time, the Harrod-Domar Model. In order to achieve the economic growth target stated above, the Second Development Decade set the target of net total financial flow, including private finance, at 1% of GNP of developed countries, and that of ODA at 0.7%. This was the first time that the 0.7% target was set forth in the UN resolution. Sections 3 (1) will examine the details of that discussion and the theory behind it.

In the 1970's, the international community experienced numerous transitions, such as transitioning from a fixed to floating exchange rate system, the rising cost of natural resources, serious environmental problem, and an active flow of cross-border capital, all of which may have caused fundamental changes in the international economic order. On the other hand, the international community benefitted from the easing of strained relations between the Soviet and the US, or the Détente. Mainly because of these changes in the international economic order, new development rhetoric was introduced, introducing ideas such as "Sustainable Growth". In fact Robert McNamara, the president of World Bank at that time, suggested the importance of a new development strategy, i.e. "reallocation with economic growth" that consisted of "poverty reduction",

[4] Measured by National Income.
[5] Simply put as "gross product.'

"employment" and other BHN (Basic Human Needs), as well as economic growth. The theory of trickle-down economics assumed, to a considerable extent, the potential inequality of growth, since it focuses on intensive growth of heavy industry that requires large capital investment in infrastructures. This transition of strategy, therefore, could be considered as a review of the trickle-down approach. However, as penetrating a view as it is, it could be assumed that, in response to the ease of political tensions in the Cold War, donors tried to replace trickle-down strategy, which requires large aid investment into BHN, with an approach that required a limited budget effort from donors. Actually, the origin of the BHN approach is from "New Direction", published by the United States Assistance for International Development (USAID), which emphasized the need to transit economic growth-oriented development strategy, which corresponded with the Détente period.

Though the "International Development Strategy for the Third United Nations Development Decade" (hereafter "Third Development Decade") adopted in 1980 contains the idea of poverty reduction and BHN, it was still economic growth-oriented, setting its economic growth target as a total 7%, and 4.5% per capita.

By the 1980's, the development strategy was under criticism due to its large donor government intervention, and structural adjustment policy was largely based on the neo-classical economic theory that had been introduced. This arose possibly due to the fact that critics of the former strategy maintained that the strategy caused an imbalanced growth in the public sector in developing counties, constant budget deficit, failure to transition focus to export or failure to stabilize raw material prices, and corruption due to big government intervention.

In the 1990's, mainly because of the end of the Cold War, development strategies became diversified. Under the Cold War, development strategies had to be in accord with international political strategies, so that it was almost impossible to introduce political conditionality such as democracy. After the collapse of the Soviet Union in 1991, development strategies were freed from politics that kept developing countries on the sidelines. At the same time, the 1990s was a period when major donors, except for Japan, lost their motivation to provide developing assistance; this period is referred to as "aid fatigue".

The "International Development Strategy for the Fourth United Nations Development Decade" (hereafter, "Fourth Development Decade") adopted in 1990, was the first decade to state world peace and stability as a development objective, as well as redirecting responsibility for developing countries. Former decades assigned responsibility as to the international community. Goals for the Fourth Development Decade were further diversified, and economic growth became only one of several agenda issues, such as environment, gender and human rights. However, it still set the quantitative target for economic growth at only 7%.

(2) From MDGs (2001－2015) to SDGs Proposal

Since 1990, intensive dialogue has been engaged in forging new development agendas and objectives. The World Summit for Social Development was held in Copenhagen by the UN in 1995, and adopted the Copenhagen Declaration, committed to diverse development agendas such as human rights, democracy, employment, poverty, etc. In this vein, OECD/DAC published *Shaping the 21st Century, the Contribution of Development Cooperation* in 1996, in which it first proposed International Development Targets (IDT), most of the content of which was transferred to MDGs. The IDT states 7 goals, as listed below.

The idea behind IDT was fully supported and became MDGs, with the goal of global partnership being added to it. From the First to Fourth Development Decades, the UN focused its quantitative target only on economic growth; but MDGs sets a diverse quantitative target to include other goals such as primary education and health. It is for this reason that MDGs is referred to as having a performance-based approach.

Post MDGs are expected to be integrated into SDGs, the contents of which are not new inventions; rather, its origin is the direct outcome of other international dialogue on development and environment. The original usage of the term "Sustainable Development" was cited in The World

Commission On Environment and Development, established under the UN in the mid-1980's, and recommended "ways concern for the environment may be translated into greater co-operation among developing countries and between countries at different stages of economic and social development and lead to the achievement of common and mutually supportive objectives that take account of the interrelationships between people, resources, environment, and development" [the World Commission on Environment and Development 1987]. In response to the Commission's report, the United Nations Conference on Environment and Development was held in Rio de Janeiro in 1992, and adopted "Agenda 21", which contains not only environment and resource issues but also social and economic issues. In 1993, in order to follow up several decisions made in at the Rio Summit, the Commission on Sustainable Development (CSD) was established, whose concerns are not limited to environmental issues but also extend to economic and social issues. In this vein, CSD independently started to fashion indicators from MDGs, and now both contents overlap.

In a preparatory meeting of the so-called Rio+20, i.e. the UN Conference on Sustainable Development held in Rio de Janeiro in 2012, there were some remarks that SDGs should be set as separate goals from MDGs, but in the end, with the participation of NGO, experts, and representatives from 30 countries, integration of both goals and the establishment of the OWG (Open Working Group) was agreed. It published the SDGs proposal, consisting of 17 goals and 169 targets in July 2014. SDGs will be set based on this proposal.

Roughly speaking, the origins of the goals and targets in the SDGs proposal can be divided into two groups, one deriving from MDGs, the other from CSDs and other newly introduced goals, such as goal 10: domestic inequality to economic resources, and goal 16: peace building and state building. As it is apparent the number of goals and targets has dramatically increased, not only the quantity but also the quality of the goals have become more demanding: while common targets of MDGs are to reduce imbalances such as poverty or infant mortality rates from half to a fourth, SDGs have the common target to extinguish them completely.

Table 1 MDGs and Target

	Goals	Targets	
1	Eradicate extreme poverty and hunger	1A	Halve, between 1990 and 2015, the proportion of people living on less than $1.25 a day
		1B	Achieve Decent Employment for Women, Men, and Young People
		1C	Halve, between 1990 and 2015, the proportion of people who suffer from hunger
2	Achieve universal primary education	2A	By 2015, all children can complete a full course of primary schooling, girls and boys
3	Promote gender equality and empower women	3A	Eliminate gender disparity in primary and secondary education preferably by 2005, and at all levels by 2015
4	Reduce child mortality rates	4A	Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate
5	Improve maternal health	5A	Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio
		5B	Achieve, by 2015, universal access to reproductive health
6	Combat HIV/AIDS, malaria, and other diseases	6A	Have halted by 2015 and begun to reverse the spread of HIV/AIDS
		6B	Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it
		6C	Have halted by 2015 and begun to reverse the incidence of malaria and other

			major diseases
7	Ensure environmental sustainability	7A	Integrate the principles of sustainable development into country policies and programs; reverse loss of environmental resources
		7B	Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss
		7C	Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation
		7D	By 2020, to have achieved a significant improvement in the lives of at least 100 million slum-dwellers
8	Develop a global partnership for development	8A	Develop further an open, rule-based, predictable, non-discriminatory trading and financial system
		8B	Address the Special Needs of the Least Developed Countries (LDCs)
		8C	Address the special needs of landlocked developing countries and small island developing States
		8D	Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term
		8E	In co-operation with pharmaceutical companies, provide access to affordable, essential drugs in developing countries
		8F	In co-operation with the private sector, make available the benefits of new technologies, especially information and communications

Source:
http://siteresources.worldbank.org/DATASTATISTICS/Resources/MDGsOfficialList2008.pdf

Table 2 SDGs proposal and other agenda of UN

	Goals	Sources
1	End poverty in all its forms everywhere	MDGs1A
2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture	MDGs1B-C
3	Ensure healthy lives and promote well-being for all at all ages	MDGs4、5A-B、6A-C
4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	MDGs2
5	Achieve gender equality and empower all women and girls	MDGs3
6	Ensure availability and sustainable management of water and sanitation for all	MDGs7C
7	Ensure access to affordable, reliable, sustainable and modern energy for all	MDGs7A
8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	From first Development Decade to fourth one
9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	New
10	Reduce inequality within and among countries	New
11	Make cities and human settlements inclusive, safe, resilient and	MDGs7D

	sustainable	
12	Ensure sustainable consumption and production patterns	New
13	Take urgent action to combat climate change and its impacts	UNFCC
14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development	MDGs7B
15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	MDGs7B、CSD27-29
16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	New（New Deal, PSGs: Peace and State building Goals）
17	Strengthen the means of implementation and revitalize the global partnership for sustainable development	MDGs8

Source：https://sustainabledevelopment.un.org/sdgsproposal

(3) History of Changes to Development Agenda and Real Economy

As previously stated, historically speaking, the development agenda of the UN was characteristic of economic growth and trickle-down economic theory. Other development agenda have been added, such as BHN in the Third Development Decade in 1980, and gender and environment in the Fourth Development Decade, but development decades have never set quantitative targets other than economic growth. Though Japanese Aid policy is sometimes criticized for its economic or industrialization-oriented focus, the UN development agenda historically focuses on economic growth.

When it comes to outcome, on a nominal basis, developing countries as a whole enjoyed far better economic growth than the objectives of the First Development Decade and the Second Development Decade on nominal basis. They also reached 5.42% as whole and 3.2% per capita in real growth, which is quite respectable. After 1980, they were unable to reach their objectives partly because of the target rising from 6% to 7% while the average economic growth of developing countries was by far larger than that of developed countries. Even though there has been some criticism of trickle-down economics, it can still be said that economic growth has had a positive influence on some development agenda especially in regards to poverty reduction.

In 2000, mainly because of the drastic change of international political situations, the development agenda of MDGs was diversified, and it is anticipated the development agenda of SDGs will be even more diversified, which may be thought of as “inflation of development agenda”.

However, though the development agenda has changed, the 0.7% target of ODA will be adopted to post-2015 development finance without any substantial review. Of course, it is true that new emerging donors, e.g., China, India and Arab donors, are growing more influential, but the economic share of both the DAC original members and the OECD members has changed very little; in fact, by little more than half. This means DAC and OECD have to continue to play important roles in development. Because of this responsibility, in order to set effective and realistic policy targets, evidence and academic based analysis should be invested. In fact, when the 0.7% target was first introduced, not only international organizations and donors but also researchers argued vehemently in favor of this, based on empirical data and economic theory that was prevalent at that time.

Table 3 Development agenda and Economic fundamenatals

	1960’s	1970’s	1980’s	1990’s	2001 －2013	2015－
Development Agenda	First	Second	Third	Fource	MDGs	SDGs
GDP Growth Rate	5%	6%	7%	7%	—	7%

GDP Growth Rate Per Capita	—	3,5%	4,5%	—	—	—
Quqntitative target of ODA	—	0.7%	0.7%	—	0.7%	0.7%
Outcomes						
GDP Growth Rate (nominal)						
LICs	6,54%	11,28%	2,61%	2,80%	10,34%	
Low and Middle	6,31%	14,95%	4,80%	6,10%	12,22%	
HICs	8,40%	14,16%	7,97%	3,66%	5,00%	
GDP Growth Rate (real)						
LICs	NA	1,97%	2,60%	2,38%	5,59%	
Low and Middle	5,25%	5,42%	3,20%	4,13%	5,85%	
HICs	5,39%	3,57%	3,18%	2,56%	1,70%	
GDP Growth Rate Per Capita(real)						
LICs		-0,45%	0,02%	-0,18%	3,35%	
Low and Middle	2,97%	3,21%	1,15%	2,44%	4,50%	
HICs	4,3%	2,69%	2,45%	1,96%	1,12%	
Share of World Economy						
DAC original members (8 countries1)	58,8%	62,5%	64,0%	65,1%	54,6%	
OECD Members	80,0%	79,6%	80,2%	82,3%	73,8%	

Note：Each figures are calculated as simple average of each terms.

1) Belgium , France, Germany, Italy, Japan, Portugal, United Kingdom, United States

Source：World Development Indicator

Table 4 Historical Change of the rate of poverty

	1981	1984	1987	1990	1993	1996	1999	2002	2005	2008	2010	2011
LICs	66,5%	67,2%	66,1%	65,9%	67%	65,2%	64,2%	61,1%	55,8%	51,4%	48,6%	46,8%
LMICs	52,8%	47,5%	42,9%	43,3%	41,6%	35,8%	34,2%	30,6%	24,8%	21,8%	19,1%	16,9%
World	N.A.	N.A.	N.A.	36,4%	35,1%	30,4%	29,1%	26,1%	21,1%	18,6%	16,3%	14,5%

Note: the proportion of people living on less than $1.25 a day

Source：World Development Indicator

3 The Origin of the 0.7% target and its modern implication

(1) The Origin of 0.7% target and Background Theory

While the quest for elements required to achieve economic growth was a major concern of classical economists like Adam Smith, Malthus, and Marx, the prevalent view from the 1950's to 1960's was concentrated on theoretical analysis and the relation between invested capital and economic growth, such as in the Harod-Dormer model, Chenery and Strout (1966), and Solow model. When some researchers found empirical data that went against those theories, they explored other elements, e.g., rather than invested capital, the role of human capital, innovation, regulation, governance and so on. When the 0.7% target was first set in 1970, the major objective of development was economic growth so it is not inappropriate to set the quantitative target for ODA in order to achieve economic growth based on the marjor economic theory of that time. In fact, the Harodd-Dormer model gives a central back bone to identifying the required number for ODA.

To put the model simple in simple terms, economic growth (ΔY) will be decided by the function of stock (s) and capital (v), as illustated below.

① $\Delta Y = s/v$

Function ① meansΔY will be identified if s and v are given. While under a closed market clause, s equals total investment, while under an open market clause the market can accept international investment and can achieve higher economic growth than the potential economic growth with domestic stock. Actually, this model is replaced by other economic growth theories because of theoretical problems in capital dynamism.

As the First Development Decade set 5% as its economic growth objective, some researchers estimated the capital quantity required to achieve it; Rosenstein-Rodan (1961 p.116) estimated 5.7 billion US Dollars in the 1970's, while Chenery and Strout (1966 p.722) estimated 10 to 17 billion US Dollars in 1970's. The total GNP of high income countries in 1961 amounted to 10.3 trillion US Dollars; Chenery and Strout's smallest estimate, i.e., 10 billion US Dollars (1966 p.722), is almost 1% of 10.3 trillion.（Clemens and Moss 2005）。

A quantitative target of total financial flow from developed countries to developing countries was advocated long before those academic estimates. The idea of a 1% financial transfer target preceded those academic estimates and was first proposed for international consideration by the World Council of Churches in 1958 [OECD/DAC 1999 p.25]. The first UN document that states this figure was the resolution 1522（ＸＶ）adopted by UNGA in 1960, which sets a 1% target as a best-effort objective. As there was no concrete background to this figure, academic work such as that mentioned above only enforced those figures, being cited in the document of international organizations. In 1968, UNCTAD recommended in its resolution that developed countries should endeavor to provide annually to developing countries financial resource transfers of a minimum net amount of 1 percent of GNP at market prices. Also in 1968, DAC/HLM adopted the recommendation that DAC donors endeavor to achieve a 1 percent target as much as possible. Also in 1969, the Committee for Development Planning that was established under the UN Economic and Social Council in order to set the Second Development Decade, chaired by Jan Tinbergen and the first winner of the Nobel Prize for Economics, published the report stating that economically advanced countries should take urgent appropriate action to achieve a 1% target and, within the target, developed countries should consider providing a minimum of 0.75% of their GNP by way of official financial resource transfers [UNCTAD 1969, p.16]. Official financial flow target of 0.75% of their GNP was first defined in the UNCTAD decision 27（Ⅱ）. Based on these estimates, the committee that former Canadian prime minister Lester B. Pearson organized in response to the request of (former) World Bank president McNamara to set a development strategy for the next decades, reported that, since non-concessional private finance is responsible for repayment, financial transfer should be covered by concessional loans with a proposed 0.7% target (based on Tinbergen's estimate). Following this, in 1970, at the moment of setting the quantitative target for the Second Development Decade, there were three possible options; 1% target of total financial flow, 0.75% of official flow, and 0.7%of ODA. After some political negotiation, a compromise was reached, and the 0.7% target was adopted in the Second Development Decade.

The origin of the 0.7% target was based on the assumption that donor countries are able to compensate for the financing gap between required capital to achieve objective economic growth and domestic stock with financial flow from developed countries to developing countries. Required total flow was estimated to be 1% of total GNP of high income countries in 1961, official flow 0.75%, and ODA 0.7%. Although the framework for this figure was reenforced by the academic estimate, it was agreed mostly by political compromise, as at that time, those estimates used a 5% economic growth objective and 1965 data, but the economic growth objective was 6% in the Second Development Decade the data needed to be updated. Despite these minor differences, the theory and the figure were consistent with the economic growth theory at that time. Also, net measurement of ODA was

rational, since net inflow was regarded as important to economic growth and ODA was expected to play major part in it.

However, there are some issues with the 0.7% target being carried over to post-2015: economic fundamentals have dramatically changed, even if the financing gap hypothesis were considered true; and economic theory has improved and replaced financing gap theory. Furthermore, as mentioned in Section 2, inflation of development agenda, the financing target should be considered consistent with its agenda. We will examine the modern implications of the target.

(2) The Outcomes of the 0.7% target and history of change in implication

This paper has reviewed the theory behind the 0.7% target in Section 3（1）, and found it to be consistent with the economic growth theory at that time, even though it contains considerable political compromise. It also establishes its relevance by using the data at that time, as well as tracing its history of change as as economic fundamentals changed. The Harrod-Domer model itself had already been rebutted, but the 0.7% target, which is based on that model, is still in effect. Clemens and Moss（2005）have already proved the financing gap required when using the model and economic data in 2003. This section will establish it by using from data from the 1960's to 2013 that includes the expansion to a wider range of private finance. Table 5 shows that the estimated financing gap and required ODA by the Harrod-Dormer model, assuming v 3.5, per Clemens and Moss (2005). It shows that in the 1963 data, the required ODA is 0.73%, which is almost equal to 0.7%. But by the 1970's, even for Low Income Countries (LICs), the ODA requirement is a maximum 0.23%, and from 2000 on, it is negative. When it comes to Low and Middle Income Countries, the ODA requirement is consistently negative after the 1970s. This is because the stock rating of developing countries was raised, and private financial flow such as FDI (Foreign Direct Investment) and remittances sharply increased. It would be fair to say that this is the reason many developing countries enjoyed economic growth as 表 3 shows, though very few donors achieved 0.7% target.

Table 5 financial flow to developing countries after 1960

	1963	60's	70's	80's	90's	2001-2013
GDP						
LICs	9,8	31,0	72,0	115,6	146,9	356,7
Low and Middle Income Countries	40,1	370,2	1166,2	2406,2	4570,4	13704,9
HICs	122,6	1712,9	5434,6	12858,4	24599,0	41191,2
Saving rates						
LICs	13,1%			13,8%	17,1%	22,4%
Low and Middle Income Countries	17,8%		19,9%注 1	21,2%	22,2%	28,5%
HICs			25,0%注 2	23,8%	22,9%	21,5%
FDI						
LICs			0,3	0,3	1,5	10,4
Low and Middle Income Countries			4,2	13,1	102,3	432,4
HICs			21,0	90,1	383,5	1005,2
Net inflow of remittances						

LICs			0,3	1,2	2,4	15,8
Low and Middle Income Countries			5,8	21,7	53,9	235,3
net inflow of OOF						
LICs		0,2	2,0	5,4	2,7	-0,6
Low and Middle Income Countries		5,2	22,2	46,9	73,4	17,5
net inflow of ODA						
LICs	0,6	0,6	3,3	9,1	12,4	29,3
Low and Middle Income Countries	5,3	5,5	17,2	35,9	53,4	107,2
share of official flow in total inflow						
LICs			90,0%	90,5%	79,5%	52,3%
Low and Middle Income Countries			79,7%	70,4%	44,8%	15,7%
share of ODA in total official inflow						
LICs			61,6%	62,6%	82,3%	102,0%
Low and Middle Income Countries			43,6%	43,3%	42,1%	86,0%
target of economic development rate	6%	5%	6%	7%	(7%)	7%
required external capital						
LICs	0,77		15,1	12,3	10,9	7,5
Low and Middle Income Countries	1.28		12,5	78,3	104,1	-549,2
required ODA						
LICs	0,54		12,5	5,4	4,3	-18,1
Low and Middle Income Countries	0.90		-19,8	-3,4	-125,5	-1234,4
Share of required ODA in GDP of all HICs						
LICs	0,44%		0,23%	0,04%	0,02%	-0,04%
Low and Middle Income Countries	0,73%		-0,36%	-0,03%	-0,51%	-3,00%

Source : Author based on World Development Indicator

While few donors achieved the 0.7% target of ODA, how much can ODA affect economic growth? Research has been made about the relation between ODA and economic growth from many angles by many theorists. It is not easy to define its cause; while it is easy to calculate relativity between ODA and economic growth rate, it is impossible to say whether ODA leads to economic growth or economic growth leads to an ODA increase only from macro-economic data. Despite this, William Easterly (1999), famous for his theories of the relativity between ODA and economic growth, concluded that, contrary to the background theory of the 0.7% target, ODA is considered to be limited in effect on short term economic growth. This is a natural conclusion because, as mentioned

in Section 2, development agenda became very diversified and not all ODA is aimed at economic growth; rather at social infrastructures such as primary health care or primary education. Any excess is spent on donor costs such as refugee or administration cost, e.g., salary or pension for aid agencies or ministries.

On the other hand, as Easterly (1999) pointed out, investment increase has a positive effect on long-term economic growth. Also as mentioned in Section 2, economic growth theory broadened behyond capital to include other elements such as innovation or governance. But this does not mean that economic growth does not require capital; indeed, capital is one of the crucial elements to economic growth. In fact, the role of ODA remains very important in terms of covering risk or cost that is too big for private sectors to cover, and catalyzing long term investment of private sectors in developing countries. This is why FfD is focusing on the importance of private finance and the catalyzing effect of ODA in developing countries.

Figure 3 Sectoral distribution of ODA

		1967-70	70's	80's	90's	2001-2013
I. Social Infrastructure & Services		8,6%	22,6%	25,0%	27,9%	36,7%
II. Economic Infrastructure & Services		20,4%	12,6%	18,7%	20,1%	14,5%
III. Production Sectors		25,9%	19,1%	19,7%	10,7%	6,6%
IV. Multi-Sector / Cross-Cutting		NA	1,8%	3,0%	5,5%	8,1%
VI. Commodity Aid / General Prog. Ass.		28,5%	16,5%	16,2%	9,2%	4,2%
VII. Action Relating to Debt		4,9%	4,4%	4,3%	8,7%	10,8%
VIII. Humanitarian Aid		NA	1,1%	1,7%	5,0%	7,5%
IX. Unallocated / Unspecified		10,8%	22,0%	11,2%	12,8%	11,7%

Note : Simple average of each term.
Source: OECD.STAT DAC5

4 Conclusion and Suggestion

As previously stated, 2015 is a very important year for development. It is necessary to set a development agenda from 2015 to 2030, and a policy target of development finance to meet the agenda. In this context, the 0.7% target for ODA, which has been centered on development finance since 1969, is expected to be carried over without any substantial review of its relevance, even though it had been agreed to modernize the outdated concept and the measurement tools of ODA. In this paper, we have analyzed the history of changes to the development agenda as international circumstances have changed in Section 2; the origin of the 0.7% original dialogue and its background theory in Section 3(1); and the history of changing economic relevance of 0.7% by using actual economic data in Section 3(2).

As a result, it may be concluded that (A) developing countries today enjoy much larger private financial flow, (B) they also enjoy increased fundamentals such as stock rates, (C) the background theory, i.e. the Harodd-Dormer model that the 0.7% target depends on has already been already replaced, (D) primiary objectives of 0.7% objective, i.e., economic growth, have already been achieved, (E) because of the inflation of development agenda other economic grown agenda has been increasing, the 0.7% target is irrelevant and should not be carried over as the post-2015 policy target. Furthermore, if all countries achieved 7% economic growth, the total economy would be doubled in 12 years. In light of this, if the other conditions were equal, double the amount of capital would be required to reach the objective in 2027, which is unrealistic. In the1960's High Income Countries enjoyed an average real economic growth rate of 5.2% (4% per capita), which means 0.7% transfers to developing countries at around 15% of economic growth. In 2014, the basic economic growth of Japan was measured at 1.4%, while the real economic growth was measured at -1%. In this case, the 0.7% transfer would cause economic recession if we assume ODA does not reassign to a

donor economy. This is also politically unrealistic for democratic countries.

How do we determine relevant and realistic policy targets for ODA? It is impossible to set the target by the share of GDP, but we should identify the financial needs and sources of each SDGs. We would then be better able to identify the share of burden to each donor dependent on their economic capacity. What ODA has been able to contribute to the SDGs proposal is set forth in pages 1-8, 10 and 16, assuming the definition of ODA as ODA is "administered with the promotion of the economic development and welfare of developing countries as its main objective." The most important, as well as the most controversial, goal is No. 8, or economic growth, as it could have a positive effect on other goals according to trickle-down theory, as mentioned in Section 2, and because tax revenue that is assumed as one of the sources of FfD would be increased with economic growth. On the other hand, there are some goals, such as goal 4: gender, goal 10：inequality, and goal 16: peace and governance, that economic growth has little effect on. In these cases, ODA should be allocated to those goals, or should mitigate and share the cost of private sector potential investors in the countries to whom it is not attractive to invest without official support.

Although the SDGs proposal is not only more diversified, but also broader than the MDGs proposal, and some indicators have yet to be decided making it impossible to estimate the cost to complete those goals at this writing, nevertheless future estimates will be made based on estimates of additional financial need to achieve MDGs. The United Nations (2001) estimated that figure at 50 billion US Dollars (2001), and the OECD as 120 billion US Dollars (2011). If ODA were to finance every financial need based on OECD (2011) estimates, with current ODA disbursement at 130 billion US Dollars in 2013, it would be only 0.56% of the total GDP of DAC donors. Furthermore, if the cost of 64 billion US Dollars were to be shared by additional tax revenue of developing countries as the OECD (2011) estimates, it would come to 0.38% of the total GDP of DAC donors and 0.36% of all HIC GDP. All things considered, we must point out that the 0.7% target is an over-estimated target. It makes little sense if the 0.7% target remains in post-2015 only because it appears the target donors have not achieved it. In conclusion, it is crucial, since the FfD 3 will be held in 2015, to give evidence-based consideration to the target goals for post 2015.

Table 6 Estimates of additional financial need to complete MDGs

	Required additional financial resources (market price)	Required additional financial Resources (constant price of 2009)
United Nations (2001)	50	61
Devarajan et al. (2002)	54-62 (MDGs1) 35-75 (MDGs2-6)	63-72 (MDGs1) 41-87 (MDGs2-6)
Millenium Project (2005)	70-130	82-152
OECD Development Center (2011)		121,3

Notes：US billion dollar
Source：OECD Development Center (2011)

Bibliography

植田大祐、2009、「開発援助の経済効果をめぐる諸論点」、『レファレンス』、平成 21 年 1 月号。
小島道一、2015、「持続可能な開発の淵源と展望」、『アジ研ワールド・トレンド』、No.232、2015 年 2 月。

白石早百合、2004、『平成１５年度独立行政法人国際協力機構　客員研究員報告書　貧困国の民間セクター開発における貿易・投資が経済成長に及ぼす効果－国際金融機関・ODA の役割へのインプリケーション－』、平成 16 年 3 月、独立行政法人国際協力機構、国際協力総合研修所。
杉山富士雄、2009、「ソロー成長モデルと開発途上国の経済成長に関する諸事実－新古典派経済成長理論の貢献と限界－」、『生活科学研究』、第 31 集、2009 年 3 月。
鈴木康夫、2001、「ハロッド＝ドーマー型モデルと現代経済成長理論」、The Hikone ronso 332, 197-214, 2001-10。
高橋清貴、2014、「日本の ODA における MDGs の位置取り」、『国際開発研究』、Vol.23, No.2、2014 年 11 月。
中村修三、2007、「ミレニアム開発目標の現状と課題」、『政策科学』、14－2。
中村光毅、2008、「持続可能性指標の展開— CSD Indicators の改良とその適用事例—」、Bulletin of the Faculty of Human and Social Studies, Saitama Institute of Technology 6, 69-78, 2008-03.
浜名弘明、2015、「ポスト 2015 の開発資金を巡る議論の現状と課題—ODA の近代化と TOSSD の設置を中心に—」、『立教経済学研究』、第 69 巻第 1 号。
弓削明子、2014、「紛争・平和構築とポスト 2015 年開発アジェンダ」、『国際開発研究』、Vol.23, No.2、2014 年 11 月。
Booth, Lorna. 2014. “The 0.7% aid target.” House of Commons Library. http://researchbriefings.files.parliament.uk/documents/SN03714/SN03714.pdf
Clemens, A. Michael and Moss J. Todd. 2005. “GHOST OF 0.7%: ORIGINS AND RELEVANCE OF THE INTERNATIONAL AID TARGET.” Working Paper Number 68 September 2005, Center for Global Development.
Easterly, William. 1999. “The ghost of financing gap: testing the growth model used in the international financial institutions.” Journal of Development Economics. Vol.60. 1999. pp.423-438
Organisation for Economic Co-operation and Development. 1968. OECD Press Release, PRESS/A(68) 57.
Organisation for Economic Co-operation and Development, Development Assistance Committee. 1999. “1999 DEVELOPMENT CO-OPERATION REPORT.” DCD/DAC(99)27.
——. 2002. “HISTORY OF THE 0.7% ODA TARGET.” *DAC Journal* 2002, Vol 3 No 4, pages III-9 – III-11. Revised June 2010 http://www.oecd.org/dac/stats/45539274.pdf
——.“DAC HIGH LEVEL MEETING・FINAL COMMUNIQUÉ.” Communique adopted by OECD/DAC HLM http://www.oecd.org/dac/OECD%20DAC%20HLM%20Communique.pdf
——. 2012. “Peer Review EUROPEAN UNION” http://www.oecd.org/development/peer-reviews/50155818.pdf
——. 2013. “CONVERGED STATISTICAL REPORTING DIRECTIVES FOR THE CREDITOR REPORTING　SYSTEM (CRS) AND THE ANNUAL DAC QUESTIONNAIRE.” DCD/DAC(2013)15/FINAL.
Roodman, David. 2015. “Toward an Improved Measure of Official Development Assistance.” http://graduateinstitute.ch/files/live/sites/iheid/files/sites/cfd/shared/EVENTS/2015/IMFCFD_1517April/papers/Roodman,%20Redefining%20ODA%20Geneva%201%20dr.pdf

Rosenstein-Rodan, P.N. 1961. “International aid for undeveloped countries.” *Review of Economics and Statistics* 43 (2): 107-138.

UNITED NATIONS. 1960. “United Nations Development Decade A program for international economic cooperation.” Resolution 1710 (XVI) adopted by 1084th plenary meeting, 19 December 1961.

———. 1970. “International Development Strategy for the Second United Nations Development Decade.” Resolution 2626 (XXV) adopted by 1912th plenary meeting, 19 November 1970.

———. 1980. “ International Development Strategy for the Third United Nations Development Decade.” adopted by 83rd plenary meeting, 5 December 1980.

———. 1990. “ International Development Strategy for the Fourth United Nations Development Decade.” adopted by 71st plenary meeting, 21 December 1990.

UNITED NATIONS ECONOMIC AND SOCIAL COUNCIL. 1969. “COMMITTEE FOR DEVELOPMENT PLANNING REPORT ON THE FORTH AND FIFTH SESSIONS.” NEW YORK.

UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT (UNCTAD). 1968. “GROWTH, DEVELOPMENT FINANCE AND AID (SYNCHRONIZATION OF INTERNATIONAL AND NATIONAL POLICIES.” DECISIONS adopted by 79th plenary meeting, 28 March 1968.

UNITED NATIONS THE PRESIDENT OF THE GENERAL ASSEMBLY. 2015. “The Zero Draft of the Outcome Document of the Third Financing for Development Conference.” http://www.un.org/esa/ffd/wp-content/uploads/2015/03/1ds-zero-draft-outcome.pdf

Human Resource Management for Sustainable Development

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Abstract: Which are the main resources of a country? Which of the resources are really needed for a sustainable development? The new theories of sustainable development and ecological economics induce us to a more complete view of the pillars of sustainability.
Human capital is increasingly considered as one of the main factors of development, both as work and as capital created by man, also in the field of sustainability. This paper follows the literature that considers the human capital a fundamental territorial resource in order to promote and support development, starting from the scientific belief that one of the main issues for the development of territories is often related not to the search of the human resources, but to their management.
We made an analysis both in a qualitative and a quantitative approach about NGO (Non Governmental Organisation) Terre des Hommes Core Trust. This organization, founded on April 18, 1994 in Thiruvannamalai (Tamil Nadu-India), plans and manages projects in the field of education, sport, vocational training and support to new business, creating, in an area with more than two million inhabitants, a slow but steady development process. This analysis shows a strong correlation between a centrifugal model of relationship with shareholders and stakeholders and an epidemic pattern of relationships for development and sustainability. Deepening the link between the organizational plan, the management of internal and external relations and a sustainable development of a territory, the embryonic pattern that emerges from the TdHC analysis is a spontaneous model. This model, which originated in an individual perspective, during the last 20 years has been unconsciously transformed in a divisional centralized structure, with some characteristics of human resource management that are very strongly related to some aspects of clan form. This paper studies the management of relations of the NGO with the inside - looking for a form of human resource management that supports sustainable development - and with the outside - with essential figures such as donors, institutions, clients, banks, universities - basic tools for the creation of an epidemic development through space and time. At end of the work, even thanks to a comparison with other non-profit organizations and traditional structures, we defined a system of human resource management which is both specific and replicable by organizations in the various steps of the development of less-favored areas.

Key Words: Human Resource Management, Matrix, Clan, Adhocracy, Trasformational Leadership.

***Summary**: 1. Human resources for sustainable development; - 2. Human resources management (HRM) – 2.1. The Organization, 2.2. Organizational Culture, 2.3. Leadership styles, 2.4. Human Resource Management in NGO; 3. Terre des Hommes CORE; - 3.1. TdH Core Organizational Structure, 3.2. TdH Core Organizational Culture; 3.3 TdH Core Leadership Style 4. Model of HRM for Sustainable Development: Solar System for NGO; 5. Conclusion; References.*

1. Human resources for soustainable development

The definition of sustainable development is not univoca, even within the scientific community. Indeed, some emphasize its historical origins, some others its political, economic, social, cultural aspects, finally others use multidisciplinary approaches.
The first definition of sustainability may be found in the Bruntland Report (1987) that has also been used by the ONU World Commission on Environment and Development (WCED): "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".
A later (and more comprehensive) definition of sustainable development has been provided in 1991 by the World Conservation Union (WCU), United Nations Environment Programme (UEP) and World Wildlife Fund for Nature (WWF), according to which it is: "Improving the quality of human life while living within the carrying capacity of supporting eco-systems".
Nel 1994, l'ICLEI (International Council for Local Environmental Initiatives) ha proposto un'ulteriore definizione di sviluppo sostenibile: " Development that delivers basic enviromental, social and economic services to all residences of a community without threatening the viability of natural, built and social system upon which the delivery of those systems depends".
Finally, in 2001, UNESCO widened the idea itself of sustainability, assessing that: "Cultural diversity is as necessary for humankind as biodiversity is for nature. (…) Cultural diversity widens the range of options open to everyone; it is one of the roots of development, unders- tood not simply in terms of economic growth, but also as a means to achieve a more satisfactory intellectual, emo- tional, moral and spiritual existence".[1]
In consonance with the UNESCO definition, sustainable development may be considered as a process that is based on 4 pillars: ecology, economics, equity and cultural diversity.

Moreover, a sustainable and balanced development path should rest on a strategy able to allow the coexistence of five factors of a virtuos cycle: Living standards, Health, Education, Quality and Persistence.[2].
The absence of one of these factors, as shown by many cases, determines a vicious cycle that may worsen the problems of a country rather than solving them. The development model to which a government should aim to is a complex, complete, balanced and sustainable one. In order to support governments in this development strategy, civil society can play a fundamental role.

Human resources are a core component of the development of a country. Both capital and natural resources are passive factors of production. Human beings gather capital, use natural resources, build social, economic end political organizations and are the real actors of development. New theories on sustainable development and ecological economics lead us having a widre approach to the real factors of sustainability. Human capital (both as human work and as capital created by men) is becoming more and more important and is now considered as a fundamental tool for long-lasting development.

[1] Art 1 and 3, Universal Declaration on Cultural Diversity, UNESCO, 2001.
[2] Rinaldi A., Sciarelli F. (2015), Economic and social causes for a late development: a comparison between India and Ethiopia, SIBR 2015 Osaka Conference, Osaka.

After the Second World War, human capital has been undervalued as a country's development tool, mostly in the poorest countries. Since they had to face many issues related to the struggle for existence of their population, education was considered as a luxury good that existed only within the preserve of the richest countries. The real aim of the so-called third world countries was, during those years, increasing productivity and that goal could have been reached by modernizing productive processes, factories, use of resources and so on. Industrialization and infrastructure development are based on gathering the needed capital and so the increase of savings and international aid are seen as the main tool for development.
Indeed, great part of literature[3] proved the correlation between investment and economic growth in many western industrialized countries.

During the early sixties a surprising reversal of the development theory began. Many researches showed that investments are just one of the factors of development and that there were many other factors that could start and support a development process, like education.
Other economic growth studies revealed that only a part of it can be explained by the amount of investment. Other factors appeared at least as important for the development.
Some economists found a strong relationship between primary education and GNP; others asserted that higher education was the key factor; others argued that general literacy is the cornerstone.
Assuming that the level of education bears a causal relationship to economic growth, economists started to see "investment in human resources", as a precondition for economic development.

In 2012, Human Development Index (HDI) globally improved. During the last decades, many countries all over the world reached higher levels of human development. Clearly, human development growth rate has been faster in less developed countries. However, real progress needs something more and great attention should be paid to income inequality, unsustainable consumption models, high military expenses and scarce social cohesion. A balanced development path should, then, imagine as the first step the increase of capabilities of human resources.

Many economic theories link globalization and development. Some of them consider a bottom-up development process, while others focus on a top-down development process. Globalization is an example of a top-down process that is related to big trends and models like westernization, internationalization, marketization and education needs. Bottom-up development focuses on the fragmentation, the inequalities and the socio-economic gap that arise from a fast development process.
While Taylorism rested on the idea that organization could not allow workers to move from their own role within the organization itself, nowadays development inequalities don't allow people coming from different countries to build the same professional skills. So, many emerging countries outsource skilled labour force, reinforcing this vicious cycle.
Finding, training and managing human resources is a priority issue of developing countries, especially in the rural areas.

2. Human resources management (HRM)

2.1. The Organization

Anthropology, Sociology, Economics, Political Science, Psychology and Management, they all analyze organizations. For example, social psychology studies in-group and out-group socialization

[3] The most popular is *'The stages of economic growth' of Rostow*, 1959.

processes, economics studies the consumers' choices, political science analyzes the links between authority and functioning as the quality of the administrative system, management studies business organizations. Many different theatrical approaches also determine several points of view on the organizations.
Organizations are open systems that use a group of people who want to reach one or more common objectives that they could hardly reach if they were alone.
Blau and Scott's (1962)[4] define a formal organization as a purposive aggregation of individuals who exert concerted effort toward a common and explicitly recognized goal. Simon (1945)[5] point out that individuals within organizations rarely have a common understanding of goals. Coase (1937)[6] and Williamson (1975)[7] view an organization such as a corporation that exists because it can mediate economic transactions between its members at lower costs with respect to a market mechanism.
March and Simon's (1958)[8] argue that an organization exists as long as it can offer its members inducements which exceed the contributions it asks of them. This position does not explain how an organization can create a whole which is much greater than the sum of its parts to the point that it can give them more than they contribute.
Organizational structures are defined by Child (1977)[9] as comprising all the tangible and regularly occurring features which help to shape the behavior of its members.
Finally, according to Armstrong and Stephens (2008) [10], organizations are open systems which are continually dependent on and influenced by their environments and that may transform inputs into outcomes. There are some basic issues faced by organizations are these issues are related to structure, relationships, and interdependence. The Tavistock Institute developed a socio-technical model that led to the development of a basic open systems theory which states that, in any organizational system, technical aspects are interrelated with human and social aspects, focusing on the relationships between the technical processes of transformation within the organization as well as the organization of work groups and the management structure of the organization[11].
Many scholars would refer to Blau and Scott's (1962)[12] definition of a formal organization as a purposive aggregation of individuals who exert concerted effort toward a common and explicitly recognized goal. Yet we can hardly accept this defi- nition whole, suspecting as Simon (1945)[13] has that individuals within organizations rarely have a common understanding of goals.
Another point of view is by Coase (1937)[14] and has recently been developed by Williamson (1975)[15]. In this view, an organization such as a corporation exists because it can mediate economic transactions between its members at lower costs than a market mechanism can.
Others would refer to March and Simon's (1958)[16] argument that an organization will exist so long as it can offer its members inducements which exceed the contributions it asks of them. While this position explains the conditions under which an organization may continue to exist, it does not explain how an organization can create a whole which is so much greater than the sum of its parts

[4] Blau P. M., & Scott W. R. (1962), Formal organizations: A comparative approach. Chandler, San Francisco.
[5] Simon H. A. (1945), Administrative Behavior, Free Press, New York.
[6] Coase, R. H., (1937), The nature of the firm, Economica, new series, 4.
[7] Williamson, O. E. (1975), Markets and Hierarchies: Analysis and Antitrust Implications. Free Press, New York.
[8] March J. G., Simon H. A. (1958), Organizations. Wiley, New York.
[9] Child J. (1977), *Organization*, Harper & Row Limited, New York.
[10] Armstrong, M., & Stephens, T. (2008). *Management and leadership: A guide to managing for results.* (2nd ed.). Kogan Page, London.
[11] Lewin K. (1951),Teoria e sperimentazione in psicologia sociale, Il Mulino, Bologna, 1972.
[12] Blau P. M., & Scott W. R. (1962), Formal organizations: A comparative approach. Chandler, San Francisco.
[13] Simon H. A. (1945), Administrative Behavior, Free Press, New York.
[14] Coase, R. H., (1937), The nature of the firm, Economica, new series, 4.
[15] Williamson, O. E. (1975), Markets and Hierarchies: Analysis and Antitrust Implications. Free Press, New York.
[16] March J. G., Simon H. A. (1958), Organizations. Wiley, New York.

that it can give them more than they contribute.
Child (1977)[17] defines organizational structures as comprising all the tangible and regularly occurring features which help to shape the behavior of its members.'
According to Armstrong and Stephens (2008) [18], organizations are open systems which transform inputs into outcomes and are continually dependent on and influenced by their environments. Basic issues faced by organizations are those relating to structure, relationships, and interdependence. The socio-technical model developed by the researchers at the Tavistock Institute led to the development of basic open systems theory which states that in any organizational system, technical or task aspects are interrelated with the human or social aspects, focusing on the relationships between the technical processes of transformation within the organization as well as the organization of work groups and the management structure of the organization[19].

Anyway, according to many of the definitions we have seen since now, organizations consist of people working cooperatively together. Theories usually consider as organizational variables:

- Organizational structure;
- Organizational culture;
- Leadership Style.

Organizational structure depends on the kind of activity and on the characteristics of external environment, as well as from its duration and the dimensions of the enterprise[20].
The structure is the form taken by the function[21]. In connection with the tasks of the organization, its structure may change. In any formal organization, relationships are described in the form of organizational chart which sets out lines of command and control. In informal organizations, relationships can be described in terms of networks which involve cooperation, communication, and exercise of power and authority[22].
We will see later on that NGOs tend to use organizational structure simple, centralized or decentralized, functional, divisional, per project, with a form matrix and hybrid, like profit enterprises. Organizational culture and leadership style are the main peculiarities of the third sector.

2.2. Organizational Culture

Organizational culture may be defined as a common set of values and beliefs that are shared by members of an organization which influences how people perceive, think, and act[23].

The organizational culture has two dimensions: cognitive and symbolic.
The cognitive dimension may be defined as "a socially acquired and shared system of cognitions that provide the actors with the mental schemes that they may use in perceiving, interpreting, valuing, acting", while its symbolic dimension may be defined as "the structure of significance that human beings use in order to interpret their experience and drive their actions"[24].

[17] Child J. (1977), *Organization*, Harper & Row Limited, New York.
[18] Armstrong, M., & Stephens, T. (2008). *Management and leadership: A guide to managing for results.* (2nd ed.). Kogan Page, London.
[19] Lewin K. (1951),Teoria e sperimentazione in psicologia sociale, Il Mulino, Bologna, 1972.
[20] Greiner L.E. (1972), *Evolution and Revolution as Organizations Grow*, Harvard Business Review, luglio-agosto 1972.
[21] Leonardo da Vinci.
[22] Armstrong and Stephens (2008).
[23] Schein, E. H. (1992). *Organizational Culture and Leadership*. Jossey-Bass Publishers, San Francisco.
[24] Galiardi P., Monaci M. (1997), La Cultura, in *Manuale di organizzazione aziendale*, Costa G., Nacamulli R.(a cura di), UTET, Vol. 2, Torino.

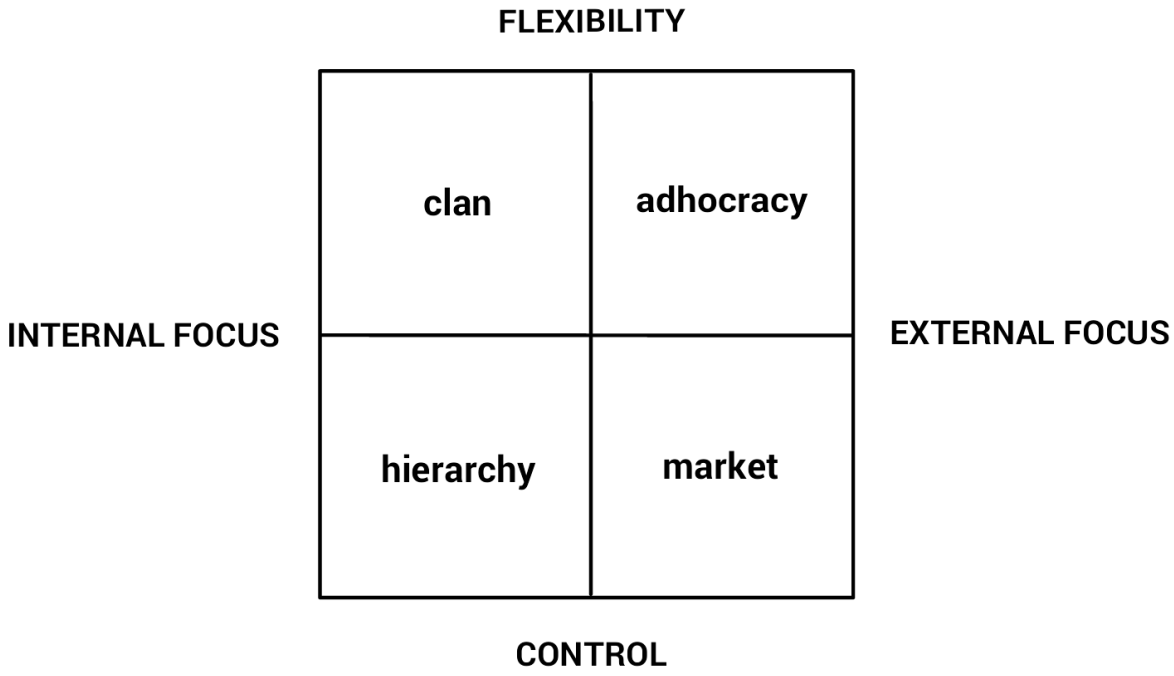
In other terms, organizational culture is a structure of significance codes that are expressed within a symbolic system that direct the behavior of organizational actors, both on the occasion of unique and extraordinary events and on the occasion of daily activities and interactions[25].Every power, exchange and sharing relationships within the organization are influenced by the organizational culture.
We may identify three different levels of the organizational culture[26]. The first level is the most immediate one, the one you can feel as soon as you enter an enterprise. The second one is related to ideologies that guide individual and collective behaviors and they arise from a combination of beliefs and values. The third one is the latent one.
In order to understand the deepest level of a culture, one has to analyze the values that have been shared from the founder of the enterprise at the very beginning, that probably are the factors that determined the success of the company. Indeed, organizational culture is dominated by those very fundamental values.
Culture becomes a basic set of assumptions that guides an organization's social relationships and are moderated by an unspoken socialization process, which is often taken for granted by vested members. This value system is used as a reference by members as they make decisions in the performance of their duties. Moreover, organizational performance has been directly linked to organizational culture[27] .
A part of the literature on organizational culture tends to give a always positive representation of this business dimension and assumes a limited capacity of the management to shape and manipulate it according to the strategy.
But the reality is that organizational culture can come into conflict with the strategy, because, especially if it is strong and stable for some time, is inflexible in relation to external changes. In these cases, organizational culture becomes an obstacle to the strategic adjustment of the company[28] [29].
Organizational culture is the archetype of the sharing relationships.

All these factors, combined in different ways, produced three basic mechanism of mediation of control: markets, which are efficient with low performance ambiguity and high goal incongruence; bureaucracies, which are efficient with moderately high goal incongruence and performance ambiguity; and clans, which are efficient with low goal incongruence and high performance ambiguity.
Ouchi[30] (1980) differentiates markets, bureaucracies, and clans through two dimensions: their underlying normative and informational requirements.
To ensure that the network is operating efficiently, without unnecessary costs of performance testing and monitoring, normative requirements shall relate to the social agreements that all members of the transactional network must share. A norm of reciprocity, according to Gouldner (1961)[31], is one of only two social agreements that have been found to be universal among societies across time and cultures.
The informational requirements of each type of control are prices, rules, and traditions. Prices are a form highly sophisticated for decision making, but difficult to evaluate correctly.

[25] Costa G., Giubitta P. (2008), Organizzazione aziendale, Mc Graw-Hill, Milano.
[26] Schein, 1985.
[27] Berrio, A. A. (2003), An Organizational Culture Assessment Using the Competing Values Framework: A profile of Ohio State University Extension, *Extension Journal*, Ohio.
[28] Compagno C. (1997), Il cambiamento e l'innovazione, in Costa G., Nacamulli, vol.2.; Consiglio S. (2000), Il cambiamento organizzativo, in Mercurio R, Testa F..
[29] Compagno C. (2003), Piccole e medie imprese in transizione, UTET Libreria, Torino; Corbetta G. (a cura di) (2005), Capaci di crescere. L'impresa italiana e la sfida della dimensione, Egea, Milano.
[30] Ouchi W. G. (1980), Markets, Bureaucracies, and Clans, Sage Publication, New York.
[31] Gouldner, Alvin W. 1961 "The norm of reciprocity." American Sociological Review, 25.

Traditions are not explicit rules that govern behavior. They are not stated and all new member will not understand them easily. The set of traditions in a formal organization may produce unwritten rules on how that organization should work . A member who deduces the rules can produce a very complete form of control.[32]

Fig. 1 - Competing Values Framework



Cameron and Quinn (1999)[33] developed the Competing Values Framework which divided organizational cultures respect on two different dimensions: organization's flexibility or central control (the vertical axis) and internal or external focus of the organization (the horizontal axis)[34].
About the vertical dimension, organizations scoring high on control tend to have many documented procedures and processes which must be followed. More flexible organizations are located higher on the vertical axis of control. On the horizontal axis, firms tend to market, new customers, and competitors, when they have a external focus. While the organizations have an internal focus when they are concerned with the morale of employees and how work is accomplished. The four discrete cultures defined and measured by the Competing Values Framework are clan, adhocracy, hierarchy, and market (Figure 1).
In the first quadrant (the upper left quadrant) of the figure we have Clan cultures. These cultures are organizations that are flexible and have an internal focus. These firms are friendly toward customers and employees and often feel like extended family to many dedicated members .[35] Clan cultures have high ethics value.
A clan culture is 'a family-like or tribe-like type of corporate environment that emphasizes

[32] Ouchi, 1980.
[33] Cameron, Kim S. & Quinn, Robert E. (1999), Diagnosing and Changing Organizational Culture: Based on the Competing Values Framework, Prentice Hall, New Jersey.
[34] Cameron & Quinn, 1999.
[35] Hooijberg, R., & Petrock, F. (Spring, 1993). On Culture Change: Using the Competing Values Framework to Help Leaders Execute a Transformational Strategy. *Human Resource Management*, 32(1).

consensus and commonality of goals and values'.
Clan cultures are the most collaborative and the least competitive of the four main corporate culture models. All commitments and engagements in this organizational culture wish to strengthen empowerment and confidence that will drive the company to success.
The weaknesses of clan cultures are: a lack of diversity; the emphasis on cohesiveness that can stifle dissent; lack of competitive spirit and consequent less productivities.

Adhocracy cultures, which are based on the ability to adapt quickly to changing conditions, are flexible like clan cultures but, in contrast to these, have an external focus. In fact with adhocracy the teams are small and temporary, they are quickly created and disbanded to respond to changing external conditions. Members are flexible, creative, and comfortable when dealing with ambiguous situations . [36].
Adhocracy is based on small working groups that aggregate people who are immediately able to solve themselves the problems thanks to their specialistic professional skills and their autonomy. Below the general director, adhocracy cultures have two first level management groups based on the market dimension (project dimension that controls innovation activities) and on the function dimension (that guarantees the career development paths and efficiency). Second level management depend on the project manager and on the function manager.
The matrix structure is a kind of adhocracy that perfectly works when:

- there are two or more critical areas within the organization;
- environment is very variable and much coordination is needed;
- there are few resources that have to be shared among different projects or products.

The main strength of adhocracy is its flexibility, while its organizational, managerial and economic weaknesses are related to inefficiency deriving from chaos, role tensions that may arise by the lack of a strict definition of tasks, high competitiveness, a very weak loyalty due to the fact that people often change the project they work on.

Adhocracy and Clan associated are excellent at recognizing and responding to changing market needs.
Hierarchy culture, which are characterized by control and a fairly rigid and fixed organizational structure, have the internal focus of the clan culture but also emphasize centralized management control[37]. This culture type often includes bureaucratic institutions such as government offices that are rule-based and emphasize following the policies and procedures of the organization. Hierarchies place importance on doing work the correct way by following existing procedures with emphasis on efficiency and smooth-running operations. These organizations respond effectively and efficiently to knowed issues but they are stiff and are unable to cope with unique situations.
The final culture to be described by the Competing Values Framework is the Market culture. This culture, which are corporate environments that emphasize competition, emphasizes centralized control too while focusing on external issues. It encourages members to be productive and competitive while measuring performance in empirical terms such as sales growth. Employees are often evaluated against each other using quantitative results. Understanding the type of organizational culture that represents an organization's current environment enables leaders to be better able to work in the culture as they attempt to exert influence over its members.[38]

[36] Cameron & Quinn, 1999.
[37] Cameron & Quinn, 1999.
[38] Schimmoeller J. L. (2011), *Leadership Styles in Competing Organizational Cultures*, Lynchburg College, Leadership Review, Vol. 11, Spring 2011.

2.3. Leadership styles

Researchers[39] have been discussing the definition of leadership for many years with differing results but most agree that leaders have a perceived influence on organizational members. There are differences in how to investigate leadership and the development of different measurements of leadership styles[40]. One of the most researched and influential frameworks for leadership is the theory of transformational and transactional leadership developed by Burns[41] [42]. While there are alternatives frameworks for describing leadership, transformational leaders have received much research attention and are included in this study because they are very effective at achieving organizational goals and outperforming other styles of leadership[43].

An important contribution to the study of leadership came from James MacGregor Burns (1978) when he studied the leadership behaviors of politicians and was the first to define their attempts to motivate followers as transactional or transformational. Bass (1985)[44] later modified Burns' model and applied it to generic organizational settings[45].

Transactional leadership theory suggests that this relationship is the result of a peer-to-peer negotiation process between leaders and collaborators.

Leaders' negotiation power lies on his capacity of distributing rewards and benefits.

Since incentives are the key factors for supporting productive behaviors, transactional leader sets the goals and tries to keep the standards.

The term transformational leader appears for the first time in 1973[46] and is one of the approaches of the new leadership paradigm born in the 80s that emphasizes emotional and charismatic aspects.

Transformational leader sets his relationship with collaborators on emotions. His tools are his ability to motivate his staff and to get it committed to the mission of the project, as well as his innovative approaches that may arise from the valorization of subjective creativity.

This leader is very sensitive to the needs, motivations and potentialities of his collaborators.

Transformational leadership is a process that combines values, ethics and long-term objectives and that changes and transforms all the individuals that are involved in the process.

Transformationally lead teams move to an elevated level on Maslow's Hierarchy of Needs as concerns are shifted from safety and security to higher order needs such as achievement and self-actualization[47]. These leaders are change agents as they project their vision for the organization onto the members of the organization[48]. Transformational leaders may have long-term and far-reaching positive effects on the organization and its performance when compared to transactional leaders whose influence is limited by the terms of the contract with their followers[49].

Transactional leadership and transformational leadership are two opposite approaches that differently reflect on the organizational structure. The first one is based on the maintenance of the

[39] Like Bohn & Grafton, 2002, Rost, 1991 and Yukl, 1989.

[40] Yukl, G. (1989), Managerial Leadership: A Review of Theory and Research, *Journal of Management*, 15(2).

[41] Burns, J. M. (1978), *Leadership*, Harper & Row, New York.

[42] Eisenbach, R. Watson, K., & Pillai, R. (1999). Transformational Leadership in the Context of Organizational Change. *Journal of Organizational Change*, 12(2); Parry, K. W. (2002), Leadership, Culture, and Work Unit Performance in New Zealand, IFSAM 2002 Conference, Gold Coast, Queensland Australia.

[43] Yammarino, F. J., Spangler, W. D. & Bass, B. M. (1993). Transformational leadership performance: a longitudinal investigation. *Leadership Quarterly*, 4(1).

[44] Bass, B. (1985). *Leadership and Performance Beyond Expectations*. New York: Free Press.

[45] Howell, J. M., & Avolio, B. J. (1993). Transformational Leadership, Transactional Leadership, Locus of Control, and Support for innovation: Key Predictors of Consolidated-Business-Unit Performance. *Journal of Applied Psychology*, 78(6).

[46] Downton J.A. (1973), Rebel leadership: commitment and carisma in a revolutionary process, Free Press, New York.

[47] Bass, 1985.

[48] Howell & Avolio, 1993.

[49] Yukl, 1989.

pre-existing dynamics of the organization, while the second one is an evolutionary approach that may change the rules of the game.
A third type of leadership proposed by Bass is laissez-faire leadership. This is a style of leadership that is inactive and is often referred to as a lack of leadership.[50]

Leadership styles and organizational culture are not independent of each other, there is constant interplay between leadership and organizational culture[51]. Bass and Avolio (1993) found that an organization's culture derives from its leaders and culture affects the development of its leadership. Furthermore, effective leaders need to be attentive to beliefs, values and assumptions in an organization, in short, the culture. By having higher levels of emotional intelligence, these leaders can understand the emotions of followers and the influence of organizational culture on the situation[52]. Leaders may use this understanding of the culture and its effect on the organizational members to aid them in selecting optimal leadership techniques. Hart and Quinn (1993)[53] found that managers are more effective when they are culturally complex. They have more tools to deal with different situations. Lok and Crawford (1999)[54] determined there are different leadership behaviors correlated with specific cultural traits. Furthermore, culture has also been measured as a strong influence to both organizational success and achievements of the leader[55]. Therefore, it is important to know which styles of leadership are found in specific types of organizational culture.
The linkage between transformational and transactional leaders suggests that both styles of dynamic leaders are necessary in the flexible environments of clan and adhocracy cultures.
Clan and adhocracy cultures' positive relationships with transformational and transactional leadership supports earlier studies such as Den Hartog, Van Muijen, and Koopmen (1997)[56] that indicated it may be difficult to distinguish between transformational leadership and the contingent reward behavior of transactional leadership. Both leadership styles are types of active management that may be successful in specific situations.
From a theoretical standpoint, the framework and model suggest finding transformational and transactional leadership styles in clan and adhocracy cultures evolved out of a need for active styles of management in cultures that have less structure and more flexibility. It is the leader's job to provide any required control, not the business systems and processes.
Avolio and Bass (1995) demonstrated that in the long run, transformational leaders are more effective than transactional and laissez-faire leaders. Followers are more motivated to perform by an inspiring vision from a charismatic leader than by the promise of short-term rewards contingent on performance.
Den Hartog, Van Muijen, and Koopmen (1997) defined transformational and transactional leaders as active leaders using the behaviors of both styles of management. Both these leadership styles are positively correlated to clan and adhocracy cultures.[57].

[50] Avolio & Bass, 1995.
[51] Bass & Avolio, 1993; Berrio, 2003; Parry, 2002.
[52] Barling, J., Slater, F., & Kelloway, E. (2000). Transformational Leadership and Emotional Intelligence: an exploratory study. *Leadership and Organizational Development Journal*, 21.
[53] Hart, S. L., & Quinn, R. E. (1993). Roles Executives play: CEOs, behavior complexity, and firm performance. *Human Performance*, 46(5).
[54] Lok, P., & Crawford, J. (1999). The relationship between commitment and organizational culture, subculture, leadership style and job satisfaction in organizational change and development. *Leadership & Organizational Development*, 20(7).
[55] Berrio, 2003.
[56] Den Hartog, D. N., Van Muijen, J. J., & Koopmen, P. L. (1997). Transactional versus Transformational Leadership: An analysis of the MLQ. *Journal of Occupational and Organizational Psychology*, 70.
[57] Schimmoeller L. J. (2010), Lynchburg College, *Leadership Styles in Competing Organizational Cultures, Leadership review*, Vol. 10, Summer 2010.

2.4. Human Resource Management in NGO

Non profit sector (also defined as the Third sector) represents a no-profit dimension that identifies all those subjects that are between State and Market[58].
As a consequence of big social, political and cultural changes, many people coming from civil society decided to commit to achieving solidarity and social utility goals. Foundations, Associations, NGOs were born to fulfill the demand that neither government or companies could satisfy[59].

Social, human and economic growth may arise from the involvement of civil society, particularly in the most marginalized areas of the country, since one of the main issues in the analyzed countries is related to the lack of professionals. It is our belief that if local communities could work jointly with international professionals, development process strategy could definitely be more complete.
Civil society (and this is also what happens with TDH CORE) should not take the place of governments, but it should support governments so that national policies may also reach the most far areas, by combining a traditional top down approach to development to a new one bottom up.
Civil society could also be asked by the government to train its employees. Foreign professionals, supported by foreign capitals, could also be useful in developing training programs in many essential services (community health workers, community education worker, community worker architecture, community planning worker, etc). This way, local manpower, that represents the link to the country's tradition and peculiarities, could be trained to manage international tools for development and countries could surely benefit from a local workforce with local capabilities and the knowledge on international tools.
If the planning of a development process governments were able to include individuals from civil society, represented in different ways, and foreign capital and innovative knowledge to the start-up phase, would be able to achieve at the same time results in the short term without losing sight of the cultural and social elements necessary for the creation of the Sustainable Development State[60].
NGOs are private no profit associations that promote and realize international cooperation projects aimed at the development of the poorest countries. They represent civil society actions for international cooperation and development both in advanced countries and in emerging ones.
In Europe, non governmental development cooperation may be classified into two models: strong corporatism and weak corporatism[61].
Small NGOs are based on a weak catholic or social corporatism model, which is characterized by a low level of volunteer work affiliation. They often can't be involved in the policy decision making process[62].
Medium and big NGOs, instead, are organized on a strong corporatism model, which is characterized by a strong private support (both from a financial and a human capital point of view) and by the presence of skilled professionals. They are also involved in the decision making process of governments[63].

[58] Bruni, L. e Zamagni, S. (a cura di), (2009), Dizionario di Economia Civile, Città Nuova, Roma.
[59] Uncredit foundation (2012), La ricerca sul valore economico del terzo settore in Italia, www.unicreditfoundation.org.
[60] Rinaldi A., Sciarelli F. (2015).
[61] Boccella N., Tozzo O. (2005), "Le organizzazioni non governative. Risorse e modelli do organizzazione", Led, Milano.
[62] Ibidem.
[63] Ibidem.

In 2000, United Nations released the Millennium Development Goals Report where it identified 8 essential goals for a more equal, peaceful and right world[64]. These are also the goals of most of NGOs:

1. eradicate extreme poverty and hunger;
2. achieve universal primary education;
3. promote gender equality and empower women;
4. reduce child mortality;
5. improve maternal health;
6. combat HIV/AIDS, malaria and other diseases;
7. ensure environmental sustainability;
8. global partnership for development.

Within these macro objectives we can find areas of NGOs intervention.
NGOs act to improve 3 out of the 5 factors of development virtuous cycle: Living standard, Health and Education[65]. NGOs organizational structure is built on democracy, participation and involvement of every member in the decision making.
The organizational structure of NGOs consists of the strategic apex, the middle line and the operating core, while the staff and the technostructure are almost absent. One of the peculiarities of NGOs is the use of volunteers both in the strategic apex and in the operating core. Volunteers are among the success factors of NGOs, they provide most of the services and help cutting costs while providing people with the chance to use their time to help other people.
Basic idea of voluntary work lies on the individual participation to spontaneous activities that improve society . In the majority of cases, the different types of volunteers, like International volunteer, senior volunteer, international cooperator and experts, may obtain only a short-term contract .This involves that the employee of NGOs must be very adaptable to discontinued operations, with different people and environments.[66].

NGOs have an ever increasing need to attract the right people in the right positions in a constantly evolving environment.
In the NGOs sector, qualified people prepared to make the necessary sacrifices about remuneration, benefits, 'living standard' has diminished rapidly in the last 18 years or so. Job opportunities in the under-development countries for educated young people are very common. For this reason the NGOs are still less attractive than in other countries. Today NGOs need and seek skilled employees to help the organisation function. A NGO should attract and retain trained and enthusiastic employees without being able to raise wages or benefits. To do all this, NGO should put on top of the list of priorities the management of human resources.
The management of human resource in a NGO is slightly different from other labour intensive sectors.[67]
Then, in addition to challenge the industry, the NGO is facing, as obstacles to its success: lack of skills, wage disparities, best practices of human resource management and opposed government policies.

3. Terre des Hommes CORE

[64] "Onu Italia" - http://www.onuitalia.it/calendar/millenniumassembly/unmildec.html Ultimo accesso: 28/05/2015
[65] Rinaldi A., Sciarelli F. (2015).
[66] "Lavorare nelle ONG" dell'Università per Stranieri di Perugia - https://www.unistrapg.it/sites/www.unistrapg.it/files/orientamento/Lavorare_nelle_ONG_marzo_2014.pdf
[67] Sokkie P. (2013), *The importance of HR management in an NGO environment*, http://www.ngopulse.org/article/importance-hr-management-ngo-environment

United Nations Human Development Report 2014 shows that India is a medium human development country, since it ranks 135th.
India's HDI value in 2013 is 0.586 (slightly growing on the previous year), life expectancy is 66.4 and GDP per capita PPP is 5,15 and years of schooling in India are very low (4.4) .
Looking at the last decades, we may see that India started to grow during the 1980s and that its growth has been stable and continuos, except for a slowdown from 2011 to 2013, gaining one positions in the HDI global ranking.
MPI in India is quite low, according to the 2005/2006 data. Poor population is over 50%, 28.6% of population is in severe poverty conditions and 28.5% is destitute.
Medium HDI and MPI values are balanced between higher values in the urban areas and lower values in the rural areas.
In emerging countries, like India, there often are two faces of economic development: industrial and technological growth in the urban areas and mere surviving in the rural areas. A more comprehensive approach to development in the long term should be based on an homogeneous growth and the diffusion of the same capabilities to the entire population and this aim can be achieved by allowing a medium class to grow.
As for the sub-index on the income dimension, as many as 10 out of the 19 major states perform as good as or better than the nation as a whole, that is 0.465.
The average loss due to inequality in income is highest for Maharashtra (19%) and Tamil Nadu (17%), while it is the lowest for Bihar and Assam (9%).[68]

Terre des Homme CORE (Children's Organization for Relief and Education) Trust implements the Tdh mission and projects directly in the state of Tamil Nadu as well as being associated with projects in other parts of India.
Its journey to serve children in Tamil Nadu and alleviate their suffering started on 18 April 1994 with the founding of TdH Core Trust by Mr Chezhian Ramu and Mr Gerd Strehle (founder of TdH) from a small rented building on the outskirts of Tiruvannamalai. The TdH mission to treat children as human beings, protect their rights, enhance their development led to the many projects established by TdHC to care for and protect as many children as possible.
In 20 years Ramu Chezhian followed personally and directly all the activities of the NGO, has taken every single worker, he checked every single euro and has supported every single child. Many of the children who have grown up in the mission, they consider the director as their father, now working within TdHC.
Terre des Hommes CORE Trust operates in the three elements of the vicious circle of poverty (Living Standards, Health and Education) in various ways, with the objective of structuring high quality and durable programs.
Regarding the development of the Living Standard, TdHC operates especially on the poorest and the orphans with financial support or by hosting children in its houses. Does not implement microcredit programs or activities funding, but makes many work training programs, as we will see later.
As for Health, TdHC launched in 1994 the South Special Medical Programme which is focused on children who suffer from chronic and congenital diseases. Since then, 350 children have benefitted under this program by receiving life saving medical and/or surgical treatment. In addition, 400 children have been rehabilitated with orthopedic corrective surgeries. Tamil Nadu's Government is also taking steps: it launched the Government Insurance Scheme, that is a special program aimed to support surgical expenses up to a certain limit. One of the peculiarities of this TDH CORE Core

[68] Source: NSS data on educational status and training in India (GoI, 2006b). The same data source is used to obtain estimate of Atkinson inequality in levels of education. Estimates of School Life Expectancy are made based on the NSS unit record data on Education in India (GoI, 2010).

program, as well as many initiatives and the mission itself of this NGO, it that it is not intended to substitute government, but rather it aims to strengthen its initiatives, by extending support to children who require major treatment or intervening in those cases where the treatment is not covered by the Government Insurance Scheme.
The mission of THD CORE is saving children. This is why it supports pregnant women since the very first months of pregnancy and, after delivery, it hosts undesired children, as well as HIV positive orphan children and pure orphan children and it has also implemented many projects to help disabled children.

As we have seen, the Education of human resources and their management is a fundamental tool of development. Data show that India lacks a wide education strategy and that territorial inequalities in education are still evident between rural and urban areas and between male and female.
In India, the Ministry of Human Resource Development and its Department of School Education and Literacy is starting to improve education in rural areas, by building new schools and paying adequate salaries to the teachers , but corruption affecting the country makes these initiatives often worthless, since teachers don't go to the forest schools and children cannot undergo an adequate education process.
Indeed, education index in Tamil Nadu grew by 44% during the last 12 years, but its average value is still 4.79 years. Even though Indian government is committed in improving the education system, its strategy is not perfectly working and this makes individuals and associations essential for implementing education programs. Education for disabled children is also a big issue: public schools are very crowded and disabled children cannot receive a proper education. Furthermore, religious and cultural beliefs make disabled children's access to education even more difficult.
TdH Core programs are focused on education in rural areas and education for disabled children. These programs cover a range of activities: among the others, training for the teachers, the creation of special schools for disabled children, training activities for the mothers of the disabled children, transportation for children to the special TdH schools and back to their homes.
All the children that are hosted in the 27 TdH Core homes are provided with a school transportation program. In tribal areas, TdH Core is starting an education program for teachers that will support government teachers and that will substitute them when they will not go to school, in order to allow children to be educated. These community education workers would be the key figures for education in the tribal villages around Thiruvannamalai[69].
Nowadays, the achievement of economic development alone is no longer sufficient.
Under this point of view, Indian case is very symbolic. Tamil Nadu's GDP grew by 106% in the last 12 years. Yet, there still are many cases of female infanticide[70], marriage between adult men and little girls, and children (mostly girls) sexually abused.

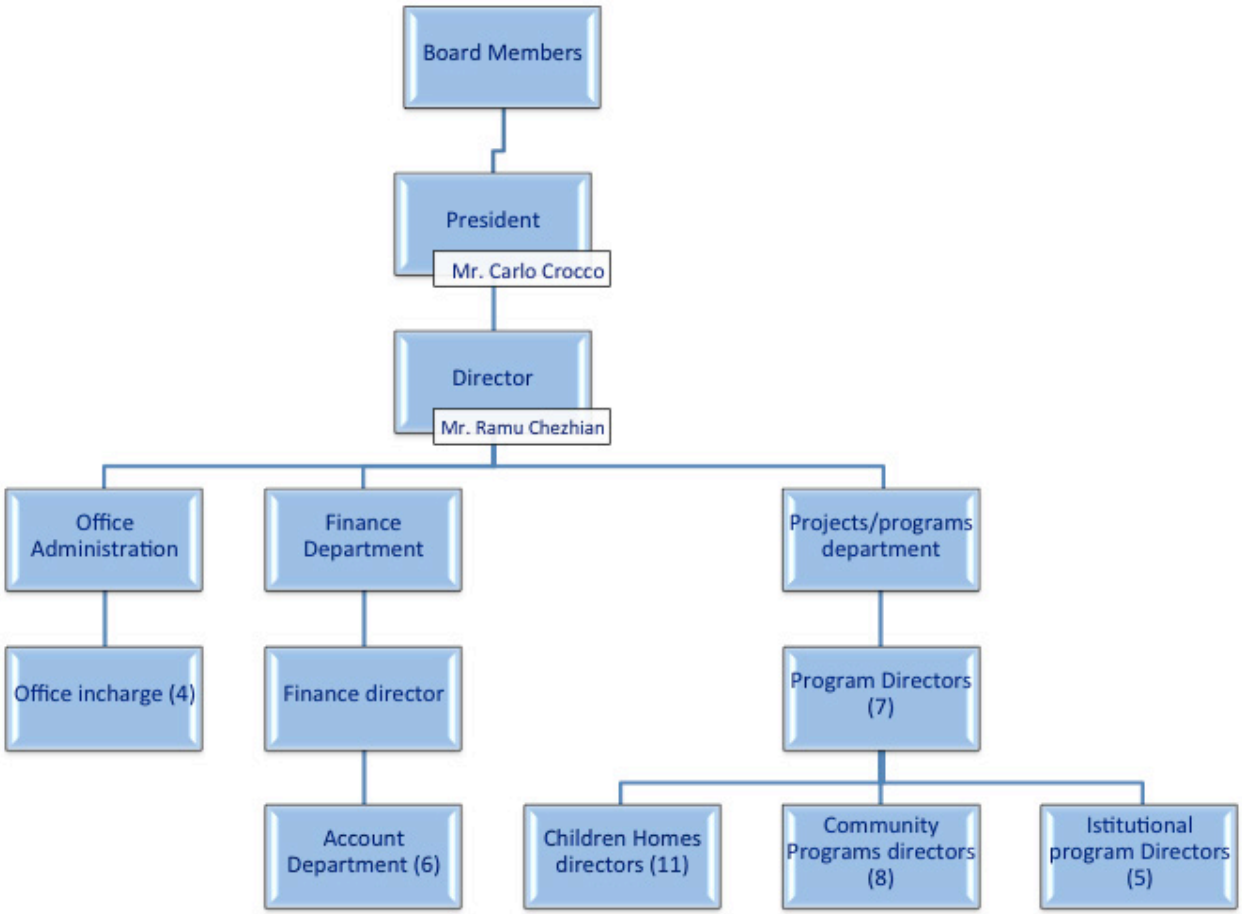
4.1. TdH Core Organizational Structure

In order to provide services to 2608 children and their communities, TDH CORE Trust has a staff of 172 people and all of them are local people.TdH Core provides for each and every member of

[69] Rinaldi A., Sciarelli F. (2015).
[70] Even though the Declaration of the Children's Rights was signed in 1998, in India TdH CORE still has to launch sensitization campaigns to raise the awareness of the population about sexual abuses on children. One of the main activities of this NGO is taking care of the mothers during pregnancy to convince them not to kill their newborn in case she is a girl. These data point out that India's human development is affected not only by economic factors, but even (in some cases, mostly) by social and cultural factors.

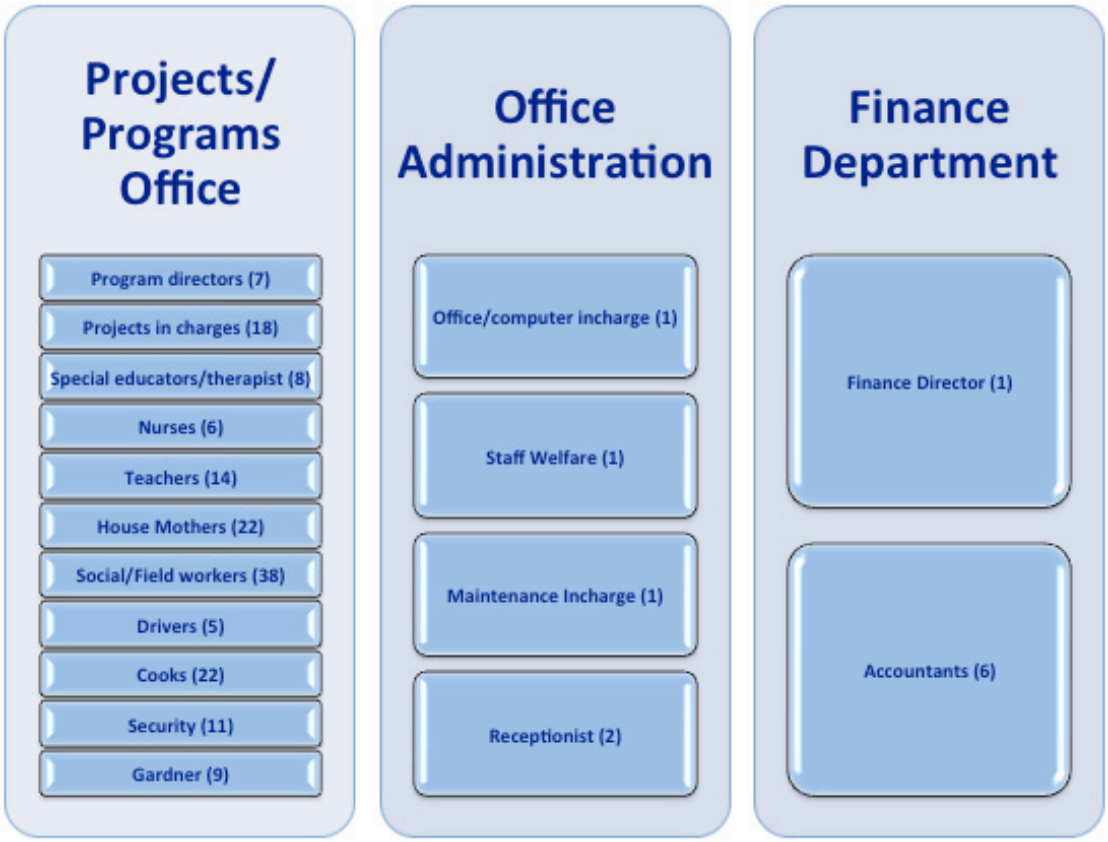
staff: Employee Provident Fund; Medical insurance for 1 lack (On Completion of 1 year);13.65% - Employer contribution & 12.00% - Employee Contribution.

Fig. 2 - TdH Core Organization Chart (1° level)



Terre des Hommes Core has an hybrid organizational structure, with a functional-hierarchical area without any internal staff and a project area which is necessary for managing the houses and the education and health projects we mentioned before.
The project area has a corporate functional level that manages financial issues and general services (office incharge).
Volunteers are not a continuous component of TDH CORE: they rather are professionals who provide their services free of charge (like architects, engineers, doctors) or students who get involved for some weeks on a specific project (like teaching football to the children).
The organization chart draws attention to the fact that there are many missing functions within the structure, like the management of human resources, the planning and development area, the communication area. All these areas are very important for an NGO that is supported by international companies while acting locally.
As usual, NGOs are primarily committed to what is needed for allowing children to survive and this is one of the strength points of Terre des Hommes CORE.
But a major issue in TdHC's organizational structure is related to the general lack of skilled professionals: many collaborators have been trained on the job, while some of them have not been trained at all. In India, many professionals don't want to work in the third sector or in depressed areas and prefer to live in the big cities and to work for big companies.

Fig. 3 - TdH Core Staff Details



This is why in the third sector are mostly employed unskilled workers. This factor affects efficiency of NGOs and also of TdHC, generating a gap between the complexity of the services that must be provided and the ability of labour force to provide those services.
TdHC has an international professional network thanks to which it arranged training courses for its physiotherapists with a french university, started a project management training program with an Italian university and will shortly begin a new training project for the teachers thanks to an agreement with a group of well-known Italian pedagogues.
Issues related to the organizational structure (that could be overcame by using a matrix structure with a first level of governance) are already known by the director and have the attention of the board.

If compared to many other NGOs, TdH Core has the characteristic of having few big international sponsors who support some projects both for their realization and for their management.
The director manages the relationships with the sponsors and is the key figure for any of the activities of the association. He is now getting aware he has to start building an organizational structure that may support him also from a managerial point of view.

The new structure the director recently presented also includes a manager for each foreign sponsor (or for a group of smaller sponsors) and for the projects that are supported by those sponsors.
This way, the director could be able to build an intermediate management group that could really support him in leading the activities, even if even new managers should be trained and new functional areas should be created (like human resources, planning and so on).

3.2. TdH Core Organizational Culture

Ramu Chezhian, who funded Terre des Hommes Core 20 years ago, has always managed himself both employees and children acting like a father and receiving respect and gratitude, an healthy graduate chemist who decided to take care of children, despite his caste and social conventions.
Director and funder of TdHC has always been the key figure of the association: even though the President of TdHC and the sponsors have been fundamental, the director always managed human resources, who have often been saved from a horrible fate (people with no jobs or families, orphans who grew up in the TdHC houses, disabled people who have been trained in the TdHC daily programs).
For these reasons the director is a key figure for his workers and community.
These elements had great influence on the organizational culture of this NGO, that is clearly a clan culture based on family structure.
Like in a family, people rely on a single person who is also the one who manages resources.
Objectives are widely spread and shared among the members of Terre des Hommes Core and productivity is quite high (differently from what usually happens in clans).

The evolution of TdHC's organizational culture is adhocracy, since its director is trying to reduce the hierarchical control and to build small groups that may be supported by some skilled voluntary staff that has the autonomy to solve problems without asking to the managerial hierarchy.
The aim is having, immediately below the director, two dimensions: a project one and a functional one, in order to reach a matrix organizational structure with a new, strong and charismatic Middle Line.

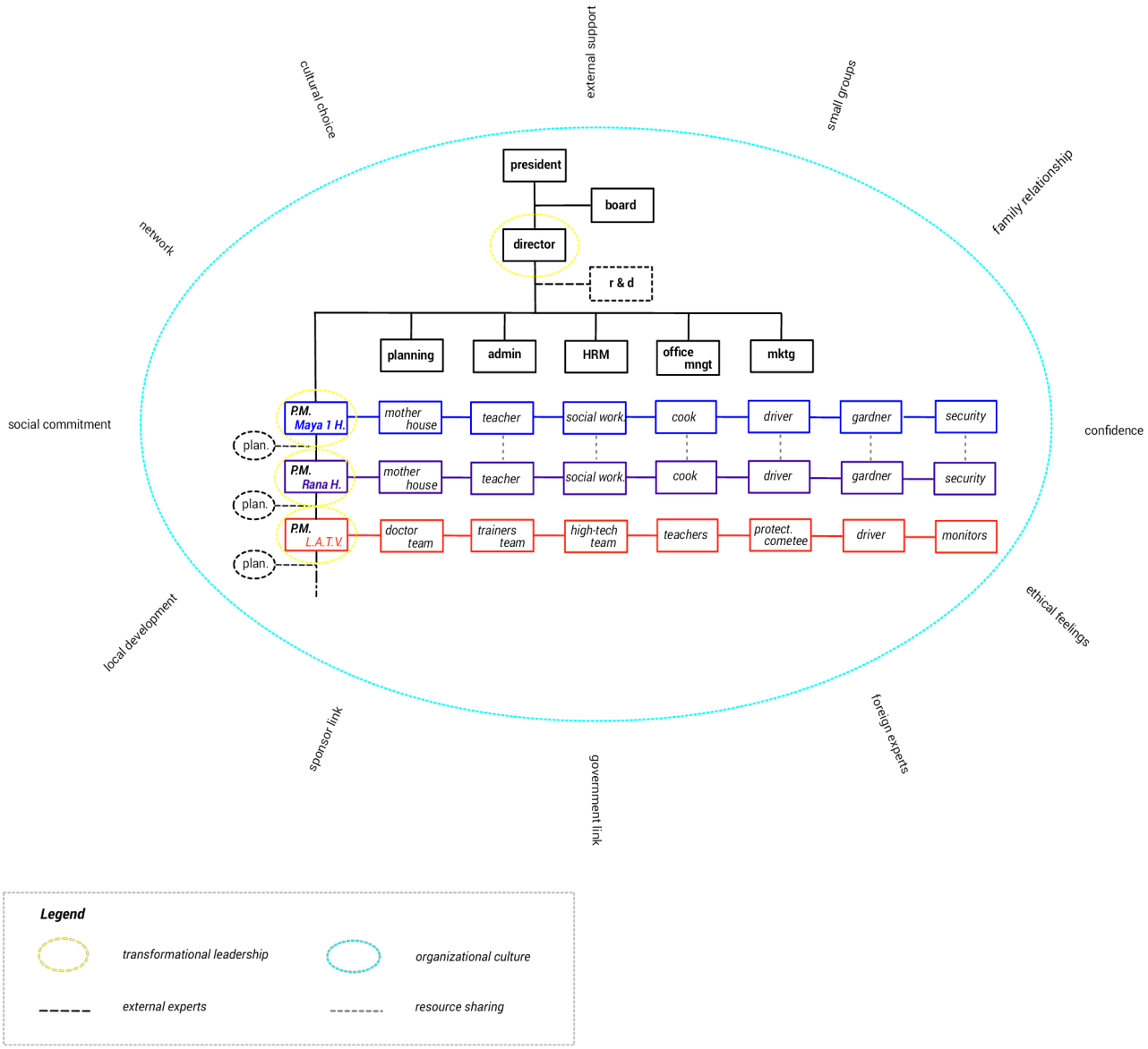
3.3. TdH Core Leadership Style

Leadership style in TdHC is absolutely in agreement with its organizational culture and connected with that.

Its director is a transformational leader who is able to get human resources emotionally involved in all the activities. He is also able to understand his collaborators' needs and motivations and to manage human resources even thanks to this awareness.
He is an active leader who can also become, on some occasions, a transactional leader, particularly while interacting with the local stakeholders and the international sponsors.
Clan and adhocracy organizational culture, which is very flexible, needs to be supported by a leadership style focused on management and control, in order to obviate the limits we mentioned before. Indeed, stronger leaders are required in those cultures that are based on less rules and more freedom. Collaborators, volunteers and sponsors get involved and transformed even thanks to the values, the ethical perspectives and the short medium and long term objectives set by the director.

Mr Ramu Chezhian is a charismatic leader, who is unwilling to delegate decision and responsibilities, the one who indicates the way to his collaborators like a good father would do.
Finding some management figures able to reply the transformational leadership style within some smaller groups could be a short/medium-term objective. The organizational structure showed in Figure 4 could be the appropriate one.

Fig. 4 - Future TdHC Organization chart



4. Model of HRM for Sustainable Development: Solar System for NGO

We aren't currently able to suggest a comprehensive HRM model for a long-lasting balanced development, since our research[71] is still in progress.
Anyway, we can provide some preliminary organizational hypothesis.
In our opinion, a sustainable, balanced and long-lasting development process needs both the national and local governments top-down actions and the NGOs bottom-up actions[72]. Human resources should then be managed under this perspective in order to reach the goal.
In this research, Sustainable Development State[73] has been chosen as the strategic model for governments and the focus has been on the human resources management in NGOs, where there is a lack of theoretical schemes although NGOs may influence the success of government policies.

[71] Compared between countries with different socio-cultural styles.
[72] Rinaldi A., Sciarelli F., 2015.
[73] Rinaldi A., Sciarelli F., 2015.

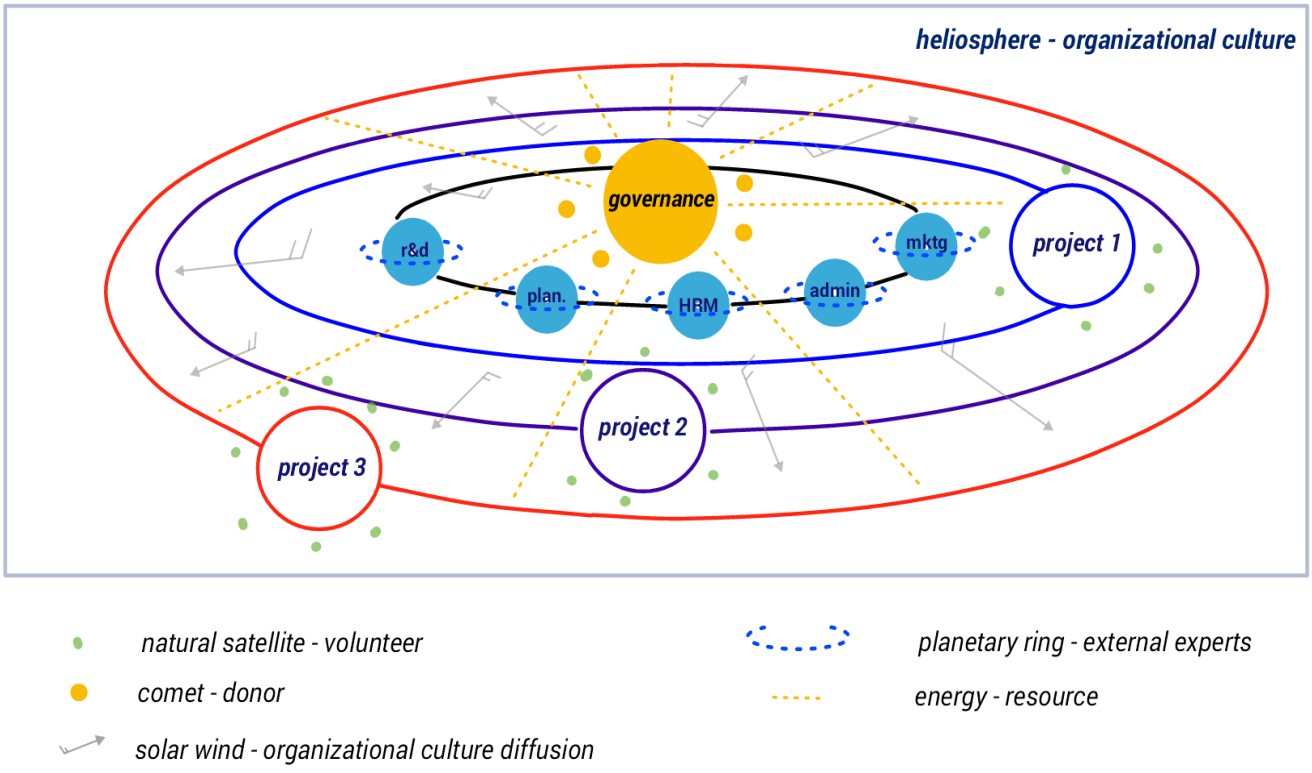
Industrial companies move from a simple structure to a functional structure, to get to a divisional structure when they expand. Even NGOs could follow a similar path, from a simple structure to a structural one, to reach a matrix one when they become highly organized.
The project structure in a first time and the matrix structure later, both with a corporate functional level, are the more effective in a flexible organization whose need is to develop several different projects that only share general services.
The organization may be initially dominated by the clan culture and, while it becomes bigger, adopt an adhocracy organizational culture. When NGOs expand, the need arises for the division in smaller groups supported by professional staff. To avoid organizational chaos, transformational leadership has to contain flexibility and, in order to boost the motivation of human resources, the integration with transactional leadership.
However, actually, big international NGOs use a divisional structure or a matrix structure, with Market organizational culture, and, to be more competitive, they use a completely transactional leadership style. HRM used by big NGOs is, then, an industrial one.
Despite that, in our opinion, NGOs should aim to a very peculiar organizational style that should be able to adequately reflect the characteristics of the third sector, its critical points, its strength points and its possibilities of development.
Motivation of individuals who choose to renounce to a better paid job in order to manage the development of an area should be taken into consideration, since it's what makes the difference.
Within the small organizations in the third sector, the ability to cooperate is linked to the faith in each other and in the leader and these is a strength point that should be maintained and managed.
Therefore, the adequate model for a big NGO should be based on a matrix structure whose limit of double hierarchy is overcome thanks to an adhocracy organizational culture that is permeated by the clan family environment.
Transformational leadership should be used, since motivation and ethics should not be threatened by the transactional style of 'do ut des'.

And third sector workers, who usually work in worst environmental conditions than industrial workers, should also be incentivized more. In order to attract those professionals, who would usually choose more traditional jobs, ethical, economic, cultural and social benefits should be provided.
In all countries, developed, developing, emerging, you have to link the work for the growth to a system of ethical, economic, social and cultural values recognized internationally.
The organizational model presented in this paper is not easily traceable in the existing models.
Strength points of NGO organization cannot be jointly combined in any other model.
So, in order to better explain this new model, we borrowed from natural sciences the solar system model, that can be usefully applied to the organizational system of NGOs.
Solar system is the planetary system that is made of several celestial bodies that are kept in orbit by the gravity force of sun.
The sun is the governance of the NGO: it's the person (like the TdHC director) whose energy makes the system survive, live and grow. Through transformational leadership (that is the gravity force), governance builds human and economic forces and keeps all the planets that follow prearranged orbits around it.
Sun also produces the solar wind, that is a continuous flow of high energy particles that are propagated and that create heliosphere that permeates the whole solar system. In the same way, governance creates the organizational culture (clan plus adhocracy) that is propagated in the organization and that permeates the whole environment of the NGO.
Through its leadership style, governance regulates the functioning (orbits) of the projects (planets) of the NGO.
Solar system is also composed by other celestial bodies like satellites and comets.

Satellites gravitate around planets, that also have an attraction force, while comets gravitate around the sun.
Volunteers are the satellites that gravitate around the NGO's projects (planets) that are managed by its project managers, who are transactional leaders and have an own attraction force. Donors are the comets that gravitate around the governance.
The functioning of the projects (the orbits of the planets) are more structured and stable, while volunteers (satellites) and donors (comets) follow more unstable orbits.
Even if it is regulated by the general laws of the solar system, every single project is like an independent planet, that is supported by a peculiar group of internal and external professionals, like planetary rings that are made of different materials.

The main weakness of this system is that, if the sun dies, the whole solar system dies, too. If the government of NGO dies, even the NGO will die.

Fig. 5 - Solar System for NGO



This is the bigger problem that the NGO must face, but this risk can be reduced if the governance is able to create a middle line with skills, capacities and charism.

Anyhow, in order to be able to answer all the needs coming from the territory and the civil society, organizational system for NGOs should be more and more based on the solar system.
In this way, the HRM model for a sustainable, balanced and long-lasting development could really be competitive thanks to the use of good professionals, charismatic managers, a productive structure and an efficient and motivating management, without losing the ethical dimension, the social commitment and the cultural choice that are the pillars of this organizational system.

5. Conclusion

In a globalized system, the development gap between countries cannot be determined only by economic resources.
Economic resources may surely start development, but cannot allow a sustainable development process. The key to a long-lasting and balanced development is rather based on the connection between economic, cultural and social factors that also guarantee an human development process. Human resources, therefore, are fundamental.
But a highly populated country (like India) is not necessarily an high human capital country, since if population is not educated it may be a threat instead that an opportunity.
Education and management of human resources is essential to achieve a sustainable development
The combined action between the Soustenible Development State and the NGO is very important.
NGOs fundamental task is supporting government policies and orienting them through a balanced economic, cultural and social development.
Civil society should not substitute governments (this is also one of the basic beliefs in TdHC), but it should rather support governments in order to make central government policies reach even the most depressed and far areas, by combining a top-down approach with a bottom-up one.
For these reasons, since they are labour intensive organizations, based on human work 90%, NGOs cannot omit HRM anymore.
Intervention effectiveness arises from organizational efficiency. A good planning and a good management allow the NGO having better results in a shorter time and with smaller costs.
In these kind of organizational systems based on emergencies, one of the main issues is related to the lack of planning, an activity that requires a time that could be perceived as wasted.
Scientific community (like the planetary rings) has the important task of providing a technical and professional support to the planning and organizational functions and to the management of human resources, so that some enlightened organization (such as Terre des Hommes CORE Trust), may understand that an advanced organizational structure is not a waste of time, but a chance for expanding and improving services to their territories.

References

Ahluwalia, M.S. (1976), *Income Distribution and Development: Some Stylized Facts*, in Ahuvia A. (2002), Individualism/Collectivism and Cultures of Happiness: A Theoretical Conjecture on the Relationship Between Consumption, Culture and Subjective Wellbeing at the National Level, Journal of Happiness Studies, 3.
Aghion, P., Bolton, P. (1997), *A trickle-down theory of growth and development*. Review of Economic Studies, 64.
Alesina, A., Cozzi, G., Mantovan, N. (2012), *The evolution of ideology, fairness and redistribution*, The Economic Journal, 122 (565).
Alesina, A., Rodrick, D. (1994), *Distributive politics and economic growth*, Quarterly Journal of Economics, 109 (2).
Alkire S., and Foster J., (2010), *Designing the Inequality-Adjusted Human Development Index* (HDI), OPHI Working Paper No 37, Oxford Poverty & Human Development Initiative, Oxford.
Anand, S., Kanbur, S. M. N. (1993), *The Kuznets process and the inequality-development relationship*, Journal of Development Economics, 40.
Apple M. W., Kenway J., & Singh, M. (Eds.) (2005), *Globalizing Education: Policies, Pedagogies and Politics*, Peter Lang, New York.
Armstrong, M., & Stephens, T. (2008), *Management and leadership: A guide to managing for results.* (2nd ed.). Kogan Page, London.

Balarajan Y., Selvaraj S., Subramanian S. V., (2011), *Health care and equity in India*, The Lancet 2011, 377(9765)
Balli M., Pellegrino E., (2011), *India. Le diseguaglianze nella salute e nell'assistenza sanitaria,* 7 luglio 2011, www.saluteinternazionale.info.
Barling, J., Slater, F., & Kelloway, E. (2000), *Transformational Leadership and Emotional Intelligence: an exploratory study*, Leadership and Organizational Development Journal, 21.
Barrett, C.B., Lee, D.R. and McPeak, J.G. (2005), *Institutional arrangements for rural poverty reduction and resource conservation.* World Development, 33.
Bass, B. (1985). *Leadership and Performance Beyond Expectations*. New York: Free Press.
Berrio, A. A. (2003), *An Organizational Culture Assessment Using the Competing Values Framework: A profile of Ohio State University Extension*, Extension Journal, Ohio.
Boccella N., Tozzo O. (2005), *Le organizzazioni non governative: risorse e modelli di organizzazione*, Led Edizioni, Milano.
Blau P. M., & Scott W. R. (1962), *Formal organizations: A comparative approach*, Chandler, San Francisco.
Bovasso J. (1976), *Standard Safety: A Play in One Act*, Samuel French Inc, New York.
Bratton M., van de Walle N. (1997), *Democratic Experiments in Africa, Regime Transitions in Comparative Perspective*, Cambridge University, press.
Brown M. B.(1997), *Africa's Choices, After Thirty years of the World Bank*, Westview Press.
Burns, J. M. (1978), *Leadership*, Harper & Row, New York.

Caillods & Hallak, J., (2004), *Education and PRSPs – a review of experiences.* International Institute for Educational Planning, Paris (www.unesco.org/iiep/PDF/ pubs/PRSP.pdf).
Cameron, Kim S. & Quinn, Robert E. (1999), *Diagnosing and Changing Organizational Culture: Based on the Competing Values Framework*, Prentice Hall, New Jersey.
Castelló-Climent, A., Domenéch, R. (2008), *Human capital inequality, life expectancy and economic growth*, The Economic Journal, 118.

Chabal P., Daloz JP. (1999), *Africa Works, Discorder as Political Instruments*, Indiana University Press.
Chabbott, C., Ramirez, F. (2000), *Development and education.* In M. Hallinan (ed.) DFID (2001), *Sustainable livelihoods guidance sheets*, Department for International Development, http;//www.livelihoods.org. Handbook of the sociology of education. Kluwer Academic Publishing, New York.
Champernowne, D.G. (1974), *A comparison of measures of inequality of income distribution,* The Economic Journal, 84 (336).
Child J. (1977), *Organization*, Harper & Row Limited, New York.
Coase, R. H., (1937), *The nature of the firm*, Economica, new series, 4.
Coleman J., Court D. (1993), *University development in the third world,* Pergamon Press, Oxford.
Compagno C. (1997), *Il cambiamento e l'innovazione*, in Costa G., Nacamulli, vol.2.; Consiglio S. (2000), *Il cambiamento organizzativo*, in Mercurio R, Testa F..
Compagno C. (2003), *Piccole e medie imprese in transizione*, UTET Libreria, Torino; Corbetta G. (a cura di) (2005), *Capaci di crescere. L'impresa italiana e la sfida della dimensione*, Egea, Milano.
Costa G., Giubitta P. (2008), *Organizzazione aziendale*, Mc Graw-Hill, Milano.
Costa G., Nacamulli R.(a cura di), *Manuale di Economia e Organizzazione aziendale*, UTET, Vol. 2, Torino.

Davico L. (2007), *Sviluppo sostenibile*, Carrocci ed, Roma .
De Gregorio, J., Lee, J. W. (1999), *Education and Income Distribution: New Evidence from Cross-Country Data*, Centro De Economia Aplicada, Universidad de Chile, Serie Economia No.55.
De la Croix, D., Doepke, M. (2003), *Inequality and growth: why differential fertility matters*, American Economic Review, 93 (4).
Deininger, K., Squire, L. (1996), *A New Data Set Measuring Income Inequality*, The World Bank Economic Review, 10 (3).
Den Hartog, D. N., Van Muijen, J. J., & Koopmen, P. L. (1997), *Transactional versus Transformational Leadership: An analysis of the MLQ*, Journal of Occupational and Organizational Psychology, 70.
Downton J.A. (1973), *Rebel leadership: commitment and carisma in a revolutionary process*, Free Press, New York.

Eisenbach, R. Watson, K., & Pillai, R. (1999), *Transformational Leadership in the Context of Organizational Change*, Journal of Organizational Change, 12(2); Parry, K. W. (2002), *Leadership, Culture, and Work Unit Performance in New Zealand*, IFSAM 2002 Conference, Gold Coast, Queensland Australia.
Ellis, F. (2000), *Rural livelihoods and diversity in developing countries*, Oxford University Press, Oxford and New York.

Foster M., Fozzard A., Naschold F. and Conway T. (2002), *How, When and Why Does Poverty Get Budget Priority? Poverty Reduction Strategy and Public Expenditure Reform in Five African Countries*, ODI, London.
Federal Ministry of Health. HSDP IV, (2011), *Annual Performance Report*. EFY 2003 (2010/11), Addis Ababa: Federal Ministry of Health.
Galor, O., Zeira, J. (1993), *Income distribution and macroeconomics*, Review of Economic Studies, 60 (202).

Gagliardi P., Monaci M. (1997), *La Cultura*, in *Manuale di organizzazione aziendale*,
Gouldner, Alvin W. 1961 "The norm of reciprocity." American Sociological Review, 25.

Government of India, (2006a), *Level and Pattern of Consumer Expenditure*, 2004-05, NSS 61st Round (July 2004 - June 2005), Report No. 508(61/1.0/1), National Sample Survey Organization, Ministry of Statistics and Programme Implementation, New Delhi.
Government of India, (2006b), *Status of Education and Vocational Training in India 2004-05*, Report No. 517 (61/10/3), National Sample Survey Organization, Ministry of Statistics and Programme Implementation, New Delhi.
Government of India, (2008), *SRS Based Abridged Life Tables 2002-2006*, Office of the Registrar General, Ministry of Home Affairs, Government of India: New Delhi.
Government of India, (2010), *Education in India: 2007-08 Participation and Expenditure*, Report No. 532 (64/25.2/1), National Sample Survey Organization, Ministry of Statistics and Programme Implementation, New Delhi.
Green, M. and Hulme, D. (2005), *From correlates and characteristics to causes: Thinking about poverty from a chronic poverty perspective,* World Development, 33.
Greiner L.E. (1972), *Evolution and Revolution as Organizations Grow*, Harvard Business Review, luglio-agosto 1972.

Hall, A. & Midgley, J. (2004), *Social policy for development,* SAGE, London.
Hanushek, E. & Wössmann, L. (2007), *The Role of education quality in economic growth,* Policy Research Working Paper 4122, World Bank, Washington D.C.
Hart, S. L., & Quinn, R. E. (1993), *Roles Executives play: CEOs, behavior complexity, and firm performance*, Human Performance, 46(5).
Horton R, (2011), *Das. Indian health: the path from crisis to progress*, Lancet 2011; 377.
Hooijberg, R., & Petrock, F. (Spring, 1993), *On Culture Change: Using the Competing Values Framework to Help Leaders Execute a Transformational Strategy*, Human Resource Management, 32(1).
Howell, J. M., & Avolio, B. J. (1993), *Transformational Leadership, Transactional Leadership, Locus of Control, and Support for innovation: Key Predictors of Consolidated-Business-Unit Performance*, Journal of Applied Psychology, 78(6).

Jones, P. (1988). *International policies for third world education, literacy and development.* Routledge, London.

Knight, J. B., Sabot, R. H. (1983), *Educational Expansion and the Kuznets Effect*, The American Economic Review, 73 (5).
Kovacevic, Milorad, (2010), *Measurement of Inequality in Human Development* – A Review, Human Development Research Paper 2010/35, UNDP, New York.
Krishna, A. (2004), *Escaping poverty and becoming poor: Who gains, who loses, and why?*, World Development, 32.
Krueger, D., Perri, F. (2006), *Does income inequality lead to consumption inequality? Evidence and theory*, Review of Economic Studies, 73 (1).
Kuznets, S. (1955), *Economic Growth and Income Inequality*, The American Economic Review, 45 (1).

LeVine, R. A. (2001), *Improve the women: Mass schooling, female literacy and worldwide social change,* Harvard Education Review 71 (1).
Lewin K. (1972), *Teoria e sperimentazione in psicologia sociale*, Il Mulino, Bologna.
Lewin, K., Little, A. & Colclough, C. (1983). *Effects of education on development objectives*, I & II. Prospects XIII, 3, 299- 311 and 4, 1983, 413-425.

Lok, P., & Crawford, J. (1999), *The relationship between commitment and organizational culture, subculture, leadership style and job satisfaction in organizational change and development*, Leadership & Organizational Development, 20(7).
Lorentzen, P., McMillan, J., Wacziarg, R. (2008), *Death and development*, Journal of Economic Growth, 13 (2).
Luckham R. (2005), *The Middle Classes and their Role in National Development*, CDD/ODI Policy Brief No.3 November.

Rao M., Rao K.D., Kumar A.K.S., Charrerjee M., Sundararaman T. (2011), *Human resources for health in India*, The Lancet.
March J. G., Simon H. A. (1958), *Organizations*, Wiley, New York.
Medard J.F., (1982), *The Underdeveloped State in Tropical Africa: Political Clientelism or Neo-Patrimonialism?,* in Christopher Clapham ed., *Private Patronage and Public Power*, Frances Pinter, London.
Mehrotra, S. (1989). *Health and education policies in high-achieving countries – some lessons.* In S. Mehrotra & R. Jolly (Eds.) Development with a human face – experiences in social achievement and economic growth. Oxford University Press, Oxford.

Narayan, D., Chambers, R., Sha M.K. and Petesch, P. (2000), *Crying out for change. Voice of the poor,* Oxford University Press, Washingthon D.C.
Nussbaum, M. C. (2000). *Women and Human Development: The Capabilities Approach*, Cambridge University Press, Cambridge.

Overseas Development Institute (2002), *Report on Progress and Preliminary Findings (PRSP Institutionalization Study. Scoping Phase)'*, London, November.
Oxenham, J. (2008). *Effective literacy programmes: options for policy-makers.* UNESCO, International Institute for Educational Planning, Paris.
Ouchi W. G. (1980), *Markets, Bureaucracies, and Clans*, Sage Publication, New York.

Padaki V. (2007), *The human organisation: challenges in NGOs and development programmes*, Development in Practice, Vol.17, Routledge Pubblishing, Oxfam.
Persson, T., Tabellini, G. (1994), *Is inequality harmful for growth?* American Economic Review, 84 (3).

Rinaldi A., Sciarelli F. (2015), *Economic and social causes for a late development: a comparison between India and Ethiopia*, SIBR 2015 Osaka Conference, Osaka.
Rostow W.W.(1959), *The Stages of Economic Growth*, Econ History Review.

Sarin, M., Singh, N.M., Sundar, N., Bhogal, R.K. (2003), *Devolution as a threat to democratic decision-making in forestry? Findings from three states in India,* Working Paper 197, Overseas Development Institute, London.
Schein, E. H. (1992). *Organizational Culture and Leadership*, Jossey-Bass Publishers, San Francisco.
Schimmoeller J. L. (2011), *Leadership Styles in Competing Organizational Cultures*, Lynchburg College, Leadership Review, Vol. 11, Spring 2011.
Sciarelli F. (2008), *La gestione del Teatro*, Franco Angeli, Milano.
Simon H. A. (1945), *Administrative Behavior*, Free Press, New York.
Stewart, F. (1996), *Globalisation and Education*, International Journal of Educational Development, 16 (4).

Suryanarayana M.H., Ankush Agrawal, Seeta Prabhu K., (2011), *Inequality- adjusted Human Development Index for India's States*, UNDP, India.

Tiezzi E., Marchettini N. (1999), *Che cos'è lo sviluppo sostenibile?*, Donzelli Editore, Roma.
Tiffen, M. and Mortimore, M. (1994), *Malthus controverted: The role of capital and technology in growth and environment recovery in Kenya*, World Development, 22.
Van de Walle N., (2001), *African Economies and the Politics of Permanent Crises, 1979-1999*, Cambridge University Press.

UNDP, (2010), *Human Development Report 2010*, The Real Wealth of Nations: Pathways to Human Development, New York.
UNESCO (2009), *Education for all global monitoring report*, UNESCO, Paris.
UNICEF (1990), *World declaration on education for all*, Adopted by the World Conference on Education, for All, Jomtien, Thailand, March 5-9, UNICEF, New York.
United Nations (2011), *The Millennium Development Goals Report 2011*, United Nations, New York.

Van Maanen J., Schein E. H. (1978), *Toward a theory of organizational socialization*, Manuscript, Sloan School of Industrial Administration, Massachusetts Institute of Technology.

Williamson, O. E. (1975), *Markets and Hierarchies: Analysis and Antitrust Implications*, Free Press, New York.
Williamson, J. D. (1985). *Did british capitalism breed inequality?,* Allen & Unwin, Boston.
Witsenburg K. and Adano, W.R. (2003), *Ethnic violence, water scarcity and the governance of resources,* A case study from Northern Kenya. In Faces of Poverty. Capabilities, mobilization and institutional transformation. Proceedings of the International CERES summerschool 2003.
Worldbank (2002), *Globalization, growth, and poverty. Building an inclusive world economy*, Oxford University Press, New York.
Worldbank (2004), *World Development Report 2005: A Better Investment Climate for Everyone,* World Development Report. World Bank, Washingthon, D.C.

Yammarino, F. J., Spangler, W. D. & Bass, B. M. (1993), *Transformational leadership performance: a longitudinal investigation*, Leadership Quarterly, 4(1).
Yukl, G. (1989), *Managerial Leadership: A Review of Theory and Research*, Journal of Management, 15(2).

Zhang, J., (2005), *The effect of life expectancy on fertility, saving, schooling and economic growth: theory and evidence*, Scandinavian Journal of Economics, 107 (1).

Sitografia

Bennell, P., Hyde, K. & Swainson, N. (2002)., *The impact of the HIV/AIDS epidemic on the education sector in Sub-Saharan Africa*. Centre for International Education, University of Sussex www.sussex.ac.uk/education/documents/aidssynpublished.pdf .
Boyle, S. (2002). *Reaching the poor – the costs of sending children to primary school*, (www. dfid.gov.uk/Documents/publications/ reachingthepoor-edpaper47.pdf).
Brons J., Dietz T., Niehof A., Witsenburg K. (2005), *Dimensions of vulnerability of livelihoods in less-favoured areas: interplay between the individual and the collecive*, Proceeding Conference of less favoured areas, https://openaccess.leidenuniv.nl/bitstream/handle/1887/15390/ASC-075287668-2518-01.pdf?sequence=2

Caillods & Hallak, J. (2004), *Education and PRSPs – a review of experiences,* International Institute for Educational Planning, Paris (www.unesco.org/iiep/PDF/ pubs/PRSP.pdf).
Conoscenza per lo sviluppo: il ruolo della scuola e dei processi di apprendimento nelle politiche di sviluppo e coesione, (2005)
Roma, http://www.dps.mef.gov.it/documentazione/qsn/seminari/Sintesi_seminario_QSN_Scuola.pdf, Sintesi del seminario.
Department of School Education and Literacy, Department of Higher Education, Ministry of Human Resource Development, Government of India (2000-2013), *Annual Report*, (http://mhrd.gov.in/documents_reports).
Palmer, R., Wedgwood, R. & Hayman, R. (2007), *Educating out of poverty?,* Centre for African Studies, University of Edinburgh (www.dfid.gov.uk/pubs/files/ educating-out-poverty-70.pdf).
Rihani, M. (2006), *Keeping the promise: Five benefits of girls´ secondary education.'* Academy of Educational Development. (www.aed.org/publications).
Schimmoeller J. L. (2011), *Leadership Styles in Competing Organizational Cultures*, Lynchburg College, Leadership Review, Vol. 11, Spring 2011.
Schultz, P. T. (2002), *Why governments should invest more to educate girls*, World Development 30 (2), 207-225. Available at http://dx.doi.org/10.1016/S0305750X(01)00107-3
Sokkie P. (2013), *The importance of HR management in an NGO environment*, http://www.ngopulse.org/article/importance-hr-management-ngo-environment.
Takala T. (2010), *Contributions of Formal Education to Social Development*, Journal of Education and Research, Vol. 2, http://dx.doi.org/10.3126/jer.v2i0.7616
Uncredit foundation (2012), *La ricerca sul valore economico del terzo settore in Italia*, www.unicreditfoundation.org.

INNOVATIVE RECYLCING TECHNIQUES AND TECHNOLOGY: ITS ECONOMICAL, ENVIROMENTAL AND ECOLOGICAL IMPACT

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Abstract:
This qualitative-quantitative research study aims to investigate the innovative recycling technologies and techniques in the 5th District of Iloilo. As per interview made, the 156 recipients of the 4Ps of the selected barangays in Iloilo revealed revealed that most of the recycling technology used was focused on plastic bottles, drinking straws, scratch papers, food wrappers and used clothings/textiles. In terms of the gender, male preferred plastic bottles while females on drinking straws. On the number of siblings, those with more than three siblings preferred drinking straws while those with less than three focused on plastic plastic bottles. In terms of location, those who are far from the town proper preferred drinking straw and food wrappers technology while within the town proper, plastic bottles and drinking straws. It was also found out that there was a slight significant impact on economical aspect of the respondents, great/strong environmental impact and ecological impact.

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Investigation of Existing Technological Challenges to Energy Efficient LED lightings

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Abstract:

Lighting contributes a significant amount of total electricity consumption. LED (Light Emitting Diode) lighting technologies are being given considerable importance as it has many potential benefits over conventional lighting technologies. The increasing concern towards energy and environmental issues has given a boost to innovation in lighting sector and it is believed that the next generation lighting device will be based on LED technology. During the last decade there has been significant development in terms of LED lighting technologies as well as bringing this technology among the common people. Even after the momentous effort by the technology developers as well as manufactures, this technology is facing a lot of challenges in terms of its reliability for longer lifetime. Currently available LED reliability standards are also deficient in specifying definite standards for measuring LED lamp's lifetime. Higher initial cost, lack of testing protocols and facilities, limited availability of LED technologies, absence of standards (still not available/adopted for many countries), and absence of incentives to promote LED technologies are the key existing challenges to promote this technology in the near future.

Keywords: Lighting, LED, reliability, lifetime, challenges

1. Introduction:

Compared with the conventional electromagnetic and electronic ballast lighting technologies, LED based lighting technologies are growing continuously because of higher energy saving potential, longer life and its compatibility with ultra-smart controllers to control its on-off, dimming, lighting colour etc(Fan, Yung, & Pecht, 2015). LED lightings are also being preferred because of no mercury content which was one of the main concerns with fluorescent lighting technologies as it causes long term damage to the environment as well as poses serious health risks. LED lighting technology development is taking place at a dramatic pace. Modern LED lamps offer a luminous efficacy of greater than 200 lm/watt while prices are falling by approximately 30% per year. This is an accurate indicator of the emphasis given to this technology to be mature enough to sustain in the competitive market. Even after this significant development during the last decade, this technology still has many disadvantages which need to be rectified to make it reliable in the global lighting market(Schratz, Gupta, Struhs, & Gray, 2013)(Tao, 2013).

In older days, the objective of the lighting technology was just to satisfy lighting needs (illumination quality) but in the current challenging world, it is must to satisfy lighting needs with minimum energy consumption and at affordable cost. It is true that LED technologies and their product designs are continually emerging but fitting all the four areas: materials, electrical, optical and thermal together in compact circuit to produce a high quality LED light is not so easy. At the same time it is also important to highlight here that not all the LED manufacturers are using quality technology to manufacture their product and it results in colour variation, colour shift, sudden drop in light output, thermal issues, permanent failure, low life etc (Sutharssan, Bailey, Stoyanov, & Rosunally, 2011)(Cai et al., 2013). In this paper some of the key technological challenges for the greater reliability of LED lamps have been discussed in detail.

2. Reliability of LED lamps:

Globally, the fluorescent technology is still the dominant lighting technology. Regular technological improvements as well as improvements in electronic ballast technology make it very energy efficient and thereby lead to greater energy savings at a very affordable cost. With the evolution of time it has developed a good level of trust factor among the consumer and therefore the people are reluctant towards going to LED technologies which are not yet well proven in the highly competitive lighting market. The reliability of LED lighting technologies is still a question which need to be answered since many LED lamps completely fail in just 4-5 months or their lumen output degrades significantly while the manufacturers are promising more than 1,00,000 lighting hours(Aman, Jasmon, Mokhlis, & Bakar, 2013).

Reliability standard is one of the most important standard to establish a sustainable LED light but the currently available reliability standards focuses mainly on lumen maintenance and there is no clear methodology to measure the LED lamp's lifetime(Li, Chen, & Chen, 2011)(Huang et al., 2011). LED lifetime has been used as important indicator of its reliability and it is defined as a time when 50% of lamp's lumen output is less than 70% of initial value either by lumen decay of light source or catastrophic failure of electronic components (Li et al., 2011). The reliability of LED lamps are directly associated with the reliability of different components used in the manufacturing of the lamp such as LED module, driver circuit, mechanical housing and optical parts etc(Jang, Choi, & Kon Son, 2011). All the thermal, electrical, electronic and mechanical part of LED lighting systems must be engineered

together with a high level of reliability to get the full potential of LED lightings (Huang et al., 2011).

As LED lighting technology is mainly based on electronic components and their failure rate is commonly unpredictable, it is quite challenging to develop reliable LED lighting technologies for the next generation (Fan et al., 2015). Even in terms of lamp testing, it is relatively easy to test the traditional lamps as they can be tested in periods ranging in months due to its shorter lifetime. However with LED lamps, manufacturers take only a certain lamps into account and therefore the lifetime of LED lamps is unpredictable.

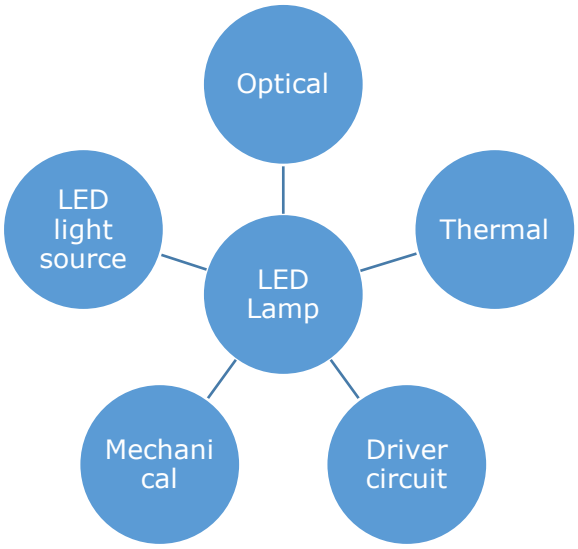


Figure 1: Main components of LED system

Figure 1 shows the main components of LED lighting system and to understand the reliability of whole system it is very necessary to understand the reliability of these different components in their lifetime and their failure modes. This paper highlights the technological challenges and therefore, the failure related to main technologies in the LED lighting have been consolidated in Table 1 which shows their common failure mechanism, causes and effects on LEDs.

Table1: Technological Failure, causes and effects

Technological failure component	Common failure modes/ mechanism	Causes	Effect on subpart	Common effect on LEDs
Capacitance	Capacitor degradation	Operating conditions i.e. voltage, current, frequency, temperature	Decrease in capacitance over time	Permanent failure of lamp/reduce the lifetime of lamp/lumen degradation
	Catastrophic failure	Operating conditions i.e. voltage, current, frequency, temperature	Complete loss of functionality due to short or open circuit	Permanent failure of lamp
Switching devices	Electrostatic	Improper handling	Permanent	Permanent

i.e. MOSFET, IGBT, BJT etc.	discharge	during assembly	system damage	failure of lamp
	Wear and tear	Die fracture, current overload, high voltage stress etc.	Permanent system damage	Permanent failure of lamp
	Circuit environment	Temperature, humidity, shock, vibration etc.	Degradation or permanent damage	Permanent failure of lamp/reduce the lifetime of lamp/lumen degradation
	Aging and inadequacy	Environment, capacity etc.	Degradation	reduce the lifetime of lamp/lumen degradation
Driver circuit	Degradation	Current spikes	degrade drive circuit	Reduce the lifetime of lamp
Magnetic Transformer (if has been used as part of driver circuit)	Degradation	Current spikes	Degradation of transformer	Reduce the lifetime of lamp

3. Technological challenges:

LED technology is an important breakthrough and instrumental in the transformation of lighting market. To help them sustain market forces for a long time, it is necessary to understand the challenges of the core technologies which have been used in the development of whole lighting system. LEDs have the potential for longer life. However, they are experiencing a much shorter life. This is a case of a systemic problem caused by using poor quality products, component degradation and shorter lifetime or failure of their components due to overheating. (Cheng & Cheng, 2006)(Khan & Abas, 2011)(Eusterfeldhaus & Barton, 2011). Some of the common challenges have been discussed below in detail:

3.1 DC lighting in AC environment: LED lights are unlike other lighting systems as they can't just run on AC electric supply nominal voltages. The normal operating voltage of a standard high brightness LED light is usually in the range of 3 to 3.6 volt. As mostly the lighting circuits are directly connected with the distribution grid so it is quite challenging to develop a compact, robust and efficient conversion circuitry which can be embedded in light source itself and can easily convert the AC line voltage to a voltage level acceptable to individual LEDs. The practicality and reliability of these new lights are mainly dependent on the electronic circuitry and which is often overlooked by using low quality electronic components (Weir B, 2012).

3.2 Power quality issues: The power quality problems with the electronic equipments are well known in the literature. Power quality problems are mainly associated with low power factor and higher level of harmonics and it is a responsibility which is of the main concern for electricity supplier as well as electricity user (Shrivastava & Singh, 2012). EN 61000 series standards specify the power quality problems by the user equipments and appliances. A compact ac/dc converter is being used in the LED lighting fixture to provide dc current to LED chips. This electronic circuitry is non-linear and switching in nature

and hence produces highly distorted currents which degrade the overall power system network. Most of the currently developed LEDs have a poor power factor and high harmonics level as many of the manufacturers are not using quality products and sometimes even they are not developing LED lightings as per specified standards. As LEDs are rapidly penetrating the market, it may introduce considerable power quality problems on the grid infrastructure and therefore, this challenge needs immediate attention. (Khan & Abas, 2011)(Uddin, Shareef, Mohamed, & Hannan, 2012b)(Uddin, Shareef, Mohamed, & Hannan, 2012a).

3.3 Capacitor degradation: Decrease in capacitance over time is called as capacitor degradation. Capacitors and switching devices such as MOSFET, IGBT, and BJT etc. are the important component of ac-dc converts used in the LED lightings and they have a high level of degradation rates as compared to other components. The failure in any of these components may result in to excessive ripple currents, transients, high voltage conditions and other similar effects. Degradation of capacitor with time affects the efficiency of converter and ultimately it affects the performance of the LED lights. There are numerous factors for the degradation of electrolytic capacitors such as environment, temperature, voltage, current etc. When it degrades with time it results as failure of the component, which impacts the working of the subsystem (dc-dc converter) that are part of the overall system (LED lights)(Kulkarni et al., 2010)(Han & Narendran, 2009).

3.4 Heat management: Thermal management is the other important issue for a greater reliability of LED lightings. Unlike incandescent bulb (only 10% of electrical energy converts into visible light), LED transforms around 50% of the total input energy in to visible light. Rest of the input energy remains at the source because of the ceramic bases of LED lamps which acts as insulators and results as rising of the temperature of LEDs. Because of high temperature the life of the LEDs shortens and it also affects the operation of the driver circuitry (Pryde, Whalley, & Malalasekera, 2014). The currently available literatures on LED thermal management have number of dedicated technologies including commonly used heat sinks to manage heat transfer from the LEDs but still are there is no clear direction and standards for their development (Hong & Narendran, 2004). Developing effective heat management to improve the operating characteristics of LEDs and minimize their failures requires more research (Pryde et al., 2014).

4. Conclusion:

The paper has highlighted the four most important technological challenges to LED lightings. It is true that lighting market transformation is in progress and is shifting from fluorescent technology to LED lamps. There has been considerable improvement in terms of LED luminous performance as well as producing low cost LED lamps during the last decade. But, as far as, its reliability is concerned, the technology is still to mature. From the consumer perspective it has certain advantages but at the same time its unreliability in life, performance variation in voltage fluctuation and its high initial cost are acting as a barrier toward its common adoption. Utilities are also highly disadvantaged as it is a highly non-linear electronic device and creates a high level harmonics and other power quality issues which are ultimately going to impact the grid infrastructure. To overcome these challenges, there is an urgent need to focus on the reliability of subparts of LED lamps so that the end users gets an accurate estimation for how long a system is going to last. Definite standards for measuring reliability of LED lamps are also need to be developed to ensure that only high quality lamps with a higher level of reliability are being penetrated in the market to gain consumer's confidence in the long term.

References:

Aman, M., Jasmon, G., Mokhlis, H., & Bakar, A. (2013). Analysis of the performance of domestic lighting lamps. *Energy Policy, 52*, 482-500.

Cai, M., Yang, D. G., Chen, W., Jia, H., Tian, K., Guo, W., & Zhang, G. (2013). A reliability analysis method for LED luminaires based on step stress accelerated degradation test. *Electronic Packaging Technology (ICEPT), 2013 14th International Conference on,* 1207-1211.

Cheng, Y., & Cheng, K. (2006). General Study for using LED to replace traditional lighting devices. *Power Electronics Systems and Applications, 2006. ICPESA'06. 2nd International Conference on,* 173-177.

Eusterfeldhaus, M., & Barton, B. (2011). Energy efficiency: a comparative analysis of the New Zealand legal framework. *J.Energy & Nat.Resources L., 29*, 431.

Fan, J., Yung, K., & Pecht, M. (2015). Predicting long-term lumen maintenance life of LED light sources using a particle filter-based prognostic approach. *Expert Systems with Applications, 42*(5), 2411-2420.

Han, L., & Narendran, N. (2009). Developing an accelerated life test method for LED drivers. *SPIE Optical Engineering Applications,* 742209-742209-8.

Hong, E., & Narendran, N. (2004). A method for projecting useful life of LED lighting systems. *Optical Science and Technology, SPIE's 48th Annual Meeting,* 93-99.

Huang, F., Yin, L., Li, S., Xu, G., Yan, H., Chen, Y., . . . Zhang, J. (2011). Study on the reliability of high-power LEDs under temperature cycle. *Electronic Packaging Technology and High Density Packaging (ICEPT-HDP), 2011 12th International Conference on,* 1-4.

Jang, J. W., Choi, S. Y., & Kon Son, J. (2011). Degradation model of LED based on accelerated life test. *Physical and Failure Analysis of Integrated Circuits (IPFA), 2011 18th IEEE International Symposium on the,* 1-4.

Khan, N., & Abas, N. (2011). Comparative study of energy saving light sources. *Renewable and Sustainable Energy Reviews, 15*(1), 296-309.

Kulkarni, C., Biswas, G., Koutsoukos, X., Goebel, K., Celaya, J., & SGT, N. (2010). Physics of failure models for capacitor degradation in DC-DC converters. *The Maintenance and Reliability Conference, MARCON,*

Li, X., Chen, L., & Chen, M. (2011). An approach of LED lamp system lifetime prediction. *Quality and Reliability (ICQR), 2011 IEEE International Conference on,* 110-114.

Pryde, J. R., Whalley, D. C., & Malalasekera, W. (2014). A review of LED technology trends and relevant thermal management strategies. *Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm), 2014 IEEE Intersociety Conference on,* 31-38.

Schratz, M., Gupta, C., Struhs, T., & Gray, K. (2013). Reducing energy and maintenance costs while improving light quality and reliability with led lighting technology. *Pulp and Paper Industry Technical Conference (PPIC), Conference Record of 2013 Annual IEEE,* 43-49.

Shrivastava, A., & Singh, B. (2012). Improved power quality based high brightness LED lamp driver. *International Journal of Engineering, Science and Technology, 4*(1), 135-141.

Sutharssan, T., Bailey, C., Stoyanov, S., & Rosunally, Y. (2011). Prognostics and reliability assessment of light emitting diode packaging. *Electronic Packaging Technology and High Density Packaging (ICEPT-HDP), 2011 12th International Conference on,* 1-7.

Tao, G. (2013). Modelling of LED light source reliability. *Physical and Failure Analysis of Integrated Circuits (IPFA), 2013 20th IEEE International Symposium on the,* 255-258.

Uddin, S., Shareef, H., Mohamed, A., & Hannan, M. (2012a). An analysis of harmonics from LED lamps. *Electromagnetic Compatibility (APEMC), 2012 Asia-Pacific Symposium on,* 837-840.

Uddin, S., Shareef, H., Mohamed, A., & Hannan, M. A. (2012b). Harmonics and thermal characteristics of low wattage LED lamps. *Przegląd Elektrotechniczny, 88*(11a), 266-271.

Weir B. (27 Feb 2012). The Subtle Circuitry behind LED Lighting. IEEE Spectrum

Latent Heat Air Conditioner Using Water

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Abstract - Air conditioning is the process of altering the properties of air (primarily temperature and humidity) to more comfortable conditions, typically with the aim of distributing the conditioned air to an occupied space to improve thermal comfort and indoor air quality. Latent heat air conditioning techniques are being used low energy working devices. Allow reduction of dust, eco-friendly and components are cheap. Water is used as medium of heat exchange. Reduction of pathogenic substance from working space gives rich O_2 supply in cabin. Hence the present study may help to the development of technologically important latent heat air conditioners.

I. Introduction

In day today life the term air-conditioning has its significance because standard of life of everyone has much increased. Latent heat air conditioning techniques are being used low energy working devices. Allow reduction of dust, eco-friendly and components are cheap. Water is used as medium of heat exchange help the reduction of pathogenic substance from working space gives rich O_2 supply in cabin. The cost of air-conditioning should decrease and also provide a healthy atmosphere to users. In the present study latent heat cooling techniques are being used in air conditioning and inside cooling towers common designs are being replaced fluid filters are being introduced in the inlet flow and outlet flow to reduce the contaminations. Special pumping flow from cabin provides a clean air circulation comparing to common air conditioners. Healthy air circulation comparing to common air conditioners will give user a healthy breathing and the Co_2 level inside the cabin is regulated.

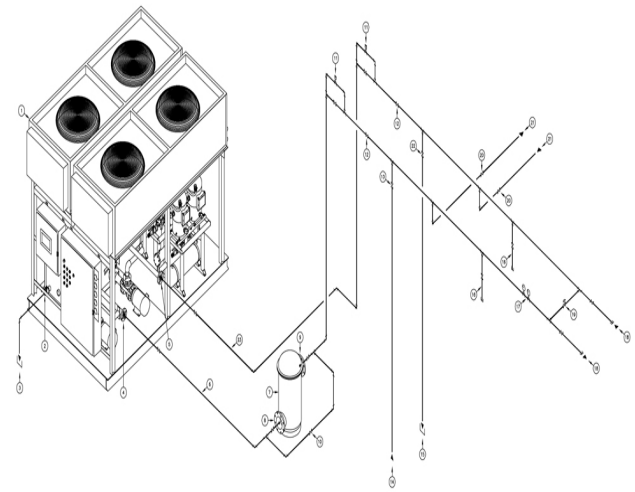
Water cooled chillers utilize a condenser that circulates water to remove the heat from the aquarium. This takes the place of a fan blown condenser that most chillers are made with. The advantages are no heat build up in a room and no need for ventilation. Noise level is greatly reduced since there is no fan operation. BTU output does not change when weather gets warmer. The amp draw on the chillers are usually 25-30% lower than fan blown chillers.

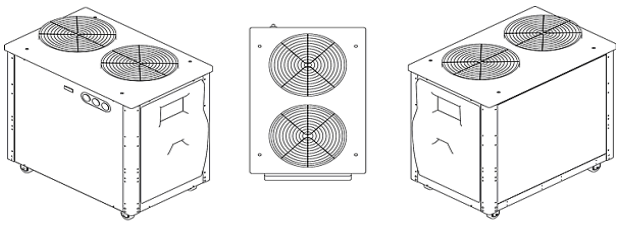
Restrictions may apply in your area as the water is usually wasted, but is not usually a problem. These chillers are available from 1/3 hp to 5hp.

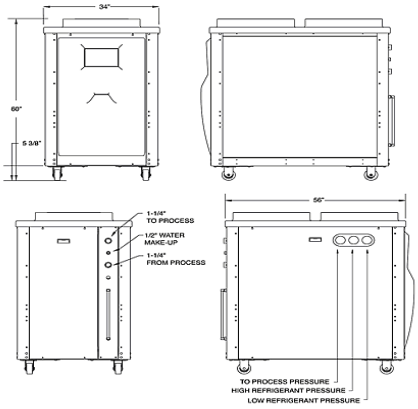
2. Materials and methods

Copper pipes, aluminium rods, plaster of Paris, steel sheets, copper and aluminium press sheets

2.1. Design







2.1.1. Chillers

Design and advantage

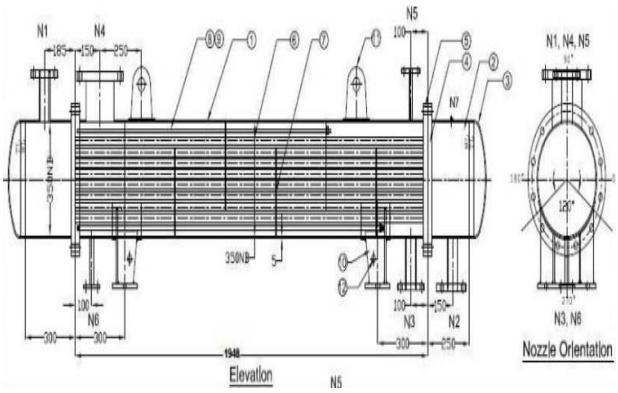
In this technique water is used a as cooling agent and special radiator arrangements are being used for application of heat exchange and the temperature of water is being lowered by the help of radiator arrangements in cooling towers and the gradually lower tempered water is being pumped into the required space and the low tempered water absorbs the heat and also the dust and micro particles are being absorbed by water molecules then the water molecules become a gaseous form or dust and moisture then this moisture is being pumped from cabin and then let to pass through liquid filters and let out 60% of water molecules are being gained back with the help of liquid filters and comparing with other designs. This plant could remain loss free and also by the application of NANO molecular fusion of heat exchange in latent heat the cabin could provide a healthy atmosphere and usual bacterial circulation chance in the cabin is being avoided by the application of liquid filters

An eco friendly coolant is being used in the design for maintaining low temperature of water and the design of coolant cabin is in the mode of heat exchange and prevents mass exchange so no mixing is being done

In inlet and outlet air filters there are coiled aluminium structures to prevent intermixing and they are powered by 9v constant supply

Main advantage is once the inlet water is being cooled then the cabin cooling process for that batch of cooled water occurs with less energy conception

Micro porous tanks are being used in radiator cabins for application of cooling



Special designed radiator seen inside cooling towers

2. 2. Specific latent heat

A *specific* latent heat (L) expresses the amount of energy in the form of heat (Q) required to completely effect a phase change of a unit of mass (m), usually 1kg, of a substance as an intensive property:

$$L = \frac{Q}{m}.$$

Intensive properties are material characteristics and are not dependent on the size or extent of the sample. Commonly quoted and tabulated in the literature are the specific latent heat of fusion and the specific latent heat of vaporization for many substances.

From this definition, the latent heat for a given mass of a substance is calculated by

$$Q = mL$$

Where:

Q is the amount of energy released or absorbed during the change of phase of the substance (in kJ or in BTU), m is the mass of the substance (in kg or in lb), and L is the specific latent heat for a particular substance (kJ-kg_m^{-1} or in BTU-lb_m^{-1}), either L_f for fusion, or L_v for vaporization.

2.3. Refrigeration cycle

In the refrigeration cycle, heat is transported from a colder location to a hotter area. As heat would naturally flow in the opposite direction, work is required to achieve this. A refrigerator is an example of such a system, as it transports the heat out of the interior and into its environment (i.e. the room). The refrigerant is used as the medium which absorbs and removes heat from the space to be cooled and subsequently rejects that heat elsewhere.

Circulating refrigerant vapour enters the compressor and is compressed to a higher pressure, resulting in a higher temperature as well. The hot, compressed refrigerant vapor is now at a temperature and pressure at which it can be condensed and is routed through a condenser.

Here it is cooled by air flowing across the condenser coils and condensed into a liquid. Thus, the circulating refrigerant moves heat from the system and the heat is carried away by the air.

The condensed and pressurized liquid refrigerant is next routed through an expansion valve where it undergoes an abrupt reduction in pressure. That pressure reduction results in flash evaporation of a part of the liquid refrigerant, lowering its temperature. The cold refrigerant is then routed through the evaporator. A fan blows the warm air (which is to be cooled) across the evaporator, causing the liquid part of the cold refrigerant mixture to evaporate as well, further lowering the temperature. The warm air is therefore cooled.

To complete the refrigeration cycle, the refrigerant vapour is routed back into the compressor. By placing the condenser inside a compartment, and the evaporator in the ambient environment (such as outside), or by merely running an air conditioners refrigerant in the opposite direction, the overall effect is the opposite, and the compartment is heated instead of cooled. See also heat pump.

The engineering of physical and thermodynamic properties of gas–vapour mixtures is called psychrometrics

3. Result

A cooled cabin is being provided over 8 hrs by 5 litter of water Average dust content inside room has been controlled due to a regulated atmosphere inside the room will provide a freshness to users and due to the use of water as medium the actual cooling level is optimum for users and in cold time also temperature inside the cabin is maintained by the reliable heat exchange of water since we use water here as a carrier we can trust the medium than that of cfc or liquid ammonia the risk factor is less in this mode of designing

4. Conclusion

The present study produce an eco friendly air conditioning technique also provide an healthy atmosphere to users so from this design as per lab scale 70 % efficiency is being provided. Latent heat air conditioning techniques are being used low energy working devices. Allow reduction of dust, eco-friendly and components are cheap. Water is used as medium of heat

exchange. Reduction of pathogenic substance from working space gives rich O_2 supply in cabin. As a result of the design can maintain cooled atmosphere by the help of water as good heat exchanging medium by the end of 2005 in India even people began to use chillers in large scale for avoiding loss but the span of cooling procedure is very high but by this method we can cool and make flow easily in extreme temperature conditions like above 50 degree and below -4 degree the system will fail. Hence the present study we can conclude that the development of latent heat air conditioner opens a new market in the field of air conditioning system.

5. Reference

http://www.sciencedirect.com/science/article/pii/S0140700714000991.

http://www.elitesoft.com/sci.hvac/itlatent.html.

https://www.spaceair.co.uk/faqs/what-is-the-difference-between-sensible-and-latent-heat.

http://www.udarrell.com/air-conditioning-latent-heat.html.

http://www.teriin.org/index.php?option=com_publication&task=details&sid=1208&q=&Itemid=151.

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As a author of this paper am introducing myself am doing studies on biotechnology as well as thermo dynamics here in this paper am introducing a new thermo dynamics application based paper and i am concentrating my studies on engineering facts

MODELLING THE ENVIRONMENT REHABILITATION USING GIS TECHNOLOGY IN ALBANIA

(*Case study - Rehova Copper mine*)

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Abstract

This paper presents a Case study on 3D modelling Environment Rehabilitation of copper mine in Rehova, Albania, using GIS technology. Rehova Cooper mine opened since 1930, from Italians and it is one of the oldest mine in country. First it has been exploited in small opencast mine. During 1950 in this mining worked Albanian and Russian geologists discovering new reserves. Underground exploitation started on 1974. Because of opencast and underground mine the environment is damaged in high scale. The most important damages are in: forestry, agricultural land, waters, landscape, flora and fauna. The papers present the way how GIS technology is used to create a 3D model of the Rehabilitation of damaged environment in this mine. The 3D modelling of the mine rehabilitation is constructed using the program ArcGIS 10.1 based on different layers as: Geography, position, land use, forestry, underground mining works, open cast mining works, flora and fauna, water treatment, danger areas, geological, infrastructure, etc. The necessary data are collected from the existing mine documentation and direct surveying in the mine. The paper gives the conclusions and recommendations for the future rehabilitation project implementation and including GIS technology in environment rehabilitation.

Keywords: *GIS, Mining, Environment rehabilitation, 3D modelling.*

1. General overview of Rehova cooper mine

Rehova cooper mine is located on North-East of Albania, in Korça region (**FIG.1**). It is opened since 1930 from Italians, and it is one of the oldest mine in country. First it has been exploited in small opencast mine. During 1950 in this mining have been working Albanian and Russian geologists discovering new reserves. Underground exploitation started on 1974. Total cooper production of this mine was over than 334,000 tons with 1.45% Cu. The relief has forced the exploitation with both ways open cast

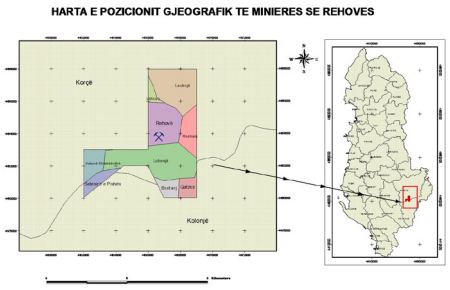


FIGURE 1 *Map of geografical position of the mine*

mine and underground. The opening of underground mine has been done with two main horizontal galleries (*traverbank*) +1000m, and +970m. The exploitation of mineral has been done using three systems: (1) Sublevels gallery system; (2) Sublevels collapse; (3) Full face demolition and scrapering.

2. Damaged caused by mining activity

Damage effects because of underground and opencast manning activity in Rehova mine are too many. This damage brought as consequences life change of the population living in this area. Main damages are kind of: surface excavation; rise and funnels coming up in the surface; drainage area formation; Non continued deformation associated with massive cracks; Collapse, slides, subsidence; hydrologic and hydro geologic transformation; infrastructure object damaging; Change of chemical components and water regime movement; Damage of underground wealth; Forestry damage; Landscape damage; Damage of flora and fauna; Air pollution; Agriculture land damage; Terrain damage; Waste deposit on the dam. **FIG.2** shows some of these damages.

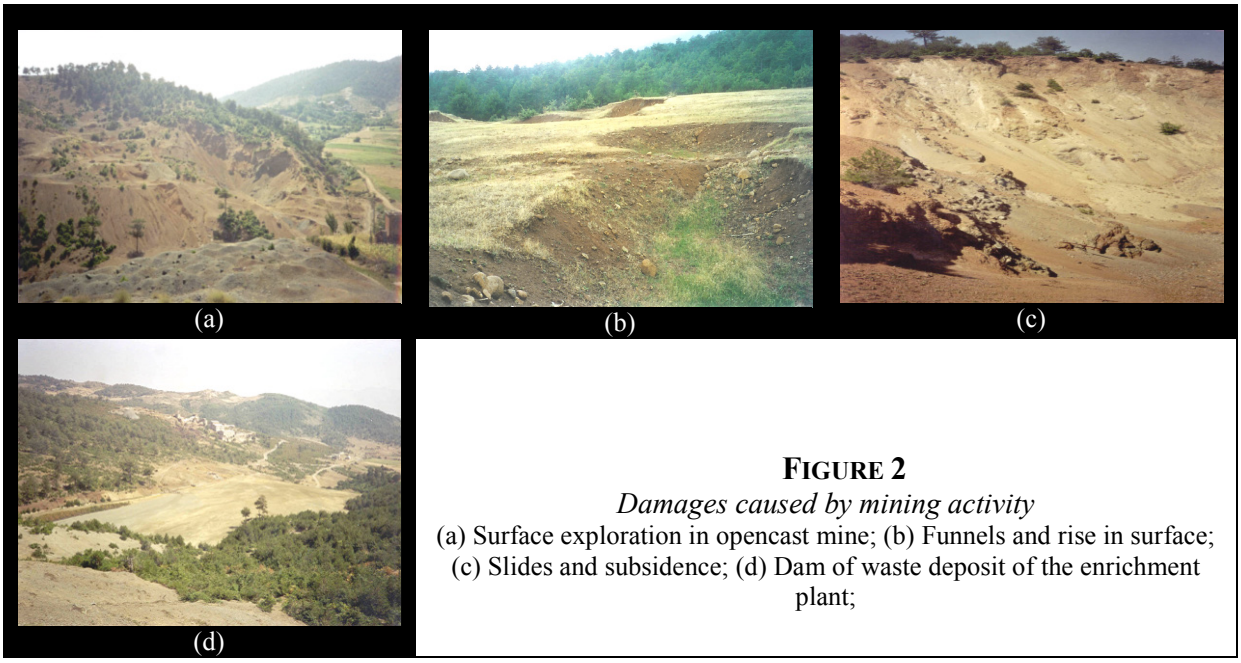


FIGURE 2
Damages caused by mining activity
(a) Surface exploration in opencast mine; (b) Funnels and rise in surface; (c) Slides and subsidence; (d) Dam of waste deposit of the enrichment plant;

The biggest impact and damage in Rehova is on the forestry. Fi.3 gives a comparative view of area development from 1977 to 2015. From the photos seen very clear that because for the mine there are damaged around 1/3 of forestry. The biggest change happened in the period of 1977-1991. Mean time in the period of 2000-2015 there is no physical change because of mine closuring.

Another big impact of the mining activity is on the agricultural used water. Because of the clean and polluted water mixing, there is a big trouble for the community, because polluted water are big risk for the population health. **FIG.8** presents damaged area (*in read*), actual flow of the waters also the deviation of clean waters channel (in blue) with purpose of eliminating the mixing up of the clean and polluted waters.

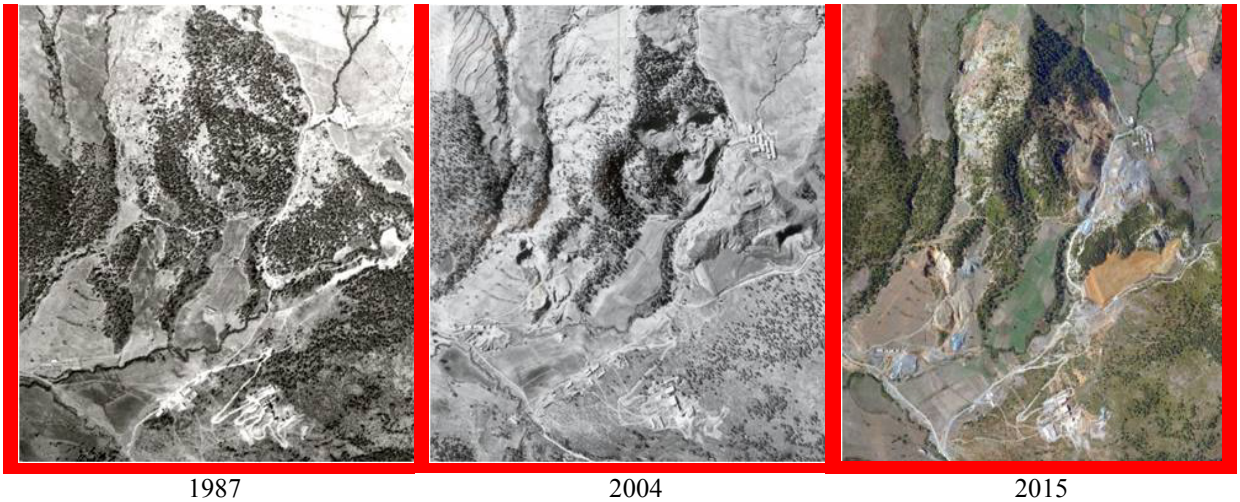


FIGURE 3 *Comparative view of Rehova copper mine area development*

3. Proposed environmental rehabilitation measures

The proposed rehabilitation measures are of two kinds: (1) Preventing; (2) Regenerating. As for regeneration measures it is proposed to intervene based on exploited area, split on 6 zones. **FIG.4** shows zones as following: Zone 1 *Kanisqel*; Zone 2 *Bregu i Gështenjës*; Zone 3 *Enrich-ment plant dam*; Zone 4 *Çiflig*; Zone 5 *"Dushku i Trashë"*; Zone 6 *Water treatment station*.

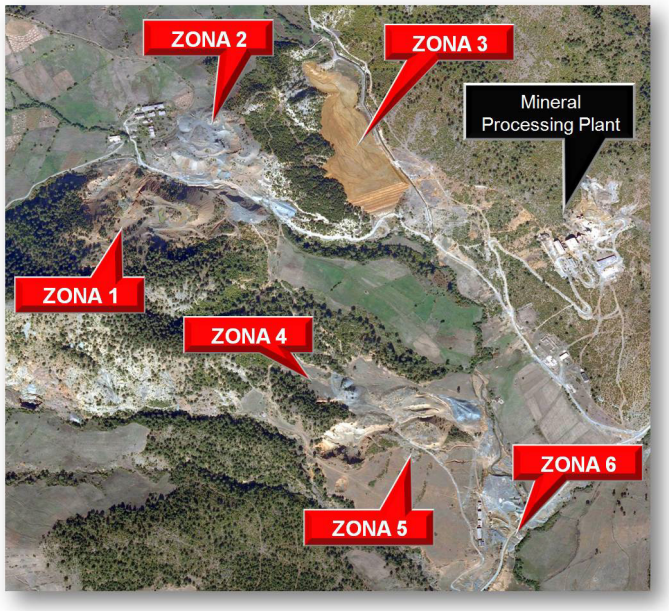


FIGURE 4 *Rehabilitation zones*

4. Modelling the rehabilitation scheme using GIS technology

One of the reasons realising this study is the desire to increase the using rate of GIS in the field of environment rehabilitation. Practically, in Albania GIS is still rarely used. It known that GIS using create a huge facilitation of the spatial phenomena and except the simple tasks as inventory, estimation, management etc, it gives also the specific task of phenomena forecasting modelling as for example, weather conditions, ecological system etc, and further more GIS contributes to the environment policy creation, natural hazards elimination etc.

Creation of 3D model, for the proposed rehabilitation scheme of damaged environment because of the mining activity, has as the goal to support the designing and implementing of rehabilitation measures works.

Construction of the 3D spatial model is realised using ArcGIS 10.1 program. Main data received from geological materials (*maps, cuts, etc*) and mining works materials as (*mining works, vertical profiles, etc*), topographic maps of the zone, observations in terrain and aerial photo of the area. The constructed model was built based on the information of layers as following: (1) Vegetation cover; (2) Infrastructure; (3) Hydrographical net; (4) Lands; (5) Forestry; (6) Open cast mining; (7) Flora and fauna; (8) Endangered zones; (9) Underground mining works; (10) Rehabilitation areas; (11) Scheme of rehabilitation measures; etc. **FIG.5** shows some of the used layers.

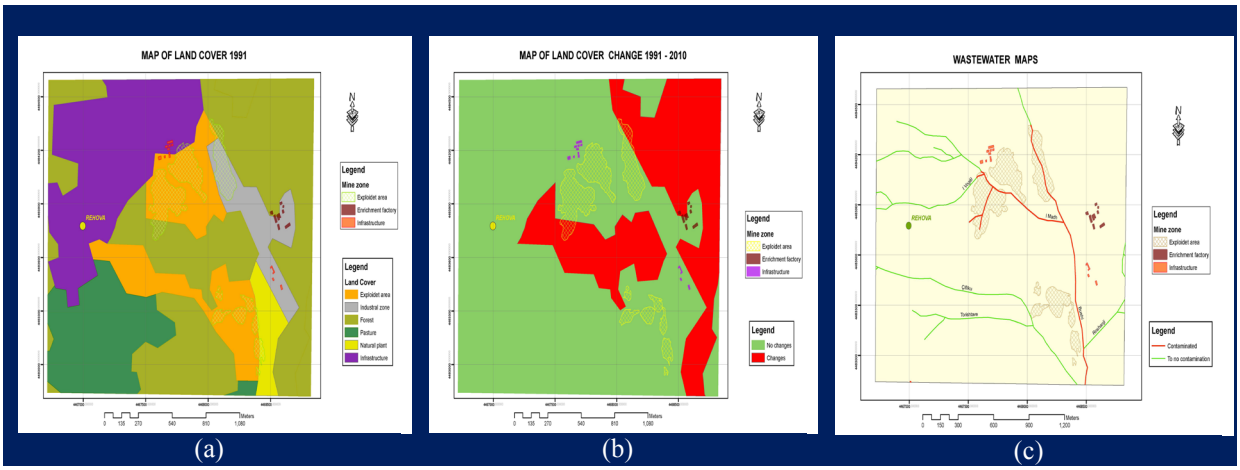


FIGURE 5 *GIS thematic maps* (a), (b) Land cover map; (c) Waste water map

The followed procedure for 3d model building of the area to be rehabilitated includes following steps: (1) Development of environment rehabilitation model/concept; (2) Data collection; (3) GIS analyses; (4) Estimation (see **FIG.6**).

4.1. *Development of environment rehabilitation model*

This phase consists of general model of environmental impact defining because of mining activity on Rehova mine. The purpose of this phase is to offer a clear vision of the pollution impacts, reasons, improvement situation ways, and technical processes to be implemented. Fig.7 shows in general schematic way interaction of mining activity (open cast, enrichment plant dam, mineral transport, mineral processing, etc). This general scheme is also applied, with some changes, in GIS Rehova mine case.

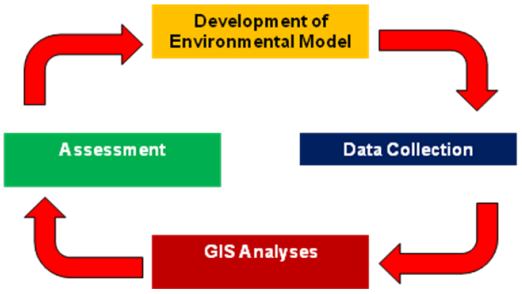


FIGURE 6 *GIS based estimation process*

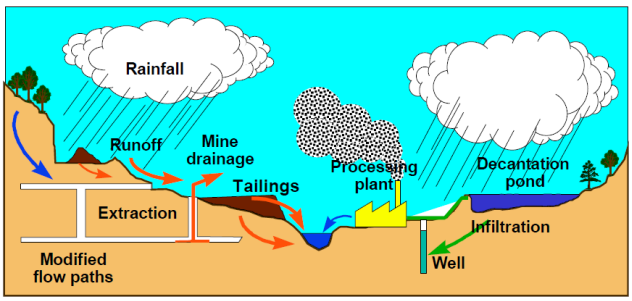


FIGURE 7 Schematic *presentation of interaction model between mining activity and environment* [Source: Mineo IST]

4.2.*Data collection and Database creation*

All appropriate data connected with environment and pollution processes, determined in the first phase, are collected

from different sources. This data include: topography, geology, land use, hydrogeology and hydrology, rain falls and weather, geochemical (lands and waters) and aerial photo. During this phase was done the digitalisation of existing maps, also electronic data was ensured from different sources and formats. This process ensured full information, quality, and unifying of coordinative systems, for all thematic layers. During this phase, also was studied carefully all the data with purpose of eliminating the unnecessary data. All the data was processed to be integrated in GIS, taking care also data topology (raster, or vector). Thematic GIS layers used to build the environment rehabilitation scheme included: Geology; Vegetation cover; Hydrographical net; Lands; Forestry; Open cast mining works; Flora and Fauna; Endangered zones; Underground miming works; Areas to be rehabilitated; Scheme of rehabilitation measures, etc.

4.3. GIS analyses and processing

GIS Data processing and analyses is the main part of modelling process of damaged environment rehabilitation from mining activity, giving as a final result; the Pollution Map, Area to be rehabilitated; and 3D Model. During this phase were overlapped different layers to create the 3D Model of the area.

Data processing included three levels: (1) Level one included data corresponding to the unprocessed data, such as: Geology, Hydrograph, etc; (2) Level two included single thematically layers or group of data; (3) Level three included layers resulted from combination and analyses such as: cleaned and polluted waters map, etc.

As for the *GIS analyses*, they can be done in different ways. In Rehova mine case, one GIS analyse application is the distribution of water pollution and its impact in agriculture.

4.4. Estimation

The estimation phase is the final step and consists on final documents production (maps. Graphics, reports, etc) which result from the elaboration, processing and data analyse where is described the environment status, endangered zones, rehabilitation zones etc. Some of the final GIS products on Rehova mine are: (1) Maps of rehabilitation zones; (2) Maps of water pollution; (3) 3D model of the rehabilitation area (see **FIG.8**).

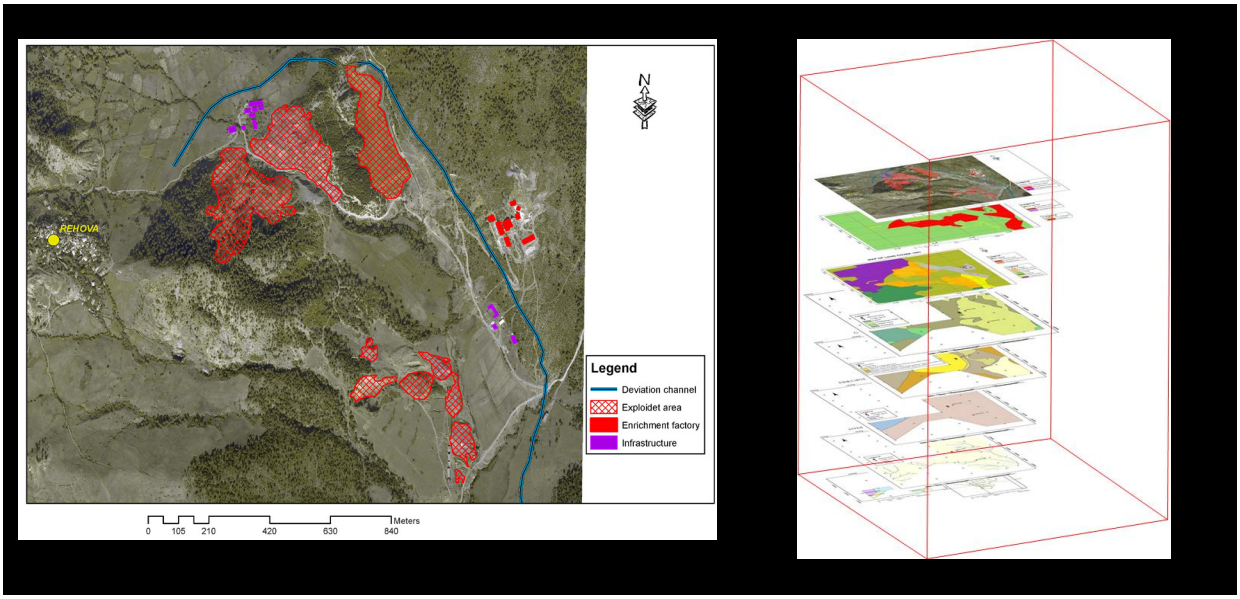


FIGURE 8 *Final GIS product.* (a) *GIS map of rehabilitation areas (red colour) and proposal of clean water deviation (blue colour). (b) GIS 3D Model of the zone*

5. Conclusions and recommendations

Considering the full information and analyses of the case we arrive in following conclusions and recommendations.

1. Using of GIS technology and including it in environment protection and rehabilitation methods in Albania is in the minimum level. In the case of Rehova mine, in existing studies and environment rehabilitation analyses there is no GIS technology use. This paper is the first effort to apply the GIS in environment rehabilitation for this mine.
2. 3D modelling of Rehova mine using GIS technology gives a clear view and offers an advanced method for information receiving and create a Data Base which can be updated and serve as a tool for decision makers in the future.
3. Considering the advantages of the GIS technology, it is recommended to include GIS in all rehabilitation plans in generally and especially in the environment damaged by mining activity.
4. Because of low experience in GIS using in environment rehabilitation is recommended to be prepared a Manual of Procedures for GIS application in this field.

Literature:

[1] **Hoxha E** "*Mbrojtja dhe rehabilitimi i ambjentit të dëmtuar nga shfrytëzimi minerar*" ILAR 2005.
[2] **Hoxha E** "Sistemet gjeografike të informacionit" GEER 2012.
[3] **Jochen H. Albrecht** "*Universal GIS Operations for Environmental Modelling*".
[4] **Mineo IST** "*General guidelines for modelling mining-related pollution dissemination from EO and GIS data, General guidelines for rehabilitation and remediation".* 1999-10337 April 2003
[5] **Lipo S** "*Safe spatial planning in abandoned mining areas*" Proceedings of the VI International Geomecanical Conference 24-28 June 2014, Varna, Bulgaria. Pg.457

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Opportunities for rural development in central Mexico through solar energy

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ABSTRACT

This study provides an analysis of the role that solar technologies may play in the development and alleviation of poverty in rural areas. Querétaro in Central Mexico is presented as a case study. Querétaro is a state with a great potential for harnessing solar energy, however projects focused on the utilization of solar energy have been very limited so far. An assessment of trends in rural electrification and solar energy use is carried out to explore the opportunities that different solar technologies can provide to the standards of living of the rural population. The results indicate that the use of solar technologies can contribute to rural development, improving people´s income and the quality of life of disadvantaged communities.

KEYWORDS: Solar energy, poverty, development

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This study provides an analysis of the role that solar technologies may play in the development and alleviation of poverty in rural areas. Querétaro in Central Mexico is presented as a case study. Querétaro is a state with a great potential for harnessing solar energy, however projects focused on the utilization of solar energy have been very limited so far. An assessment of trends in rural electrification and solar energy use is carried out to explore the opportunities that different solar technologies can provide to the standards of living of the rural population. The results indicate that the use of solar technologies can contribute to rural development, improving people´s income and the quality of life of disadvantaged communities.

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INTRODUCTION

According to the World Bank (2015), in 2011, 14.5 % of the world's population could be classified as extremely poor and one out of every five people does not have access to electricity (United Nations, 2011). Lack of electricity in rural areas exacerbates poverty, as it is associated with lack of productivity in the primary, secondary and tertiary sectors and the opportunities it provides for working, learning, or operating a business. Similarly, the lack of electricity is the source of serious health problems caused by emissions from stoves and coal or wood heaters (WHO, 2011). Therefore, one of the key steps towards the eradication of poverty is to improve access to energy services, since energy contributes decisively to the economic and social welfare of populations by promoting access to water, employment, rural productivity, the levels of health and welfare standards (ISES and Dieter Holm, 2005; Sharif and Mithila, 2013).

In Arid and semi-arid regions the highest amount of solar radiation, is a steady source of energy for rural and urban households for a multitude of purposes. Therefore, solar technologies play an important role in the alleviation of poverty, by providing disadvantaged people with access to basic energy services.
The geographical location of Mexico and its solar resources are congruent to a great potential for solar energy development. However, investment and government support in the sector have been very limited so far (Meisen and Krumpel, 2009). According to SENER and IEA (2011) the potential growth of renewable energies in Mexico depends on the availability of the resource, the cost of investment, the cost of generation and the transmission cost.

In rural communities, renewable energy technologies can provide energy services which may drive development and improvement of living conditions. In addition they can mitigate many of the negative impacts of traditional energy sources, such as deforestation, air pollution and climate change; thereby achieving sustainable economic growth and social development.

METHODS

In this study, meteorological data from the CEA meteorological station network are used to quantify radiation availability and to analyse the opportunity of solar technologies to fight poverty. The solar radiance measurements were taken using pyranometers . Solar irradiation as the energy from the sun reaching a unit surface during a certain time is expressed in $kWhm^{-2}day^{-1}$. Average daily global irradiance for every month was calculated using data for the period 2010-2014.
Queretaro, in central Mexico, is presented as a case study to investigate the impacts of available electricity on the socioeconomic levels of the population of different municipalities of the State. Development indexes such as education, occupation, per capita income and infant mortality rate are used to explore and highlight any relationships between the different variables and availability of electricity.
Queretaro State consists of 18 municipalities: Amealco de Bonfil, Arroyo Seco, Cadereyta de Montes, Colón, Corregidora, El Marques, Ezequiel Montes, Huimilpan, Jalpan de Serra, Landa de Matamoros, Pedro Escobedo, Peñamiller, Pinal de Amoles, Queretaro, San Joaquin, San Juan del Rio, Tequisquiapan and Toliman (Figure 1) .



Figure 1. Map of Queretaro.

The topography is rugged, with long mountain chains and narrow valleys. Elevations range between 900 m and 3,000 masl. The Trans-Mexican Volcanic Belt and the Madre Oriental mountain range occupy about half of the state. The climate ranges from dry to temperate.
The population of the state is concentrated in the metropolitan area of Queretaro, where the standards of living are higher than in the rural areas. From 1970 to 2010, the urban zone of Queretaro City multiplied by almost a factor of 17. Migration from other parts of Mexico has been the main cause. Approximately, 49 new families move to Queretaro every day. The the metropolitan area of Queretaro includes the capital and the municipalities of Corregidora and El Marques. According to the Federal Electricity Commission (CFE) more than 44,000 people lack electricity service in their homes.
In this study, data from the National Institute of Geography and Statistics (INEGI) are used to build a comprehensive picture of local energy requirements

RESULTS

Results show that Queretaro is a state with great potential for the use of solar energy. Average daily global irradiance is about 4.5 KWh/m ^{2} day (Figure 2). The highest values of global irradiance are recorded during the spring equinox (March to May) and the lowest values in December and January. The maximum values are shown in Amealco, Huimilpan, Peñamiller and Toliman.

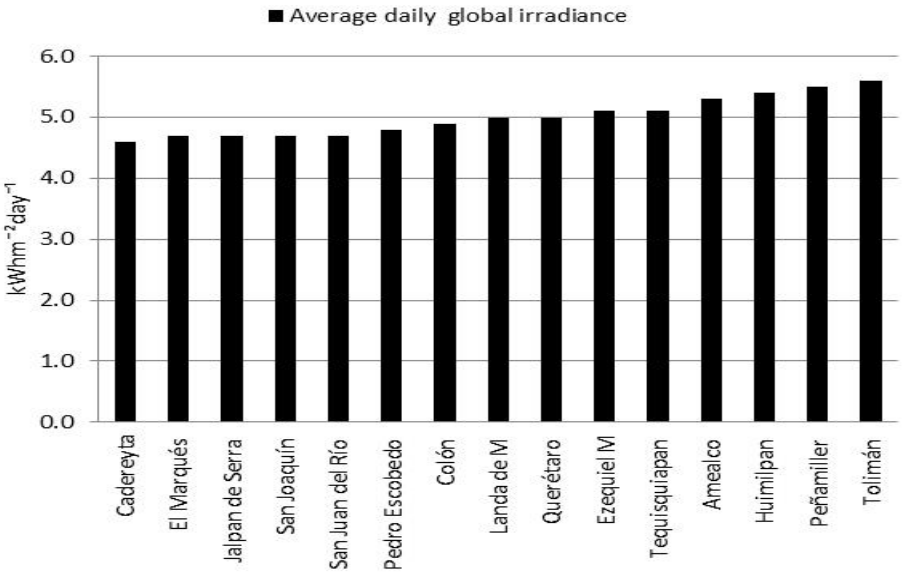


Figure 1. Average daily global irradiance for the municipalities of Queretaro.

According to the population census (INEGI, 2010) the total population of the State of Querétaro is about 1,827,937 inhabitants, of which 43.87% reside in the city of Queretaro.

The municipality with the lowest number of inhabitants is San Joaquin with only 8,865 residents/people followed by Arroyo Seco, Peñamiller and Landa de Matamoros, each of which do not exceed 20,000 inhabitants. Corregidora, El Marques, San Juan del Rio, Queretaro and Ezequiel Montes have the highest growth rate. Agriculture and livestock have been traditionally important for the state, and while it only provides about four percent of the state's GDP, it employs a far larger percentage of the population, it also continues to be the foundation of the economy in many rural areas. 30.48% of state land is used for agriculture, however, most farmlands are seasonal, limited to the rainy season and only 18.51% is irrigated. (Figure 3). Livestock production is also important . It consists of cattle, pigs, sheep, goats, horses and domestic fowl and chicken. The largest producers of livestock in the state are Jalpan, Cadereyta, San Juan del Río and Querétaro (SEDEA, 2014). There are also some forestry, textile and tourism activities in some regions. The urban area consists of only 2.52% of state land. The main urban areas are Queretaro, San Juan del Río y Corregidora. The main industrial parks are located in these areas and employ most of the industrial workers of the state. The area also has productive irrigated farms of crops and livestock.

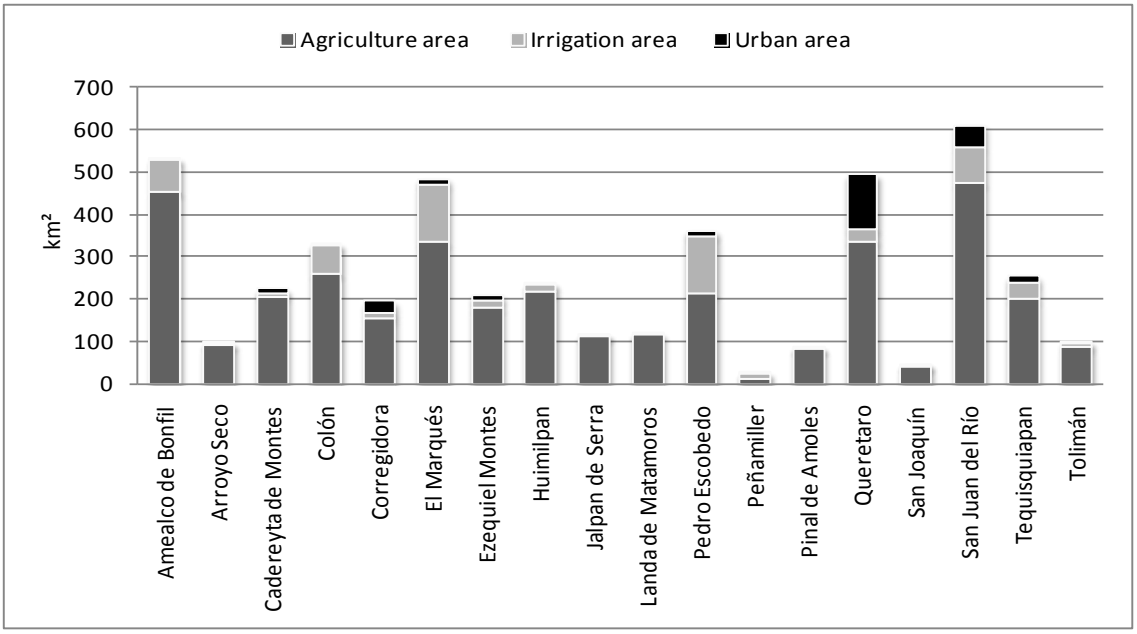


Figure 3. Main land uses for Queretaro State.

Results indicate that Pinal de Amoles, San Joaquìn, Landa de Matamoros, Peñamiller, Toliman and Amealco are the municipalities with the highest percentages of households without electricity (Figure 4). Accordingly, infant mortality, as the number of deaths of children under one year of age per 1000 live births, has the highest rates in these municipalities. There is also a high correlation with the lowest literacy rates which are observed in Amealco, Landa, San Josquin and Pinal de Amoles.
Per capita income, as a measure of population standard of living is expressed in terms of a commonly used international currency such as the United States dollar. This helps to compare development status across the state of Queretaro. It is important to note that income inequality is very high in the state of Queretaro with more than half of the municipalities of the state having an income 85% below the metropolitan area. Although urbanised municipalities have gone through a process of economic growth, in most urban areas there is a high level of poverty, especially in those areas where electricity is scarce. The analysis, carried out based on the statistical data, highlight the fact that employment in rural areas is mainly provided by agriculture, there exists a lower level of education and health, furthermore there is evidence of lower wages and few opportunities of work in the secondary and tertiary sector of the economy.

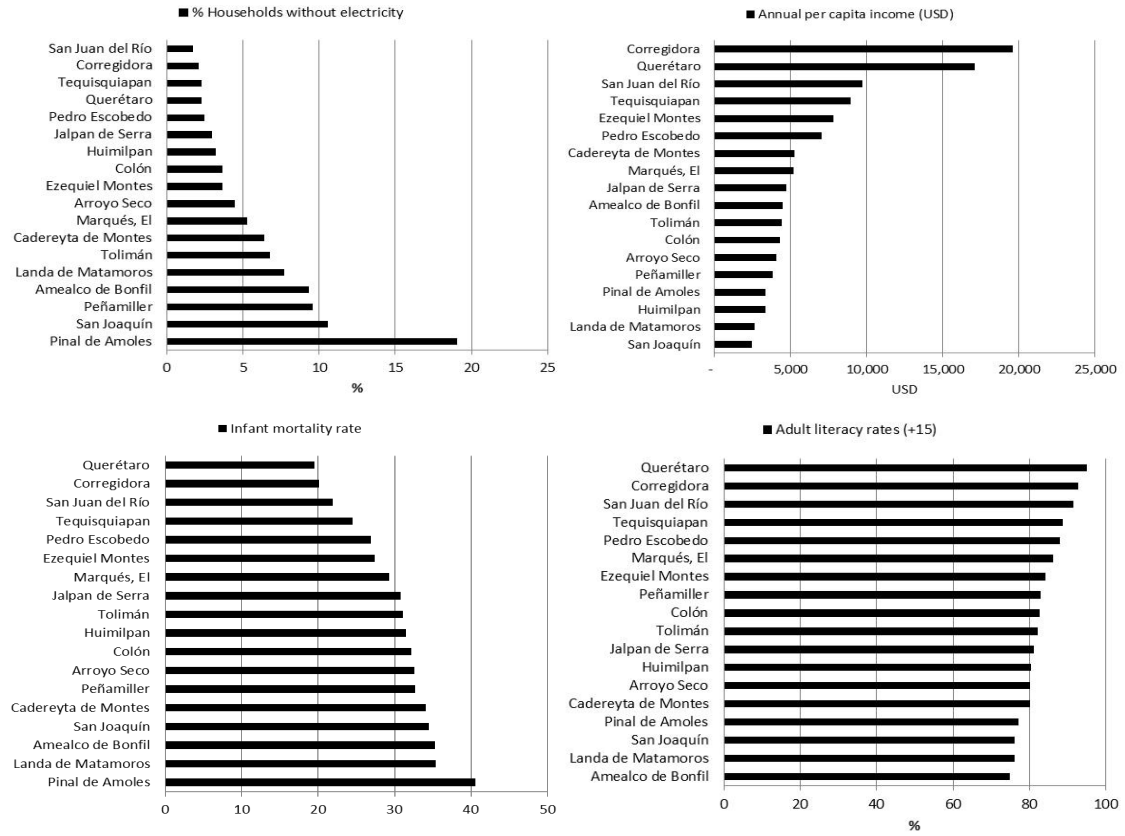


Figure 4. Comparison of availability of electricity against development indices in Queretaro. Source: INEGI, 2010.

DISCUSSION AND CONSLUSION

Energy consumption is one of the indicators that is studied to identify the level of economic development of any settlement. Availability of energy can stimulate employment in all economic sectors and consequently is a necessary condition for the reduction of poverty (OECD, 2009). In order for poverty to be reduced, productivity and earnings must increase sufficiently to boost the income of poor people. Rural electrification has a contributory value for growth, as it leads to increased productivity and is not an end in itself. Thus rural electrification schemes may go beyond power output, and can lead to long-term positive development when designed properly (Pirlogea and Cicea, 2012). As rural electrification gradually becomes more commercial the sector moves towards a market-based approach reducing poverty (Mustonen, 2010). Economic growth is sustained through consumption, which directly leads to production, progress and finally to development.

According to Sathaye et al. (2011) renewable energy plays an important role in increasing access to technologies. The connection between renewable energy and economic growth has been described Tajibaeva (2012); (Pirlogea and Cicea) 2012; Nautiyal and Varun (2012).

In Mexico many factors have impeded progress toward sustainable energy for all. For example, regulatory policies and practices protecting existing sources of energy, the high initial costs of clean energy technologies, and the lack of the technical capacity and financial schemes (SENER and AIE, 2011) .

Rural areas in Queretaro are facing poverty caused by the existence of an inefficient employment structure based mainly on agriculture, low levels of employment in

services and industry, low labour productivity and a low level of the employed population with tertiary education etc. Under these circumstances, in order to have a sustainable economy with high levels of employment, productivity and social cohesion it is desired to adopt and implement active measures that should ensure growth in employment (Herman and Georgescu, 2012).

Queretaro is geographically located in an area with a great amount of solar radiation. Nevertheless, the legacy of abundant local hydrocarbons has led to ignore other sources of energy available such as solar energy. Solar energy can contribute to ensure a fair and equal access to energy resources for everyone; improving the standard of living in rural areas through its impact on education, health and poverty and leading to the development of other sectors. Therefore, economic growth can be stimulated by encouraging the use of solar energy which may lead to the use of technologies which could induce productivity in the secondary and tertiary sectors. This in turn will lead to an increase in employment and consequently the income of poor people. For example, in Tequisquiapan solar dehydrators have been used to dry chilli and different fruits instead of the traditional method (open air). This process not only saves time but also is more hygienic, diminishes spoiling by precipitation and allows for better returns. Hence, it is important to develop policies and regulations that promote the use of renewable energy resources in order to reduce energy inequity, to provide the most basic of human needs, to contribute to human development, and the reduction of the poverty.

It is concluded that by studying the relationship between energy and human development, it is possible to promote solar energy as a tool to provide rural areas with a healthy lifestyle, better education and a better standard of living.

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REFERENCES

INEGI (2010) *Population and Housing Census 2010. Main results by locality*.Instituto Nacional de Estadística y Geografía. http://www .inegi.org.mx/est/contenidosproyectos/ ccpv/cpv2010/pub_y_prod/default.aspx?t=28097. Consultado el 29 de julio 2014.

ISES and Dieter H (2005) *Un Futuro Para el Mundo en Desarrollo Basada en las Fuentes Renovables de Energía*. *White Paper*. International Solar Energy Society, Freiburgo, Alemania.

Herman E, Georgescu MA (2012) Employment strategy for poverty reduction. A Romanian perspective. *Procedia- Social and Behavioral Science* 58:406-415.

Meisen P. y Krumpel S (2009) *El potencial de América Latina con referencia a la energía renovable.* GENI Global Energy Network Institute. http://www. geni.org/ globalenergy/library.

Mustonen, S.M (2010) Rural energy survey and scenario analyses of village energy consumption: a case study in Lao People's Democratic Republic. *Energy Policy* 38, 1040–1048.

Nautiyal,H.,Varun (2012) Progress in renewable energy under clean development mechanism inIndia. *Renewable and Sustainable Energy* Reviews16: 2913–2919.

Pirlogea, C., Cicea, C. (2012) Econometric perspective of the energy consumption and economic growth relation in European Union. *Renewable and Sustainable Energy Reviews* 16: 5718-5726

Sathaye, J., O. Lucon, A. Rahman, J. Christensen, F. Denton, J. Fujino, G. Heath, S. Kadner, M. Mirza, H. Rudnick, A. Schlaepfer, A. Shmakin (2011) *Renewable Energy in the Context of Sustainable Development. In IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation* [O. Edenhofer, R. Pichs-Madruga, Y. Sokona, K. Seyboth, P. Matschoss, S. Kadner, T. Zwickel, P. Eickemeier, G. Hansen, S. Schlomer, C. von Stechow (eds)], Cambridge University Press, Cambridge, United Kingdom .

SENER and AIE (2011) *Energy efficiency indicators in Mexico: five sectors, five challenges.* Secretaria de Energía y Agencia Internacional de Energía, México.

Sharif I. y Mithila M (2013) Rural Electrification using PV: the Success Story of Bangladesh. *Energy Procedia*. **33**: 343-354.

Tajibaeva, S.L.(2012) Property Rights, Renewable Resources and Economic Development, Environmental and Resource Economics 51: 23-41.

United Nation (2011) *Sustainable Energy for All*. New York.

World Bank (2015) *Ending Poverty and Sharing Prosperity.* Global Monitoring Report 2014/2015. A joint publication of the World Bank Group and the International Monetary Fund. Washington DC.

WHO (2011) *Sustainable energy for all. A Vision Statement by Ban Ki-moon, Secretary-General of the United Nations*. World Health Organization, United Nations, New York, USA.

Prediction of Asbestos Slate Waste Amount in City Unit after Earthquake: Focusing on Gyeongju City, South Korea

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Abstract

This study seeks to develop a prediction formula for asbestos slate waste amount after earthquake by unit of city as the basic research for post-earthquake asbestos waste disposal plan. And this study seeks to predict asbestos slate waste amount generated by residential structures in Gyeongju city after earthquake by using the prediction formula. As a result, a prediction formula for post-earthquake asbestos slate waste amount was developed based on the review of the post-disaster debris amount estimation method of Ministry of the Environment Government of Japan and Standard of Construction Estimate of Korea Institute of Civil Engineering and Building Technology. Asbestos slate residential structures in Gyeongju city numbered 6,157 in total, and maximum amount of asbestos slate waste from residential structures in Gyeongju city after earthquake that measured 6.7 on the Richter scale was 268,360kg.

Keyword : Asbestos Slate, Earthquake, Waste

1. Introduction

1.1 Background and purpose of the research

Asbestos is a natural mineral with excellent thermal and electricity insulation properties as well as strong tolerance against tension and fire.[1)2)] Since the 20th century, asbestos has been widely utilized in architectural structures for fire prevention and heat insulation.[3)] Asbestos, however, is a fatal material possibly causing lung cancer, malignant mesothelioma and pulmonary asbestosis.[4)] After the harms of asbestos were revealed, the International Agency for Research on Cancer (IARC) has designated asbestos as a Group 1 carcinogen.[5)] Some advanced countries including the US and Japan, fundamentally prohibited the use of asbestos in the 1990s. And global use of asbestos declined rapidly.[6)]

Since asbestos is fatal to human body, special treatment is necessary to remove and dispose of asbestos-containing materials from structures. For this reason, most of the countries banning the use of asbestos have established laws and regulations applicable to asbestos-containing material removal and disposal to manage the process specifically. However, in the event of large-scale earthquakes such as the great east Japan earthquake, a lot of asbestos waste is generated at once and its amount is too large to be properly managed under any normal measure. It is necessary to establish plans to deal with post-earthquake asbestos waste.[7)] Nevertheless, such post-earthquake asbestos waste disposal plan is globally absent. Also study or discussion on the asbestos waste amount after earthquake has not been made at all, which could be the basic data for post-earthquake asbestos waste disposal plan.

In this recognition, this study seeks to develop a prediction formula for asbestos slate waste amount after earthquake by unit of city as the basic research for post-earthquake asbestos waste disposal plan. And by using the developed equation, this study seeks to predict amount of asbestos slate waste from residential structures in Gyeongju city after earthquake.

1.2 Method and procedure of research

This study considered the post-disaster debris amount estimation method of Ministry of the Environment Government of Japan and Standard of Construction Estimate of Korea Institute of Civil Engineering and Building Technology to develop a prediction formula of post-earthquake asbestos slate waste amount in city unit. And by using the developed equation,

the amount of asbestos slate waste from residential structures in Gyeongju city was predicted. The study follows the procedures in Figure 1.

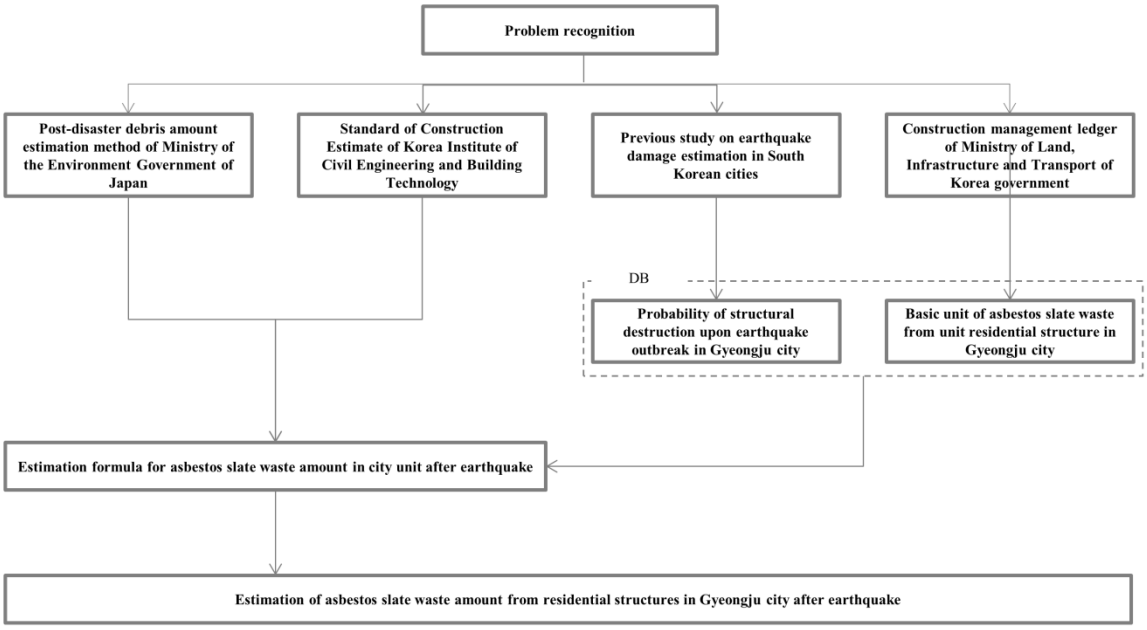


Figure 1. Procedure of the research

2. Theoretical consideration

2.1 Formula to calculate the area of slate roof with the building area

In Korea, asbestos slate was produced until 2006 by KCC and Byucksan, a South Korean construction material manufacturer.[8)] Its main ingredients are cement and white asbestos accounting for about 10%. Residential structures used small-corrugated slate while warehouses or plants used large-corrugated slate. The general specifications of asbestos slate used in Korea are as in Table 1.

Table 1. General specifications of asbestos slate used in Korea

Classification		width (cm)	length (cm)	area (m^2)	Weight per unit area (kg/m^2)	Asbestos content
small-corrugated slate	No.6	720	1,820	13,104	10.5kg	10%
	No.7	720	2,120	15,266		
	No.8	720	2,420	17,424		
large-corrugated slate	No.6	960	1,820	17,472		
	No.7	960	2,120	20,352		
	No.8	960	2,420	23,232		

The Standard of Construction Estimate of Korea Institute of Civil Engineering and Building Technology stated, in the section of joining slate in roof and gutter construction, to use lap joint to overlap 9.5cm perpendicular to the frame and 15cm towards the frame in small-framed slate construction.[9] Thus, the slate roof area can be calculated by adding the general area, horizontal overlapping area and vertical overlapping area and then subtracting the horizontal and vertical cross area. Based on this the additional rate graph was produced as in Figure 2.[10] Formula to calculate the area of slate roof with the building area is as follows

$$A_s = A_B \times K \times R$$

Where,

A_s = Area of slate

A_B = Building area

K = Roof drainage according to inclination (1.3-1.6)

R = Additional rate by slate (1.16)

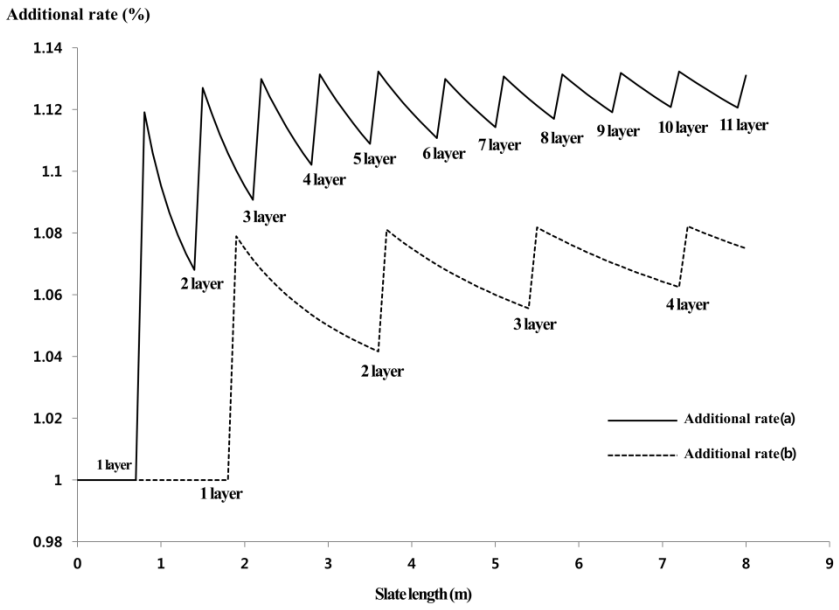


Figure 2. Additional rate by slate According to length (a) and width (b)

2.2 Literature review on the post-disaster debris amount estimation method of Ministry of the Environment Government of Japan

As Japan is located in the circum-Pacific orogenic zone, the country has stricken by lots of huge-scale earthquakes and has performed diversified studies in this regard. Japan's Environment Ministry estimated the amount of post-earthquake debris (combustible debris, incombustible debris, concrete waste, metal waste, tsunami sediments) to appropriately respond to a lot of debris generated by earthquake. [11] The ministry estimates such amount in the manner shown in Figure 3.

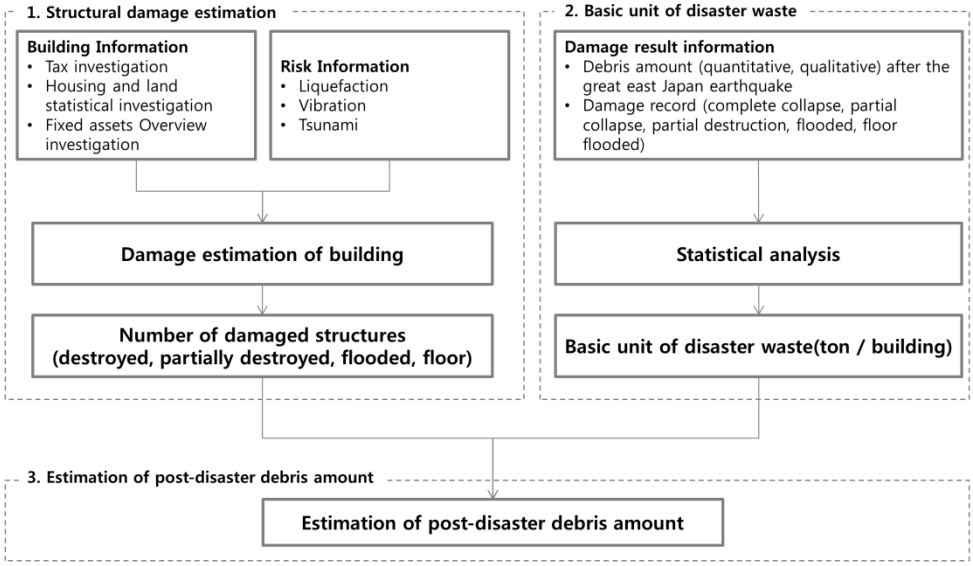


Figure 3. Post-disaster debris amount estimation method of Ministry of the Environment Government of Japan

The guideline about the plan for asbestos dispersion prevention in the event of disaster occurrence of the Environment Ministry recommends to establish asbestos waste disposal plan for proper response against large amount of asbestos waste. However, the ministry estimates only the post-disaster debris amounts of combustible debris, incombustible debris, concrete waste, metals and tsunami sediments.

2.3 Literature review on earthquake damage estimation in South Korean cities

Ik-Bum Gang and Jung-Ho Park utilized the HAZUS, a natural disaster estimation and assessment system, to research about earthquake damages in the Chungnam region of South Korea. [12] In their study, the researchers investigated Korea's earthquake record and instrumental earthquake data while calculating the max acceleration value in the underground basement based on deterministic and probabilistic method. For the purpose of their study, the researchers created a virtual earthquake in Hongseong, South Korea, and estimated earthquake damages in the Chungnam region. Suyoung Gang, et al., used the HAZUS, a natural disaster estimation and assessment system, to perform a simulation of earthquake loss estimation regarding the earthquakes occurred in the Gyeongju city. [13] The study reproduced the magnitude 6.7 earthquake experienced in AD 779 in the area and estimated damages in surrounding areas including Gyeongju city, Pohang city and Ulsan metropolitan city. Chang-hwi Hwang utilized MAEViz, an earthquake damage assessment system, and performed the modelling and digitization of uncertain earthquake damage. [14] In the study, about 300,000 building structures in the Gangnam region, Seoul, South Korea, were examined for their earthquake risk. The previous studies on earthquake damage estimation in South Korean cities are summarized as in Table 2 below.

Table 2. Previous studies on earthquake damage estimation in South Korean cities

Classification	Ik-Bum Gang and Jung-Ho Park (2002)	Suyoung Gang, et al. (2008)	Chang-hwi Hwang (2013)
Software	HAZUS	HAZUS	MAEViz
Region	Chungcheongnam-do, Korea	Gyeongju-si, Korea	Gangnam-gu, Seoul, Korea
virtual Scenario	A magnitude 6.0 earthquake occurred in Hongseong-gun, Chungcheonnam-do (epicenter : 10km deep underground)	A magnitude 6.7 earthquake occurred in Gyeongju-si, Gyeongsangbuk-do (epicenter : 10km deep underground)	A magnitude 6.3 earthquake occurred in Gwangju-si, Gyeongsangbuk-do (epicenter : 10km deep underground)
Structural damage	(according to structural use) Residential structures: - high structural damages in Hongseong-gun, Yesan-gun and Boryeong-si Commercial structures: high structural damages in Hongseong-gun, Yesan-gun and Boryeong-si	(according to ground classification) Normal rocks - 0.38% of the total houses were completely destroyed. Soft rocks -1.49% of the total houses were completely destroyed. Firm sand ground - 3.46% of the total houses were completely destroyed.	(according to structural use) Higher damage in generation facility, waste disposal facility, hazardous material treatment facility (according to building structure) High damage in buildings with wooden structure

3. Prediction of asbestos slate waste amount in city unit after earthquake

3.1 Development of a prediction formula for asbestos slate waste amount in city unit after earthquake

To develop a prediction formula for asbestos slate waste amount in city unit after earthquake, this study reviewed the Standard of Construction Estimate of Korea Institute of Civil Engineering and Building Technology in Section 2.1 as well as the post-disaster debris amount estimation method of Ministry of the Environment Government of Japan in Section 2.2. The prediction formula developed in this study is as follows.

$$A_{ASW} = U_{AS} \times N_D$$

$$U_{AS} = (A_{AS} \times K \times R \times W_{AS})/N_{AS}$$

$$N_D = P_D \times N_{AS}$$

Where,

A_{ASW} = Asbestos slate waste amount after earthquake

U_{AS} = Basic unit of asbestos slate waste from unit structure

N_D = Number of asbestos slate structures destroyed by earthquake

A_{AS} = Total area of asbestos slate structures

K = Roof drainage according to inclination (1.3-1.6)

R = Additional rate by slate (1.16)

W_{AS} =Weight per unit area

N_{AS} = Total number of asbestos slate structures

P_D = Probability of structural destruction in earthquake

3.2 Estimation of basic unit of asbestos slate waste from unit residential structure in Gyeongju city

For this research experiment, Gyeongju city was selected. And to estimate the basic unit of asbestos slate waste from unit residential structure in Gyeongju city, the construction management ledger containing all information of Korean building was analyzed. [15)]

As a result, Gyeongju city was found to have a total of 70,396 building structures with total building area of 13,229,555m^2. Of the whole structures, residential structures were 46,323, accounting for 65.80% of the total structures. In terms of areas, the residential structure area is 8,039,430m^2, accounting for 65.80% of the total structure area. The asbestos slate residential structure in Gyeongju city numbered 6,157 in total (8.75% of the entire structures in Gyeongju city) and its total area is 398,612 m^2 (3.01% of the total structure area of Gyeongju city).

To estimate the total amount of asbestos slate in the city, the Standard of Construction Estimate of Korea Institute of Civil Engineering and Building Technology was applied herein as stated in Section 2.1. The total asbestos slate amount in Gyeongju city ranged from 6,311,622kg to 7,768,150kg. And the basic unit of asbestos slate waste from unit residential structure that is produced by dividing the total asbestos slate waste amount by the number of asbestos slate structures ranged from 1,025kg to 1,261kg.

3.3 Prediction of asbestos slate waste amount from residential structures in Gyeongju city after earthquake

The prediction formula described in Section 3.1 of this study was utilized to predict asbestos slate waste amount generated by residential structures in Gyeongju city during earthquake. In the prediction formula, for the probability of structural destruction, the previous studies on Gyeongju regional earthquake damage estimation. The present study results are described in Figure 4.

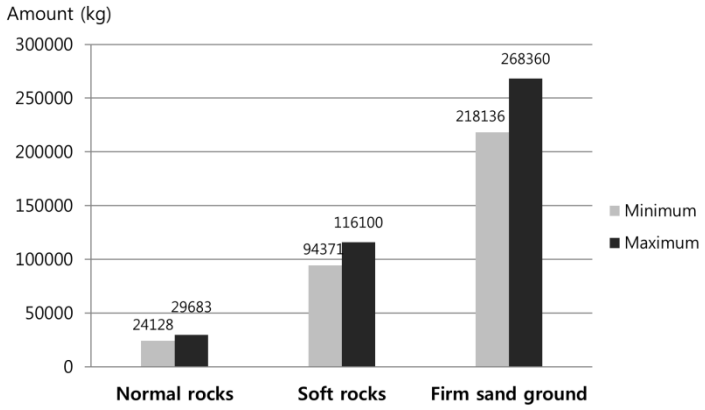


Figure 4. Amount of asbestos slate waste from residential structures in Gyeongju city after earthquake

As for the underground conditions, on normal rocks, the asbestos slate waste amount from residential structures in Gyeongju city after earthquake that measured 6.7 on the Richter scale was found to be from 24,128kg up to 29,683kg. On soft rocks, asbestos slate waste amount was predicted from 94,371kg to 116,100kg and from 218,136kg to 268,360kg, on firm sand ground.

4. Conclusion

This study seeks to develop a prediction formula for post-earthquake asbestos slate waste amount in city unit. And this study seeks to predict asbestos slate waste amount generated by residential structures in Gyeongju city after earthquake by using the prediction formula.

First, the prediction formula for post-earthquake asbestos slate waste amount was developed based on the review of the post-disaster debris amount estimation method of Ministry of the Environment Government of Japan and Standard of Construction Estimate of Korea Institute of Civil Engineering and Building Technology.

Second, asbestos slate residential structures in Gyeongju city numbered 6,157 in total, and maximum amount of asbestos slate waste from residential structures in Gyeongju city after earthquake that measured 6.7 on the Richter scale was 268,360kg.

This study is significant in predicting asbestos slate waste amount generated in a city after earthquake at a point when there is no study or discussion on post-earthquake asbestos waste amount prediction in the world. Also in planning for post-disaster asbestos waste, this study is expected to be great help as the basic research.

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References

1. Li, J., Dong, Q., Yu, K., Liu, L., 2014. Asbestos and asbestos waste management in the Asian-Pacific region: trends, challenges and solutions. J. Clean. Prod., 218-226.
2. Sim, M.R., 2013. A worldwide ban on asbestos production and use: some recent progress, but more still to be done. Occup. Environ. Med. 1, 1-2.
3. Bourgault, M., Gagné, M., Valcke, M., 2014. Lung cancer and mesothelioma risk assessment for a population environmentally exposed to asbestos. Int. J. Hyg. Environ. Health. 2–3, 340-346.
4. Steenland, K., Stayner, L., Silica, asbestos, man-made mineral fibers, and cancer, Cancer Causes & Control, vol. 8, no. 3, pp. 491-503, 1997.
5. Bahk, J., Choi, Y., Lim, S., Paek, D., 2013. Why some, but not all, countries have banned asbestos. International journal of occupational and environmental health. 2, 127-135.
6. Virta, R.L., 2006. Worldwide asbestos supply and consumption trends from 1900 through 2003, US Geological Survey Reston, VA.
7. The Ministry of Environment of Japanese Government, 2007. Guidelines about the Plan for Asbestos Dispersion Prevention in the Event of Disaster Occurrence. The Ministry of Environment of Japanese Government.
8. The Ministry of Environment of Korean government, 2009. Asbestos Management Catalogue. The Ministry of Environment of Korea government.
9. The Institute of Civil Engineering and Building Technology, 2014. Standard of construction estimate. The Institute of Civil Engineering and Building Technology
10. Kim, Y., Hong, W., Son, B., 2013. Analysis of Generation Pattern and Generation Amount of Asbestos Containing Material, When Demolition of Buildings in the Housing Redevelopment District. Journal of Architectural Institute of Korea Planning & Design. 7, 317-324.
11. The Ministry of Environment of Japanese Government, 2013. Post-disaster debris amount estimation method. The Ministry of Environment of Japanese Government.
12. Kang, I., Park, J., 2002. The seIsrnlc Hazard study on Chung-Narn ProvInce using HAZUS. Journal of Korean Society of Hazard Mitigation. 2, 73-83.
13. Kang, S., Kim, K., Suk, B., Yoo, H., 2008. A Simulation of Earthquake Loss Estimation for a Gyeongju Event. Journal of Korean Society of Hazard Mitigation. 3, 95-103.

14. Hwang C.H., 2013. A Study on Urban Damage Assessment by Earthquake Damage Assessment System, Seoul-Venture University, Doctor's thesis.

15. The Ministry of Land, Infrastructure and Transport of Korean government, 2014. Construction management ledger. The Ministry of Land, Infrastructure and Transport of Korea government.

PROGRESS, PRIORITIES AND PROJECTIONS OF THE SOUTH AFRICAN GOVERNMENT GREENHOUSE EMISSIONS OBJECTIVES: 1994-2050

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PROGRESS, PRIORITIES AND PROJECTIONS OF THE SOUTH AFRICAN GOVERNMENT GREENHOUSE EMISSIONS OBJECTIVES: 1994-2050

Climate change or global warming is the "biggest environmental and humanitarian crisis of our era" (Adam, 2013a:1). Climate change is "changing our economy and communities in diverse ways. Scientists warn that if we do not aggressively reduce the emission of the greenhouse gases (GHGs) which are responsible for climate change now, the results will inevitably be catastrophic" (Lakewood, 2014:Internet sources; Adam, 2013b:Internet source). The United Nations has spearheaded various initiatives to combat climate change and a number of global conventions have resulted from these initiatives. South Africa is one of the many signatories to a number of international conventions on climate change. Using a critical analysis and assessment of the available publications on the topic at the time of writing, this qualitative research aims to answer this research question: What has South Africa achieved in terms of the reduction of GHGs that are responsible for the destruction of the Ozone-layer and global warming since it became the signatory of these international conventions? In an attempt to answer this question, this analysis also aims to highlight the most significant economic sector, industries and types of Ozone-layer depleting gases which South Africa should focus on in order to make a significant contribution to the global fight against climate change.

Keywords: Climate change, carbon emissions in South Africa, greenhouse gases, global warming**.**

INTRODUCTION

"Recently, global warming has been getting some attention in the news" (Leiserowitz & Smith; 2010a&b:8). According to these authors, "Global warming refers to the idea that the world's average temperature has been increasing over the past 150 years, may continue to increase even more in the future if no action is taken to stop it, and that the world's climate may change as a result (Leiserowitz & Smith; 2010a&b:8). However, the most elaborate layman's definition of the term global warming is perhaps provided by the National Academy of Sciences (2012a:1) which states:

> "*Climate is commonly thought of as the expected weather conditions at a given location over time. People know when they go to New York City in winter, they should take a coat. When they visit the Pacific Northwest, they take an umbrella. Climate can be measured at many geographic scales—for example, cities, countries, or the entire globe - by such statistics as average temperatures, average number of rainy days, and the frequency of droughts. Climate change refers to changes in these statistics over years, decades, or even centuries*" (Also National Science Academy Internet Source).

Therefore, based on the fact that climate changes forces humans to take a certain level of precaution to protect themselves from the elements, it can be deduced that 'global warming is an increase beyond man's tolerance of the temperature in the atmosphere' (Akoptaire, 2007 cited in Emetu, 2007:1). According to the National Geographic "Scientists often use the term 'climate change instead of global warming' and sometimes use the two terms interchangeably, thought "the former is broader than the latter: the globe is on average heating up, which has more impacts than just warmer temperatures" (Anderson & Bausch, 2006:7; National Geographic Internet Source; also cited in Emetu, 2007:1). The use of the term climate change by the UNEP- Intergovernmental Panel on Climate Change (IPCC) refers to "any change in climate over time, whether that change is due to natural variability or as a result of human activity (anthropogenic)" (IPCC Assessment Report, 2007:2. According to the online Merriam-Webster dictionary, "the term '*anthropogenic'* (from the Greek word '*anthropos'* meaning human/mans and '*genic'* meaning caused or produced by" (see http://www.merriam-webster.com/). Thus the term anthropogenic, as used in this article, refers to the fact that any viewed climate changes are not just due to natural variability but that greenhouse gas (*hereafter referred to as GHG*) emissions that have an influence on the climate is often due to "human activities" (Anderson & Bausch, 2006:7; Adam, 2013b Internet Source). Based on these definitions, it can be deduced that climate change is a result/product of global warming and that global warming is a result of the GHG emissions resulting from "natural and anthropogenic activities" (Shah, 2013). That is, human's and nature's activities are emitting the GHGs which are responsible for climate change in general (which could include global warming or global cooling) (Karl & Melillo, 2009; Leiserowitz & Smith, 2010:67; Adam 2013b Internet Source). The result/impact of climate change (including global warming as well as global cooling) include all the natural disasters/calamities the world is facing today and is likely to continue to face in the future if no action is taken today to stop the production and emission of GHGs from natural and human activities which are responsible for global warming (Adam 2013b). However, while the focus is on global warming, global cooling is also a problem because "*as the earth's average temperature climbs (global warming), winds and ocean currents move heat around the globe in ways that can cool some areas and warm others, thus changing the climate (weather, amount of rain and snow falling, wind, temperature etc.) in those areas*" (National Geographic Internet Source; Emetu, 2007:3; Earth Wealth, 2010; Bookman, 2012:2). Thus, the use of the term global warming throughout this article is not to ignore the fact that global

cooling is also a problem, but because of consistency. The term global warming is preferred because, if there was no problem for global warming in one or more places on Planet Earth, then there is a great chance that there would be no problem for global cooling in the others. For example in his article '*To The Horror Of Global Warming Alarmists, Global Cooling Is Here*' Ferrara (2013:2) argues that 'Faith in Global Warming is collapsing in formerly staunch Europe following increasingly severe winters which have now started continuing into spring'. Literature has shown that "any problem is best solved if its root causes are first eliminated" (Bitting, n.d.:1). This is because "if you only fix the symptoms – what you see on the surface – the problem will almost certainly happen again, which will lead you to fix it, again, and again, and again" (Bitting, n.d.:1). Therefore, as Bitting (n.d.:1) further argues, 'if, instead, you look deeper to figure out why the problem is occurring, you can fix the underlying systems and processes that cause the problem'. Thus in order to fight global warming, one needs to know first what its causes/drivers are and then deal with them head on. The following section attempt to provide the answer to this and other questions.

METHODOLOGY, SCOPE AND CONCEPTUAL APPROACH

The methodology adopted in this article essentially follows a qualitative approach in order to understand what South Africa has achieved in terms of the reduction of GHGs that are responsible for the destruction of the Ozone-layer and global warming since it became a signatory of the international conventions dealing with GHG emission and Ozone-layer depleting gases. The article attempts to trace the key arguments of scholars who have over the past few decades postulated the formulation and re-formulation of a body of ideas for the causes and impact of greenhouse emissions on climate change and global warming. In this article, such systematic analysis and critique essentially takes the form of document and literature analysis as well as theoretical postulation in an attempt to explain the development of the subject matter and unravel its implications for South Africa. In terms of the literature review, the objective was not to compile a bibliography but rather to identify references that focus on the key issues raised by the author. However, while the author acknowledged that global warming is a global problem and that the impact of greenhouse emission in one country (such as South Africa) could have devastating effects far beyond the South African borders; the main focus of this article is generally on the progress made by the South African government in terms of its greenhouse emissions objectives. Therefore, while the global and continental effects of greenhouse emissions are accommodated in the analysis and inferences are drawn from different countries and continents as much as the analysis allows, the main focus is on South Africa.

CLIMATE CHANGE: CAUSES AND EFFECTS

Literature shows that climate change (in terms of global warming and cooling) has happened in the past, and long before humans were around (Union of Concerned Scientists, 2009:1). Many factors (often called "climate drivers") can influence earth's climate (Ekwurzel, Cole, Frumhoff & Shaw, 2009:1). Some of these climate drivers such as changes in the sun's intensity and volcanic eruptions are beyond human causes and control but others such as the production and emission of heat-trapping gases (also known as GHG) in the atmosphere are partly in human control (Union of Concerned Scientists, 2009:1). For example, while the year 2011 was reported by the World Bank to be the'fifth consecutive year flaring of gas associated with oil production has registered a drop worldwide: between 2005 and 2010, gas flaring decreased by 22% from 172 billion cubic meters (bcm) to 134 bcm' it was reported at the same time that approximately 140-150 billion cubic meters (bcm) of natural gas is flared

into the atmosphere annually (World Bank, 2011:1). According to Ebrahim & Friedrichs (2013:1, citing calculations by the World Bank), the current levels of natural gas flaring is "equivalent to three quarters of Russia's gas exports, or almost one third of the European Union's gas consumption". While gas flaring roughly accounts for 1% of global carbon emission, it remains a regrettable practice from an economic viewpoint because a valuable resource is wasted and even more regrettable from an environmental perspective because 140-150 bcm of flared natural gas translates into 270-290 million tons of $C0_2$ emissions per year (Ebrahim & Friedrichs, 2013:1).

Ten countries, namely Russia and Nigeria are often cited as the largest flaring culprits, along with Iran, Iraq, US, Algeria, Kazakkhstan, Angola, Saudi Arabia and Venezuela (Ebrahim & Friedrichs, 2013:1). However, natural gas flaring is not the only, or even the biggest culprit as far as global warming is concerned. According to the Nature Conservancy, an organisation whose mission is to preserve the plant, animals and natural resources that represent the diversity of life on earth "Climate change, more commonly known as global warming is caused by the natural, [but mostly] also anthropogenic emission of heat trapping gases, produced by vehicles, power plants, industrial processes and deforestation" (World Nuclear Association (2013:3). In fact, "the Fourth Assessment Report of the Intergovernmental Panel on Climate Change" (UNED-IPCC) went as far as stating: "it is a greater than 90% certainty that emissions of heat-trapping gases from human activities (as opposed to from natural mechanisms) have caused most of the observed increase in globally averaged temperatures since the mid-20th century" (UNED-IPCC, 2007, also cited in Leiserowitz & Smith, 2010:67). This view is also supported by Ekwurzel et al (2009:1) who argue that "When all the natural and human-induced climate drivers are compared to one another, the dramatic accumulation of carbon from human sources is by far the largest climate change driver over the past half century". In his 2013 article "*Not much climate change doubt, science says*" Peter Hannam, an Environment Editor, of The Sydney Morning Herald wrote that "More than 97% (97.1% to be exact) of climate scientists accept that humans are causing climate change and only about 1.9% reject that view" (Hannam, 2013:1, Clarke, 2014:2). These figures, according to Clarke (2014:2) are "the finding of a University of Queensland-led study that surveyed the abstracts of almost 12,000 scientific papers from 1991-2011 and claims to be the largest peer-reviewed study of its kind" (see also Wind in the Bush, 2014: Internet Source).

The above reports clearly show that, while "the popular media gives the impression that there is still argument over the reality of Human induced climate change, … the peer-reviewed literature of the climate scientists is almost 100% unanimous" on the fact that "human activities, especially the burning of fossil fuels (coal, oil, and gas), are responsible for most of the climate change currently being observed" (National Academy of Sciences, 2012b:2; Adam, 2013b: Internet Source; Petes Place: Internet Source; Wind in the Bush, 2014: Internet Source; Clarke, 2014:2; National Science Academy: Internet Source). The findings in the literature are backed by scientific evidence which shows that 'significant increases of Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide potent (or GHGs) have accumulated after the industrial revolution (early 1750)' (Wallington, Srinivasan, Nielsen & Highwood, 2013:7). "The analysis of the ice samples show that the atmosphere contained 295ppm of CO_2 in 1910, 315 ppm in 1950 and 365ppm in 1998 to 379 ppm3 in 2005" (UNED-IPCC, 2007:2; Tillmann& Siemann, 2011). The acronyms "ppm (parts per million) or ppb (parts per billion, 1 billion = 1,000 million) is the ratio of the number of GHGs molecules to the total number of molecules of dry air" (UNED-IPCC, 2007:3; IPCC Fourth Assessment Report: Climate Change 2007 Internet Source; Stocker et al., 2013:ii). For

example, “500 ppm means 500 molecules of a GHG per million molecules of dry air” (UNED-IPCC, 2007:3; IPCC Fourth Assessment Report: Climate Change 2007 Internet Source; Stocker et al., 2013:ii). Such increase constitutes “nearly 30% of CO_2 concentration in the atmosphere, more than double the methane gas, and a 15% rise in nitrous oxide concentration” (The National Academy of Sciences, 2012a&b:3). There is a view that “the atmospheric concentration of carbon dioxide in 2005 exceeded by far the natural range over the last 650,000 years (180 to 300 ppm) as determined from ice cores” (UNED-IPCC, 2007:2; Filho & Manolas, 2012:32; 2007, Stocker et al., 2013:ii). The annual carbon dioxide concentration growth-rate was “larger during the last 10 years (1995 – 2005 average, 1.9 ppm per year), than it has been since the beginning of continuous direct atmospheric measurements (1960 – 2005 average: 1.4 ppm per year)” (UNED-IPCC, 2007:2; IPCC Fourth Assessment Report 2007: Internet Source; Biggs, 2009:iv; Stocker et al., 2013). The fact that most GHG emission happened after the industrial revolution leaves no doubt that the increase of GHG causing climate change and global warming is generally (though not solely) a result of human activity (Adam 2013b Internet Source). “With the eventual large scale burning of coal, oil and gas - literally fossil fuels (coal, oil and natural gases), that followed the industrial revolution, the entombed remains of plants and animals that lived a million years ago, the atmospheric levels of CO_2 accelerated” (Emetu, 2007:20; Audubon Internet Source). Literature also suggests that “Carbon Dioxide (CO_2) remain the biggest contributor to the global warming problem the world is facing” (Audubon Internet Source). According to Swilling (2012:22) “the main source of CO_2 emissions is the energy sector- which has been generating 89.7% of total CO_2 emissions since 1990 and 91.1% in 1994”. Like most researchers and scientists on the climate change, Swilling (2012:22) also argues that “the high CO_2 emissions levels observed between 1990 and 1994 was directly connected to the high energy intensive period that followed the industrial revolution”. “Most scientists and researchers on climate change argue that burning coal is the dirtiest and biggest contributor of carbon dioxide and GHG emission of all fossil fuels” (http://www.123helpme.com/global-warming-causes-and-solutions-preview.asp?id=216029). Currently “a whopping 86% of energy used worldwide is still coming from fossil fuel combustion” (The Centre for Biological Diversity, 2005:1). This percentage “correlates with the 89.7% of total CO_2 emissions over the years” (IPCC, 2007:2)**.**

Unfortunately, as the same report continues to show ‘fossil fuels are also the primary culprit behind climate change’ (The Centre for Biological Diversity, 2005:1). For example, ‘in the United States, they are to blame for more than 80% of greenhouse gas emissions — and 98% of CO_2 emissions alone’ (The Centre for Biological Diversity, 2005:1; Leiserowitz & Smith, 2010:67). According to the 2007 IPCC Fourth Assessment Report on Climate Change (IPCC, 2007:2):

> “*The primary source of the increased atmospheric concentration of carbon dioxide since the pre-industrial period results from fossil fuel use, with land-use change providing another significant but smaller contribution. Fossil carbon dioxide emissions include those from the production, distribution and consumption of fossil fuels and as a by-product from cement production. An emission of 1 GtC corresponds to 3.67 $GtCO_2$. Annual fossil carbon dioxide emissions increased from an average of 6.4 [6.0 to 6.8] GtC (23.5 [22.0 to 25.0] $GtCO_2$) per year in the 1990s to 7.2 [6.9 to 7.5] GtC (26.4 [25.3 to 27.5] $GtCO_2$) per year in 2000–2005. Carbon dioxide emissions associated with land-use change are estimated to be 1.6 [0.5 to 2.7] GtC (5.9 [1.8 to 9.9] $GtCO_2$) per year over the 1990s…” (IPCC, 2007:2). According to Virgilio, Marshall, Zerbock & Holmes (2013:14) “One gigaton (Gt) is equal to one*

billion tons". Thus "five gigatonnes are equal to five billion tonnes of CO_2 emissions" (see also Taylor, 2007: Internet Source; Virgilio, et. al, 2013).

However, CO_2 emissions are not the sole culprit for the current global warming problems. Some reports such as the UNEP-IPCC (2007:2) argue that there are many other types of GHGs in the atmosphere, such as Methane gases (CH_4), Nitrous Oxide (N_2O), Chlorofluorocarbons (CFCs) and Ozone (O_3) that are responsible for global warming and earth's stinking (Emetu, 2007:3). Thus, according to an organisation called Global Greenhouse Warming (n.d.), at least another 1.6 GtC emissions from land-use should be added because fossil fuel use is not the only human contribution to CO_2 levels.

Finally, while the observed anthropogenic global increases in carbon dioxide concentration are due primarily to fossil fuel use (motor cars etc.) and land-use change (such as deforestation), those of methane and nitrous oxide are primarily due to human's agricultural activities (IPCC, 2007:2)**.**

Based on this analysis, it can be deduced that the main causes of global warming are the GHGs emitted by natural and anthropogenic activities. While the activities of nature are often beyond human control, humans are responsible for their own activities. Thus the focus of this analysis is not on how to stop nature's activities, but humans' activities that produce GHG emissions which are responsible for the global warming problems. Before going into the details of this debate, one needs to understand how and why the GHGs emission is responsible for global warming.

HOW GREENHOUSE GASES CAUSE GLOBAL WARMING?

There is almost unanimity in the literature that global warming is a direct result of the GHGs build up in the atmosphere (Hannam, 2013:1). "As these GHGs build up in the earth's atmosphere, they act as a big blanket or dome which traps the heat and reflects it back onto the earth's surface" (Emetu, 2007:1). "Once emitted back onto the earth's surface, that heat overheats the planet, threatens our health, our economy and our environment" (Emetu, 2007:1, Nature Conservancy, 2007:1; BIMUN Internet Source). These GHGs are not the ones that overheat the planet. However, they have heat trapping capacity and the effects of the heat they trap, often known as the "greenhouse" is what causes global warming (The National Geographic, cited in Emetu, 2007). "Like the glass walls of a greenhouse, these gases let light in and keep heat from escaping into space but instead emit it back onto the planet" (National Geographic Society, 2014:1; National Geographic Internet Source). The more GHGs there are in the atmosphere, "the more heat gets trapped and radiated back onto the earth's surface" (National Geographic Society, 2014; National Geographic Internet Source). Thus the more GHG emitted into the atmosphere, the more heat gets trapped, the higher the danger of global warming and the more the earth is likely to face the negative effects of global warming (National Geographic Society, 2014). In an attempt to explain the concept of global warming to a four year old child Robotman (2006, cited in Emetu, 2007:3), uses an analogy of a person or a group of them sleeping in one bed and one or a number of them farting in the blanket they are covering themselves with. Robotman explains to the child that when in bed under a blanket, and you fart, "it gets all warm and stinky in the bed and the room. This is what humans are doing to the earth" (Emetu, 2007:3). Humans are said to be farting when, through their industrial and economic activities, they release the gases that are responsible for building up GHGs in the atmosphere (Emetu, 2007:3). All of the farts (i.e. greenhouse causing gases such as Methane gases (CH_4), Nitrous Oxide (N_2O), Chlorofluorocarbons (CFCs) and CO_2) are "getting stocked in the atmosphere which is like our bed blankets and it

is making our earth all warm and stinking" (Emetu, 2007:3). Unfortunately, the humans, and the industries in particular, which are doing all the farting are not, cannot and should not really be expected to stop farting (Robotman, 2006:1; Emetu, 2007:3). People need transport, the manufacturing industries and both subsistence and mechanised/commercial farming in order to grow the economy which is necessary for their own socio-economic wellbeing (Auriacombe & van der Waldt, 2014). However, because growing the economy produces a lot of GHG emission and these gases have been positively linked to the current challenge of global warming, then all things that have life on land, air and water should reconcile themselves to the effects and consequences of global warming.

CONSEQUENCES ASSOCIATED WITH GLOBAL WARMING

Literature on climate change and global warming shows that the threats that rapid climate change poses to society and the natural world are unprecedented (Flavin & Dunn, 1997:9 cited in Emetu, 2007:14). But, an ordinary person hearing about the issues of climate change or global warming in the media might ask what the fuss about climate change is. Whether she/he is affected and how he/she is affected by climate change or why we should concern ourselves about it? Emetu (2007) cites a study conducted by the World Watch Institute in 2002 which argues that the temperature change resulting from the projected doubling of effective CO_2 concentration in the next century could shift the ecological zone of one third of the world's forests northward at a rate well beyond the maximum migration rates of most trees and shrubs, resulting in widespread forest death and wildfires (Flavin & Dunn, 1997:9). The same study found that an increase in extreme weather such as floods and droughts is likely to exacerbate water and food scarcity. For example, because of climate change: wheat, rice and corn yields decline with 10% if temperature rises with 1 degree (Flavin & Dunn, 1997). It was estimated that a third of the world population (over 870 million) was suffering from malnutrition and 842 million people in the world did not have enough to eat in 2013 (UN World Food Programme, 2014:1). But, one does not need scientific evidence which is difficult for an ordinary person to understand. The increase of natural disasters in recent years could be used to explain the impact of global warming on an ordinary person, no matter age, level of education or location. Few people could forget the devastating effects of the Tsunamis in New Orleans and the Mississippi Gulf in the USA (2005), the Indonesian Islands (2004 and 2006), and the earthquake in Haiti and many other areas (World Watch Institute, 2006:1). All of these natural disasters could be directly linked to the effect of global warming.

Research shows that "natural disasters such as hurricanes are becoming more and more prevelent and more intense, and sea levels are continuously rising" (National Academy of Sciences, 2012:2). For example, according to Sutter (2009:1), chronic erosion and flooding are making remote areas such as "Alaskan village of Shishmaref uninhabitable, so much so that the 1000 years old Inupiag Eskimo community wants to move from that entire village and find refuge somewhere else" (Emetu, 2007:22). Research, such as that conducted by environment specialist Agarwal (2001:4, also cited in Emetu, 2007:22) shows "that a 15-95cm rise in sea level could turn people now living on islands and in coastal areas into environmental refugees". Both Agarwal (2001) and Boyle (1999:80) agree that "a 20-inch rise in sea level, predicted by 2100, could inundate 5,000 square miles of dry land and drown 15 to 60% of the US coastal wetlands" (see also Lofi.physforum.com: Internet Source). If no action is taken, as Boyle continues to argue, "Louisiana could lose as much as 3,500 square miles of dry and wet land" (Boyle, 1999:80; see also Lofi.physforum.com: Internet Source). "By some estimates, as Boyle, (1999:87) puts it "a one-foot rise in sea level along the Gulf and Atlantic coasts is likely by 2050 and could even occur by 2025". Some such as Gaan

(2008:93) and Emetu (2007:22) observe that "a two-foot rise is inevitable in the next century", but that "a four-foot rise" is also possible (see also Lofi.physforum.com: Internet Source).

In the US, according to Titus (1986:2), "the majority of coastal wetland loss is now taking place in Louisiana, which loses fifty square miles of wetlands per year, mostly to open water" (see also National Service Center for Environmental Publications (NSCEP), 1988:iii). As a result "navigation channels, canals, and flood control levees have impeded the natural mechanisms that once enabled the wetlands of the Mississippi Delta to keep pace with subsidence and rising sea level" (Titus, 1986:2; NSCEP, 1988:iii). Titus (1986:2) argues that "the majority of coastal wetland loss in South Carolina results from impoundments that have converted wetlands to open water during part of the year" (also NSCEP, 1988:iii). A study conducted by the US Environmental Protection Agency (USEPA) estimated that, "one-foot rise in sea level along the Gulf and Atlantic Coasts is likely to be seen by 2050" (Gaan, 2008:93 citing USEPA, n.d.:1; NSCEP, 1988:iii).

Some studies conducted on the African continent show the continent faces serious climate change challenges. Emetu (2007) uses "the Victoria Island off the Lagos coast where most of the Nigeria's wealthier people live" to demonstrate the direct impact of global warming on some African countries. He cites" a study conducted by the Nigerian Institute for Oceanography and Marine Research (NIOMR), looking at the potential effect of global warming and sea level rise in Victoria Island", which found that "besides the possible loss of property, the landmass of Victoria Island and Lekki could shrink by as much as 230 square miles and could one day be completely submerged due to coastal and rising sea level" in the next few decades (NIOMR, 2002:1-2, also cited by Emetu, 2007:10). This is contrary to nearly 100 years ago when, according to NIOMR (2002:1-2) and Emetu (2007:10), "the fine white sands of Victoria Island's bar beach, stretched for about seven tenths of a mile wide". According to NIOMR (2002:2), the same beach has now been "eaten away by rising waters to less than a third of a mile wide today" (see also Emetu, 2007:10). Furthermore, "the increase of heat waves and expended range of infectious diseases such as malaria and cholera" resulting from climate change could cause major health problems for millions of poor people especially those in developing countries such as in Africa, Latin America and Southeast Asia" (Emetu, 2007:14). Some reports such as the one in the The Asian Tribune (2003:1), estimate that "approximately, 160,000 people are currently dying every year as a result of the side effects of global warming such as malaria and malnutrition in these countries" (see also Doyle, 2003:1 and Emetu, 2007:15). A conference on climate change which took place in Moscow in 2003 predicted "the numbers of people dying from 'side-effects' of climate change, such as malaria and malnutrition, could double by 2020" if not action is taken right now (Jones, 2003:1; Doyle, 2003). Unfortunately, "computer models, such as that constructed by the US Department of Navy in 2004 estimated that "by 2050, the global temperature could be 3 degrees Fahrenheit warmer than it is today, and that in the next 100 years" Planet Earth could get as "hot as it was 65 million years ago, when the dinosaurs disappeared" (US Department of Navy, 2005:1; Emetu, 2007:18). The main question then is whether South Africa should also be worried about the effects of global warming or not.

SHOULD SOUTH AFRICANS BE WORRIED ABOUT CLIMATE CHANGE AND ITS EFFECTS OR NOT?

South Africans, like the rest of the world's inhabitants are not immune to the negative effects of global warming. In fact, if nothing is done about climate change and South Africans

continue, among other things, to burn fossil fuels and chop down the forests at current rates, according to United Nations COP17/CMP7 (2011:1), a climate change conference which took place in Durban, South Africa in 2011, and many other reports including an unpublished document summarising the key finding of COP17 prepared by Wits Communications in 2011, and especially the 2015's DEA "Climate Change Awareness" document to name but a few, then the following is predicted for South Africa:

- "*South Africa's coastal regions will warm by around 1-2°C by about 2050 and around 3-4°C by about 2100;*
- *South Africa's interior regions will warm by around 3-4°C by about 2050 and around 6-7°C by about 2100;*
- *There will be significant changes in rainfall patterns and this, coupled with increased evaporation, will result in significant changes in respect of water availability, such as the western side of the country is likely to experience significant reductions in the flow of streams in the region;*
- *South Africa's biodiversity will be severely impacted, especially the grasslands, fynbos and succulent Karoo where a high level of extinction is predicted;*
- *Small scale and homestead farmers in dry lands are most vulnerable to climate change and although intensive irrigated agriculture is better off than these farmers, irrigated lands remain vulnerable to reductions in available water;*
- *Some predictions suggest that maize production in summer rainfall areas and fruit and cereal production in winter rainfall areas may be badly affected;*
- *Commercial forestry is vulnerable to an increased frequency of wildfires and changes in available water in south-western regions;*
- *Rangelands are vulnerable to bush encroachment which reduces grazing lands;*
- *Alien invasive plant species are likely to spread more and have an ever-increasing negative impact on water resources;*
- *Although strong trends have already been detected in South Africa's seas, including rising sea levels and the warming of the Agulhas current and parts of the Benguela, we are not yet sure what impacts these could have on South Africa's seas, the creatures living in the seas or on the communities dependent on the sea;*
- *Because of South Africa's already poor health profile, South Africans are specifically vulnerable to new or exacerbated health threats resulting from climate change. For example, some effects of climate change may already be occurring due to changes in rainfall (droughts and floods) and temperature extremes and Cholera outbreaks have been associated with extreme weather events, especially in poor, high density settlements;*
- *There will be an increase in the frequency and severity of extreme weather events. Damage costs due to extreme weather-related events (flooding, fire, storms and drought) have already been conservatively estimated at being roughly 1 billion rand per year between 2000 and 2009*" (United Nations, COP17/CMP7, 2011:1; Wits Communications, 2011:1-3; South African Government, 2011:Internet Source and DEA, 2015:Internet Sources).

This summary suggest South Africa, like the rest of the world should be worried about the negative effects of climate change. There is a consensus that South Africa, Africa and the developing countries are particularly vulnerable to climate change because, among other things, "a large proportion of their population has low resilience to extreme climate events (poverty; high disease burden; inadequate housing infrastructure and location)" (PACJA, 2009:9; South African Government, 2011:Internet Source; van der Bank, 2014:32). Although

the poor are only minor contributors to climate change, they are the most vulnerable and, hence, will be the most impacted (van der Bank, 2014:32). There is no doubt that the rest of Africa is possibly even worse off because of "their already existing low levels of living standards, high levels of poverty, hunger, diseases and so on" (PACJA, 2009:9; United Nations, COP17/CMP7, 2011). According to the Economist (2009:2), Bird & Peskett (2008:4) and PACJA (2009:9-21) among many others, "Even if environmental costs were distributed equally to every person on earth, developing countries would still bear 80% of the burden (because they account for 80% of world population)" (see also The Economist, 2008 Internet Source; Mulholland, 2009 Internet Source; Dutt, 2014: Internet Source). Thus, the only way to save the world is to get humans in all countries to find ways to stop or reduce the rate of CO_2 and other GHGs they put in the atmosphere (PACJA (2009. Following is the analysis of South Africa's GHG emissions over the past few decades.

SOUTH AFRICA'S GHG INVENTORIES

In August 1997, according to DEAT (2009:7) "the Republic of South Africa joined the majority of countries in the international community in ratifying the UNFCCC" (see also DEA, 2010:34). The United Nations Framework Convention on Climate Change (UNFCCC) "is an international environmental treaty negotiated at the United Nations Conference on Environment and Development (UNCED), informally known as the Earth Summit, held in Rio de Janeiro from 3 to 14 June 1992" (United Nations, 1992:1). The UNFCCC "was opened for signature on 9 May 1992, after an Intergovernmental Negotiating Committee produced the text of the Framework Convention as a report following its meeting in New York from 30 April to 9 May 1992" (United Nations, 1992:5; Wikipedia Internet Source). It come into force on 21 March 1994. The UNFCCC states that "the main objective of the treaty is to stabilise GHGs concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (UNCED, 1992:5; Wikipedia Internet Source). As of March 2014, the UNFCCC has 196 parties (ibid). One of the first tasks set by the UNFCCC, according to Burdick (2012:14), was "for signatory nations to establish national GHG inventories of emissions and removals, which were used to create the 1990 benchmark levels for accession of Annex I countries to the Kyoto Protocol and for the commitment of those countries to GHG reductions and to provide annual reports on what they have done and achieved in the reduction of the GHG emissions" (see also United Nations, 1992:5; Burdick 2012). Updated inventories must be regularly submitted by Annex I countries (Burdick 2012:14, citing United Nations, 1992:5) and these include: The United States, Russian Federation, Japan, Germany, Canada, United Kingdom, Italy, Australia, France, Spain, Ukraine, Poland and Turkey" (Burdick, 2012:14-26).

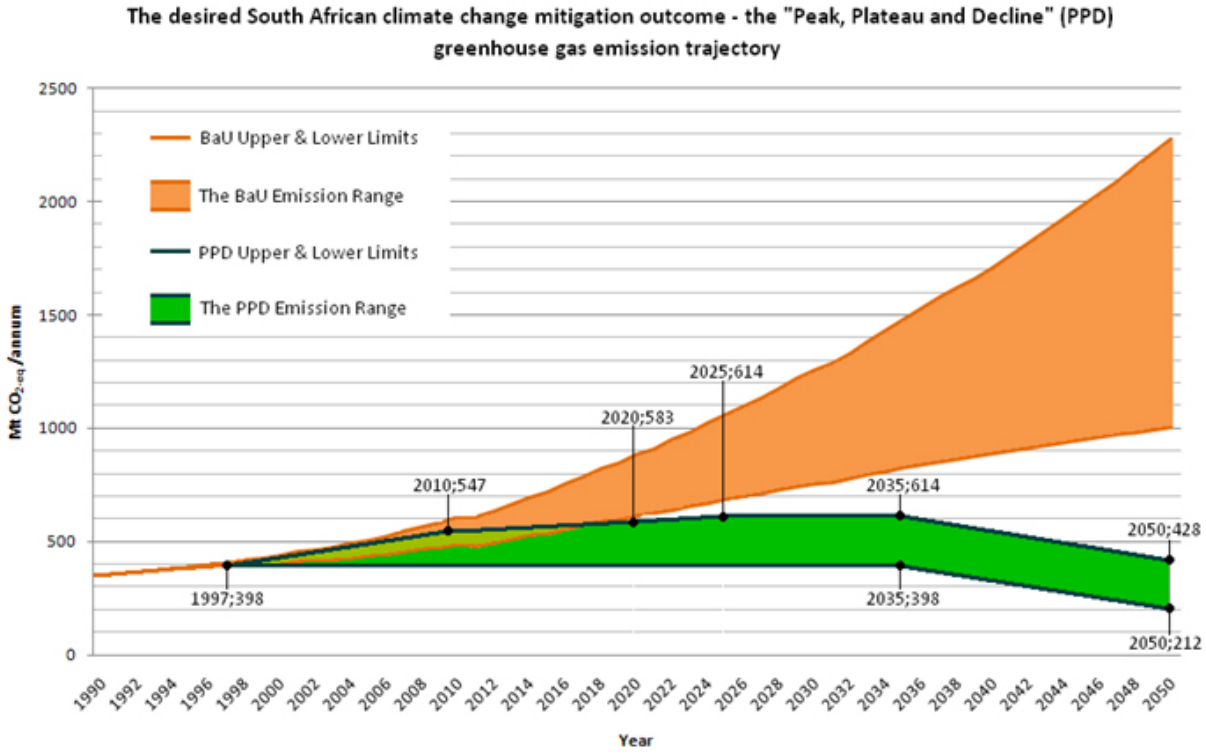
While South Africa is not one of these countries on Annex I, , as a member of the UNFCC the Republic of South Africa is also required to undertake several projects related to climate change and provide annual reports on the GHG emission situation to the UNFCC (DEAT, 2009:ii). This includes the preparation of the GHG inventories, which comprises one of the outputs of the agreed National Communications to the UNFCCC (DEAT, 2010:22). The first national GHG inventory in South Africa was compiled in 1998 and the activity data used was for the year 1990. South Africa compiled the second GHG inventory for the year 1994 and this was published 10 years later in 2004. For both 1990 and 1994 the GHG inventories were compiled based on the 1996 guidelines of IPCC (DEAT, 2010:22). The third national GHG inventory was compiled in 2000 using activity data from the year 2000 (DEAT, 2010). This 2000 GHG inventory is said to have been more extensive as it reported on the GHG trends for a ten-year period (2000-2010) (DEAT, 2010:12).

Following are some of the factors that influence the South African GHG emissions and a summarised analysis of the desired South African climate change mitigation outcomes.

THE DESIRED SOUTH AFRICAN CLIMATE MITIGATION OUTCOMES: 1997 - 2050

Figure 1 shows South African climate change mitigation outcomes. The Figure shows the desired peak, plateau and decline starting in 1997 to 2050. Figure 1 shows that South Africa produced 398 Ggt of GHG in 1997. By 2010 South Africa had almost doubled its 1997 GHG emissions to 547Ggt of GHG emissions. While South Africa aims to reduce its GHG emissions in the long term, it is projected that its GHG emissions will grow to as high as 614 Ggt in 2025 and to stay at that level till 2035 (see also Marquard, Trollip and Winkler, 2011:8). It is only in 2035 that South Africa aims to start a decline in GHG and to achieve 428GHG emission in 2050 (also Marquard, Trollip and Winkler, 2011:8).

Figure 1: The desired South African climate mitigation outcomes: 1997 - 2050



(Source: Burton & Coetzee, 2012:1, citing DEAT, 2011:36).).

As argued above in this article, it is important to target and remove the root causes of the GHG emission, if South Africa is going to succeed in its plans to reduce its GHG emissions by2035. The following paragraphs summarise a number of main contributing factors to the South African GHG emissions, the process of global warming and its consequences for Planet Earth.

THE MAIN FACTORS THAT INFLUENCE THE SOUTH AFRICAN GHG EMISSIONS

There are various factors that can influence a nation's GHG emissions, including government's infrastructure, population growth, geography, economic growth, energy

consumption, technology development, climate and soils, agriculture and land-use management (DEAT, 2010:22). In the South African context, these are further categorised in four main inventory sectors, namely: (1) Energy, (2) Industrial Processes and Product Use (IPPU), (3) Agriculture, Forestry and Other Land Use (AFOLU) and (4) Waste (DEAT, 2010:26). Following is an analysis of these four main inventory sectors in terms of "Level Assessment" and "Trend assessment" (GHG Inventory for South Africa: 2000 – 2010, DEAT, 2010:13). These analyses often exclude the Land sub-sector because the problem of acquiring data in this sub-sector and the fact that land and forestry usually act as CO_2 sinks (World Nuclear Association 2013:3; Mbugua, n.d.:37). In fact, according to the World Nuclear Association (2013:3) 'study of the atmospheric carbon cycle shows that … both oceans and some terrestrial ecosystems provide sinks which function as a negative feedback, that is to say, they have increased their uptake as the atmospheric concentration has increased' (see also Mbugua, n.d.:37). As the following table shows, the levels of GHG emissions increase when the data for land use is removed and increase when it is added to the calculation of GHG emission.

(a) Level Assessment results for 2010 (with 2000 as the base year)

Table1 summarises the Level Assessment of GHG in 2010. A Level Assessment of South Africa's GHGs emission shows that "the most significant sources of GHG emissions in South Africa (excluding the *Land* sub-sector) in 2010 were the *Energy industries* (solid fuels), *Road transportation*, *Manufacturing industries and Construction* (solid fuels), and *Enteric fermentation"* (see DEAT, 2010:30). Table 1 shows that the top contributing sectors to South Africa's GHG emissions are energy industries – Solid Fuels (324,244.75 Ggt CO_2), Road Transport (42,515.18 Ggt CO_2). Other emissions from Energy Production include Manufacturing Industries and Construction - Solid Fuels (35,142.52 Ggt CO_2), Enteric Fermentation (27,299.46 Ggt CO_2) and other related energy Sectors such as Other Solid Fuels (27,024.86 Ggt CO_2) to name but a few (GHG Inventory for South Africa: 2000 – 2010, DEAT, 2010:13). These figures clearly shows that South Africa should first focus on its Energy Industries (Solid Fuels) and then any of these other top GHG emission contributing sectors in order to achieve its GHG emission reduction targets.

Table 1. Level assessment results for 2010, excluding the Land sub-sector contributions

IPCC Category	GHG	2010 (Gg CO2)
Energy Industries - Solid Fuels	CO2	324,244.75
Road Transportation	CO2	42,515.18
Manufacturing Industries and Construction - Solid Fuels	CO2	35,142.52
Enteric Fermentation	CH4	27,299.46
Other Sectors - Solid Fuels	CO2	27,024.86
Other Emissions from Energy Production	CO2	22,181.07
Other Sectors - Liquid Fuels	CO2	17,589.76
Solid Waste Disposal	CH4	16,568.60
Iron and Steel Production	CO2	12,448.40
Ferroalloys Production	CO2	6,457.98
Cement production	CO2	4,186.73
Energy Industries - Liquid Fuels	CO2	4,051.68
Manufacturing Industries and Construction - Gaseous Fuels	CO2	3,837.58
Civil Aviation	CO2	3,657.68

Indirect N2O Emissions from Managed Soils	N2O	3,392.06
TOTAL		**550,598.3**

(Sources: Table 1 adapted from DEAT, 2010:10).

(b) Trend Assessment results for 2010 (with 2000 as the base year), excluding Land sub-sector

Table 2 summarises the Trend assessment results for 2010 (with 2000 as the base year), excluding Land sub-sector. There are striking similarities between the level assessment presented above and the Trend assessment in Table 2. Table 2 shows that Energy Industries-Solid Fuels (324,244.75 Ggt CO_2), Road Transportation (42,515.18 Ggt CO_2), Manufacturing Industries and Construction - Solid Fuels (35142.52 Ggt CO_2) and Enteric Fermentation (27299.46 Ggt CO_2) were the top key categories (Table 2) (DEAT, 2010:30). However, when the *Land* sub-sector was included, then *Forest land* becomes the 14th and 4th most important key category in the Level and Trend Assessment, respectively (DEAT, 2010:30).

Table 2: Trend assessment results for 2010 (with 2000 as the base year), excluding Land sub-sector. IPCC code

IPCC Category	**GHG**	**2000 Year Estimate Ex0 (Gg CO_2 eq)**	**2010 Year Estimate Ext (Gg CO_2 eq)**	**Trend Assess-ment (Txt)**	**% Contri-bution to Trend**
Other Sectors - Solid Fuels	CO2	5,578.19	27024.86	0.0433	0.2741
Other Emissions from Energy Production	CO2	26,658.56	22181.07	0.0240	0.1520
Enteric Fermentation	CH4	29,601.08	27299.46	0.0209	0.1323
Iron and Steel Production	CO2	15,385.78	12448.40	0.0146	0.0925
Solid Waste Disposal	CH4	9,704.24	16568.60	0.0096	0.0608
Energy Industries - Solid Fuels	CO2	256,361.41	324244.75	0.0086	0.0548
Energy Industries - Liquid Fuels	CO2	4,715.48	4,051.68	0.0040	0.0251
Road Transportation	CO2	32,623.34	42,515.18	0.0038	0.0241
Other Sectors - Liquid Fuels	CO2	12,766.46	17,589.76	0.0035	0.0224
Indirect N_2O Emissions from Managed Soils	N2O	3,992.53	3,392.06	0.0034	0.0218
Manufacturing Industries and Construction - Solid Fuels	CO2	29,056.22	35,142.52	0.0025	0.0158
Civil Aviation	CO2	2,040.00	3,657.68	0.0024	0.0152
Manufacturing Industries and Construction - Gaseous Fuels	CO2	2,217.75	3,837.58	0.0023	0.0146
Refrigeration and Air Conditioning	HFCs, PFCs	0.00	799.88	0.0017	0.0109
Direct N_2O Emissions from Managed Soils	N2O	2,520.34	2,524.81	0.0017	0.0109
Nitric Acid Production	N2O	499.06	104.78	0.0011	0.0071
Aluminium production	PFCs	2,156.76	2,229.04	0.0010	0.0064
TOTAL		**435,877.2**	**545,612.1**		

(Table 2 adapted by the author from DEAT, 2010:10).

COMBINED SUMMARY OF NATIONAL EMISSION AND REMOVAL TRENDS (2000-2010)

The combined summary shows clearly where the problem in South Africa lies and where South Africa should focus if it wants to meet its GHG emissions target for 2050. Table 3 presents the contribution of the main sectors to the trend in national CO_2 emissions (excluding *Land*) and then (including land) in the calculation. The analysis of the data (excluding land) in Table 3 shows that the emissions increased by 27.1% between 2000 and 2010. The Energy sector was by far the largest contributor to CO_2 emissions in South Africa, contributing an average of 88.9% between 2000 and 2010, with the categories *Energy Industries* (70.6%), *Transport* (10%) and *Manufacturing industries and Construction* (8.4%) being the major contributors to CO_2 emissions in 2010 (DEAT, 2010:35). However, the addition of land data reduces the GHG emissions as clearly demonstrated in the last column of Table 3. It looks like land act as GHG emission sink.

Table 3: Combined Summary of national emission and removal trends (2000-2010)

	Energy	**IPPU**	**AFOLU (excl. Land)**	**AFOLU (incl. Land, (Gg CO_2 eq.)**	**Waste**	**Total (excl. Land)**	**Total (incl. Land)**	**Effect of adding Land to Total calculation**
2000	381 790	29 961	39 565	9 037	12 434	463 750	433 221	-30 529
2001	383 620	28 652	39 725	12 772	13 122	465 118	438 166	-26 952
2002	392 107	30 368	38 916	16 060	13 789	475 180	452 324	-22 856
2003	421 121	30 987	36 995	10 310	14 477	503 581	476 895	-26 686
2004	439 835	32 548	37 049	19 545	15 179	524 611	507 107	-17 504
2005	433 719	33 400	37 235	29 667	15 907	520 262	512 693	-7 569
2006	453 536	34 190	37 148	23 869	16 649	541 523	528 244	-13 279
2007	479 058	33 871	36 522	23 435	17 409	566 860	553 773	-13 087
2008	475 817	30 229	37 580	25 280	18 170	561 797	549 497	-12 300
2009	476 346	27 456	36 658	21 688	18 989	559 450	544 480	-14 970
2010	495 432	29 634	37 577	18 248	19 806	582 449	563 120	-19 329
TOTAL	**4, 832,381**	**341,296**	**414, 970**	**209, 911**	**175, 931**	**5,764,581**	**5,559,520**	**-205061**

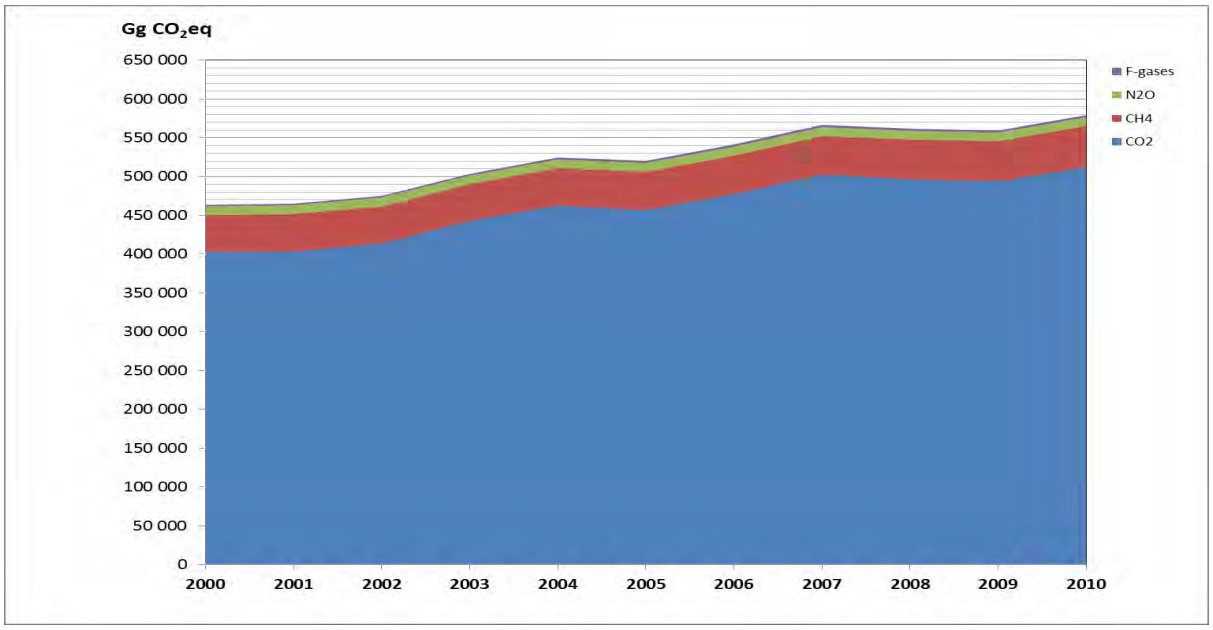
(Source: Table 3 adapted by the authors using data from DEAT, 2010).

TRENDS FOR AGGREGATED GHG EMISSIONS

In 2010 the total GHG emissions (excl. the *Land* sub-sector) in South Africa were estimated at 579,256 Gg CO_2eq (DEAT, 2010). Figure 3 shows "the trends and relative contributions of the different gases to the aggregated national GHG emissions (excluding *Land*)" (UNFCCC, 2009:31). There was a 27.1% and 12% increase in CO_2 and CH4 (in CO_2eq) respectively between 2000 and 2010, and a slight decline (1.8%) in N_2O emissions over this period (DEAT, 2010). Fluorinated gases (F-gases) increased from 2,157 Gg CO_2eq in 2000 to 2,229 Gg CO_2eq in 2010. The analysis of Figure 3 leads one to conclude that South Africa needs to find strategies to seriously reduce all the major GHG emissions, but the CO_2 emissions seem to be needing more attention than any other GHG if South Africa wants to make a dent in its GHG emission and to achieve its 2050 targets. Unfortunately, according to Burton and Coetzee (2012:1) "although there is an overall desire to shift from the use of coal (current 90% reliance to 65% in 2030), there are serious challenges in achieving this objective". This

is because, as these authors continue to argue "several powerful energy-intensive industries and mining companies such as Xstrata, Exxaro, Anglo American & the Chamber of Mines had representatives on the Technical Reference Group consulted by the Department of Energy" (Burton & Coetzee, 2012:1).

Figure 2: GHGs: Trend and emission levels (excluding *Land* sub-sector), 2000 – 2010



(Source: GHG Inventory for South Africa: 2000 – 2010, DEAT, 2010:13).

CONCLUSION

The objective of this research was to analyse what South Africa has achieved in terms of reducing the emission of GHG responsible for the destruction of the Ozone-layer and global warming since it became the signatory of the international conventions dealing with GHG emission and Ozone-layer depleting gases. The research provided conclusive evidence to suggest that many types of GHGs in the atmosphere, such as Methane gases (CH_4), Nitrous Oxide (N_2O), Chlorofluorocarbons (CFCs) and Ozone (O_3) that are responsible for global warming. However, the dramatic accumulation of CO_2 from anthropogenic sources has been by far the largest climate change driver over the past half century and is likely to remain so if nothing is done to reduce its emission. In line with international trends, the South African GHG emission is also dominated by CO_2 gas emissions. The CO_2 contribute about 88.9% of all GHG emissions for South Africa between 2000 and 2010. Thus South Africa needs to find ways to reduce its CO_2 gas emissions significantly if it wants to make a significant contribution to the reduction of Ozone-layer depletion in the atmosphere.

The article shows that South African performance in terms of national GHG inventory is not impressive. The South African GHG emission has been climbing since 1997 and is going to continue till at least 2035 because of its dependency on coal fired energy production.

The above analysis of South African GHG emissions shows that energy production (examples) is the main culprit in the production of GHG emission. This finding confirms the already existing statement by some such as Brown & Taylor (2014:44), that "It is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century" (also IPCC, 2014:3; also Lakewood, 2014: internet source) as discussed in different sections of this article. It therefore follows that South Africa needs to find

alternative means of producing the energy it needs for growing its economy. There is definitely a need to move away from the dependency on coal-fired energy production as this is the main producer of the large quantities of CO_2 emissions, if South Africa is going to make a significant reduction in its GHG production and emission by the year 2035.

The Level and Trend Assessments of South Africa's GHG emission shows that the most economic factors which contribute significant sources of GHG emissions in South Africa (excluding the Land sub-sector) in 2010 were the Energy industries (solid fuels), Road transportation, Manufacturing industries and Construction (solid fuels), and Enteric fermentation. More than 80% of South African greenhouse emissions are a result of energy production. The analysis shows that South Africa would need to find alternative sources of energy or better technology to produce energy with less or no GHG emissions into the atmosphere. Without alternative sources of energy or advanced technology to reduce CO_2 emissions and the greenhouse emission South Africa will not be able to make a dent in its current GHG emission let alone achieve its 2050 targets.

REFERENCES

Adam, A. (2013a). Global Classroom: International students exchange their views. http://www.johnbritto.com/?p=25429 (Accessed: 08 June 2015)

Adam, A. (2013b). The causes and effects of climate change. http://www.johnbritto.com/?p=25429&session-id=ff6fc6bc5bc40ff3ab90bb1a8bcb14a9 (Accessed: 08 June 2015).

Agarwal, A. (2001). Climate change a challenge to India's economy: briefing paper for members of parliament - An Occasional Paper from the Centre for Science and Environment, http://www.cseindia.org/userfiles/cse_briefing.pdf (Accessed: 10 September 2014).

Amnesty International (2007). The state of the world's human rights. http://www.amnesty.org (Accessed: 15 July 2014).

Anderson, J. & Bausch, C. (2006). Policy Brief for the EP Environment Committee: Climate change and natural disasters: Scientific evidence of a possible relation between recent natural disasters and climate change. http://www.ieep.eu/assets/287/IEEP_Ecologic_climate_change_natural_disasters.pdf (Accessed: 27 August 2014).

Audubon (n.d.). Internet Source. http://www.audubon.org/global.html (Accessed: 08 June 2015).

Auriacombe, CJ & van der Waldt G. 2014. Internal Handbook: Section A: Government, environment and sustainable development. University of Johannesburg.

Biggs, D. (2009). Plant Microevolution and Conservation in Human Influenced Ecosystems. Cambridge: Cambridge University Press.

BIMUN. (Internet Source). Emerging issues in global environment - climate challenges and

natural disasters. http://bimun-unaserbia.org/index.php/committees-and-topics/unea/topic (Accessed: 08 June 2015).

Bird, N. & Peskett, L. (2008). Recent bilateral initiatives for climate financing: Are they moving in the right direction? ODI. http://asiasociety.org/files/pdf/Binder5_LeadershipandSustainableDevelopment.pdf (Accessed: 08 June 2015).

Bitting, R. (n.d.). Effective leadership strategies in workplace: A dozen organizational development programs. *http://www.robertbitting.com/pdf/A-Dozen-Organizational-Development-Programs.pdf* (Accessed: 09 September 2014).

Bookman, J. (2012). Changing climate alters the Southeast. http://blogs.ajc.com/jay-bookman-blog/2012/04/09/11173/?cp=5 (Accessed: 09 September 2014).

Boyle, R.H. (1999). Global warming: You're Getting Warmer..., Audibon, November-December, 80-87. http://archive.audubonmagazine.org/global.html (Accessed: 10 September 2014).

Brown, DA & Taylor, P. (2014). Ethics and Climate Change: A Study of National Commitments: IUCN Environmental Policy and Law Paper No. 86. http://cmsdata.iucn.org/downloads/iucn_eplp_86_advanced_copy.pdf (Accessed: 08 June 2015).

Burdick, D. (2012). Management Report for 82 Corals Status Review under the Endangered Species Act: Pacific Islands Regional Office National Marine Fisheries Service National Oceanic and Atmospheric Administration Department of Commerce. http://www.fpir.noaa.gov/Library/PRD/Coral/12-11-09-Final_Corals_Mgt_Report.pdf (Accessed: 05 June 2015).

Burton, J. & Coetzee, K. (2012). Rhetoric vs Reality: Climate Change and Energy Policy in South Africa: Energy Research Centre, University of Cape Town, South Africa. http://www.academia.edu/1749578/Rhetoric_vs_Reality_Climate_Change_and_Energy_Policy_in_South_Africa (Accessed: 05 June 2015).

Centre for Bilogical Diversity (2005). Energy and global warming. http://www.biologicaldiversity.org/programs/climate_law_institute/energy_and_global_warming/ (Accessed: 09 September 2014).

Chrisjohn, R.D., Wasacase, T., Nussey L., Smith, A., Legault, M., Loiselle, P. & Bourgeois, M. (2002). 'Genocide and Indian residential schooling: the past is present' in Wiggers RD & Griffiths AL *Canada and International Humanitarian Law: Peacekeeping and War Crimes in the Modern Era* Halifax: Dalhousie University Press.

Clarke, D. (2014). Greenhouse/Climate Change and Australia. http://ramblingsdc.net/Australia/Greenhouse.html (accessed: 09 September 2014).

COP17. (2011). Effects of Climate Change on South Africa. http://www.cop17-cmp7durban.com/en/south-africa-on-climate-change/effects-of-climate-change-on-south-africa.html (Accessed: 05 June 2015).

DEAT (2010). GHG Inventory for South Africa: 2000 –2010. http://www.saaqis.org.za/ (Accessed: 29 August 2014).

DEAT (2009). Greenhouse gas inventory South Africa: 1999 to 2000. http://pmg-assets.s3-website-eu-west-1.amazonaws.com/docs/ 090812 greenhouseinventory.pdf (Accessed: 05 June 2015).

DEAT (2011). National climate change response: White paper. http://www.sanbi.org/sites/ default/files/documents/documents/national-climate-change-response-white-paper.pdf (Accessed: 05 June 2015).

Doyle, A. (2003). 160,000 Said Dying Yearly From Global Warming. http://www.rense.com/general42/160000saiddying.htm (Accessed: 05 June 2015).

Duffy, G., Moran, J. & Riley, W. (2012). Solve the real problem using root cause analysis. http://webcache.googleusercontent.com/search?q=cache:bvC3N-YxJgYJ:www.asq-qm.org/resourcesmodule/download_resource/id/880/src/%40random48c1507d20943/ +&cd=2&hl=en&ct=clnk&gl=za (Accessed: 08 September 2014).

Dutt, V. (2014). Don't let climate change issue go adrift. http://www.mydigitalfc.com/ op-ed/don%E2%80%99t-let-climate-change-issue-go-adrift-927 (Accessed: 08 June 2015).

Earth Wealth (2010). Earth Wealth Minerals http://earth-wealth.blogspot.com /2010_09_01_archive.html (Accessed: 08 September 2014).

Ebrahim, Z. & Friedrichs, J. (2013). Gas Flaring: The Burning Issue, Published by Resilience.org on 2013-09-03. http://www.resilience.org/print/2013-09-03/gas-flaring-the-burning-issue (Accessed: 08 September 2014).

Ekwurzel, B., Cole, N., Frumhoff, P & Shaw, S. (2009). (UCS). How Do We Know that Humans Are the Major Cause of Global Warming? http://www.ucsusa.org/global_warming/science_and_impacts/science/human-contribution-to-gw-faq.html (Accessed: 09 September 2014).

Emetu, R.I. (2007). The impact of law on threats of climate change and global warming in Nigeria. Thesis submitted to Faculty of Law, University of Benin, Benin City.

Ferrara, P. (2013). To The Horror Of Global Warming Alarmists, Global Cooling Is Here. http://www.forbes.com/sites/peterferrara/2013/05/26/to-the-horror-of-global-warming-alarmists-global-cooling-is-here/ (Accessed: 09 September 2014).

Filho, W.L. & Manolas, E. (2012). English through Climate Change: A Publication of the Department of Forestry and Management of the Environment and Natural Resources, Democritus University of Thrace. http://dl.klima2012.de/ccf/english_through_climate_change.pdf (Accessed: 08 June 2015).

Flavin, C. & Dunn, S. (1997). Rising Sun, Gathering winds: Policies to stabilise the climate

And strengthen economics: World Watch Paper, 138(1):1.

Gaan, N. (2008). Climate change and international politics. India: Kalpaz Publications.

Global Greenhouse Warming (n.d.). Anthropogenic Climate Change. http://www.global-greenhouse-warming.com/anthropogenic-climate-change.html (Accessed: 09 September 2014).

Global Warming Causes and Solutions. (n.d.). http://www.123helpme.com/global-warming-causes-and-solutions-preview.asp?id=216029 (Accessed: 09 September 2014).

Hannam, P. (2013). Not much climate change doubt, science says, The Age. http://www.smh.com.au/environment/climate-change/not-much-climate-change-doubt-science-says-20130515-2jmup.html#ixzz3CpTi45xi (Accessed: 09 September 2014).

Hattingh, J. (2001). Conceptualising ecological sustainability and ecologically sustainable development in ethical terms: Issues and challenges. Annale No. 2, 2001: University of Stellenbosch.

IPCC Assessment Report (2007). Climate Change 2007: Working Group I: The Physical Science Basis. http://www.ipcc.ch/publications_and_data/ar4/wg1/en/spmsspm-human-and.html (Accessed: 27 August 2014).

IPCC (2014). *Climate Change 2014: Impacts, Adaptation, and Vulnerability:* IPCC WGII AR5 Summary for Policymakers.

Jones, G. (2003). World oil and gas 'running out'. http://edition.cnn.com/2003/WORLD/europe/10/02/global.warming/ (Accessed: 05 June 2015).

Karl, T.R. & Melillo, J.M. (2009). Global Climate Change Impacts in the United States. U.S. Global Change Research Program.

King, D., *et al.* (July 2011), "Copenhagen and Cancun", *International climate change negotiations: Key lessons and next steps*, Oxford, UK: Smith School of Enterprise and the Environment University of Oxford, p. 12.

Lakewood (2014). Internet Source. http://lakewood.ca-local.org/ (Accessed: 08 June 2015).

Leiserowitz, A. & Smith, N. (2010a). *Knowledge of Climate Change Across Global Warming's Six Americas.* Yale University. New Haven, CT: Yale Project on Climate Change Communication. http://environment.yale.edu/climate-communication/files/Knowledge_Across_Six_Americas.pdf?&session-id=ff6fc6bc5bc40ff3ab90bb1a8bcb14a9 (Accessed: 08 June 2015).

Leiserowitz, A. & Smith, N. (2010b). Climate Change in the American Mind: Americans' Global Warming Beliefs and Attitudes in January 2010, George Mason University, Center for Climate Change Communication. http://e360.yale.edu/images/digest/AmericansGlobalWarmingBeliefs2010.pdf (Accessed: 27 August 2014).

Lofi.physforum.com. Global Warming. https://lofi.physforum.com/Global-warming_8866.html (Accessed: 08 July 2015).

Malanczuk, P. (1997). Akehurst's modern introduction to international law (7th ed). London: Routledge.

Marquard, A. Trollip, W. & Winkler, H. (2011). Opportunities for and Costs of Mitigation in South African Economy. https://www.environment.gov.za/sites/default/files/docs/cost_mitigation_opportunities.pdf. (Accessed: 05 June 2015).

Mbugua, D. (n.d). Forest Outlook studies in Africa (FOSA). ftp://ftp.fao.org/docrep/fao/003/AB569E/AB569E00.pdf (Accessed: 05 June 2016).

Merriam Webster Dictionary (n.d.). http://www.merriam-webster.com/dictionary/anthropogenic (accessed: 08 September 2014).

Moffat, D & Linden, O. (2002). Perception and Reality: Assessing Priorities for Sustainable Development in the Niger Delta, Ambio, Stockolm, 24 (78): 525-538.

Mulholland, G. (2009). Greg Mulholland warns of effect of climate change on developing world. http://gregmulholland.org/en/article/2009/0128934/greg-mulholland-warns-of-effect-of-climate-change-on-developing-world (Accessed: 08 June 2015).

National Academy of Sciences (2012a). Climate Change: Evidence, Impacts, and Choices. http://www.ianas.org/books/Climate_Chance.pdf (Accessed: 09 September 2014).

National Academy of Sciences (2012b). Climate Change: Evidence, Impacts, and Choices: answers to common questions about the science of climate change. http://nas-sites.org/americasclimatechoices/files/2012/06/19014_cvtx_R1.pdf (Accessed: 08 June 2015).

National Academy of Sciences (internet source). Climate Change: Evidence, Impacts, and Choices: answers to common questions about the science of climate change. http://www.scribd.com/doc/98458016/Climate-Change-Lines-of-Evidence?&session-id=ff6fc6bc5bc40ff3ab90bb1a8bcb14a9 (Accessed: 08 June 2015).

National Geographic Society (2014). What Is Global Warming? The Planet Is Heating Up—and Fast. http://environment.nationalgeographic.com/environment/global-warming/gw-overview/ (Accessed: 09 September 2014).

National Service Center for Environmental Publications (NSCEP). (1988). Greenhouse Effect, Sea Level Rise and Coastal Wetland. http://www.islandvulnerability.org/slr1989/epa1988.pdf (Accessed: 08 June 2015).

Nature Conservancy (2007). Climate Change Impacts: Feeling The Heat. http://www.nature.org/initiatives/climatechange (Accessed: 10 July 2014).

NIOMR (2002). Africa underwater: Nigeria's coastline is besieged by Global Warming. (Currents). http://www.thefreelibrary.com/Africa+underwater%3a+Nigeria%27s+coastline+is+besieged+by+Global+Warming....-a083667620 (Accessed: 08 June 2015).

PACJA (2009). The Economic Costs of Climate Change in Africa. *http://www.slideshare.net/cenafrica/economic-costofclimatechangeinafrica (Accessed: 08 June 2015).*

Pack, D.C. (2006). The Real Truth Magazine. Www:therealtruth.org (Accessed: 10 July 2014).

Petes Place (n.d.). Pete'sPlace On Global Warming/Climate Change**:** Exploring the issue of global warming and/or climate change, its science, politics and economics. http://petesplace-peter.blogspot.com/ (Accessed: 08 June 2015).

Robotman, C.B. (2006). Explaining the Concept of Global Warming to a four year old". http://robotman.cracked.com/2006/06/ (Accessed: 10 July 2014).

Shah, A. (2013). Climate Change and Global Warming Introduction. http://www.globalissues.org/article/233/climate-change-and-global-warming-introduction (Accessed: 09 September 2014).

Stocker et al. (2013). IPCC, 2013. Climate Change 2013: The physical Science Basis. Contribution of the Working Group 1 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.

South African Government (2011). Address of MEC for Human Settlements and Public Works, Ms Maggie Govender at the COP17 Roadshow at Ilembe District. http://www.gov.za/address-mec-human-settlements-and-public-works-ms-maggie-govender-cop17-roadshow-ilembe-district (Accessed: 08 June 2015).

Sutter, J.D. (2009). Climate change threatens life in Shishmaref, Alaska. http://edition.cnn.com/2009/TECH/science/12/03/shishmaref.alaska.climate.change/index.html?eref=rss_tech (Accessed: 09 September 2014).

Taylor, K. (2007). http://ffden-2.phys.uaf.edu/212_spring2007.web.dir/Kevin_Taylor/CO2.htm (Accessed: 08 June 2015).

The Asian Tribune (2003). Global Warming Deaths on the Rise. http://www.asiantribune.com/news/2003/10/02/global-warming-deaths-rise (Accessed: 05 June 2015).

The Economist (2009). Developing countries and global warming: A bad climate for Development. http://www.economist.com/node/14447171 (Accessed: 10 September 2014).

The Economist (2008). A bad climate for development.

http://www.economist.com/node/14447171 (Accessed: 08 June 2015).

Tillmann, P & Siemann, D. (2011). Climate Change Effects and Adaptation Approaches in Marine and Coastal Ecosystems of the North Pacific Landscape Conservation Cooperative Region. http://www.nwf.org/~/media/PDFs/Global-Warming/2014/Marine-Report/NPLCC_Marine_Climate-Effects_Final.pdf (Accessed: 08 September 2014).

Titus, J.G. (1986). "Greenhouse Effect, Sea Level Rise, and Coastal Zone Management." *Coastal Zone Management Journal 14:3.* http://www.papers.risingsea.net/federal_reports/sea-level-rise-and-wetlands-chap1-Titus.pdf (Accessed: 10 September 2014).

Tomoya (2014). Causes of the global warming". http://www.newsactivist.com/en/articles/academic-writing-iii-t50/causes-global-warming (Accessed: 08 September 2014).

UN (1992). United Nations Framework Convention on Climate Change. http://www.environment-ecology.com/climate-change/599-united-nations-framework-convention-on-climate-change.html (Accessed: 05 June 2015).

UNCED (1992). UN Conference on Environmental Development (UNCED). https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf (Accessed: 05 June 2015).

UNDP (2013). Millennium Development Goals: Country Report: South Africa 2013, http://www.za.undp.org/content/dam/south_africa/docs/Reports/The_Report/MDG_October-2013.pdf (Accessed: 11 June 2014).

UNEP (1972). Environment for Development, 21st plenary meeting. Stockholm. http://www.unep.org/Documents.Multilingual/Default.asp?documentid=97&articleid=1503 (09 July 2015).

UNFCCC (2009). Fifth Netherlands‟ National Communication under the United Nations Framework Convention on Climate Change. http://unfccc.int/resource/docs/natc/nld_nc5.pdf (Accessed: 08 June 2015).

Union of Concerned Scientists (2009). Global Warming FAQ. http://www.ucsusa.org/global_warming/science_and_impacts/science/global-warming-faq.html (Accessed: 27 August 2014).

United Nations (1992). Commission on Sustainable Development (CSD). https://www.cbd.int/doc/legal/cbd-en.pdf (Accessed: 25 August 2014).

United Nations (1992). United Nations framework convention on climate change. http://unfccc.int/resource/docs/convkp/conveng.pdf (Accessed: 25 August 2014).

UNESCO (1972). The World Heritage Convention. http://whc.unesco.org/en/convention/ (Accessed: 25 August 2014).

United Nations (1994). United Nations convention to combat desertification in those

countries experiencing serious drought and/or desertification, particularly in Africa. http://www.unccd.int/Lists/SiteDocumentLibrary/conventionText/conv-eng.pdf (Accessed: 25 August 2014).

United Nations, COP17/CMP7 (2011). Effects of Climate Change on South Africa. http://www.cop17-cmp7durban.com/en/south-africa-on-climate-change/effects-of-climate-change-on-south-africa.html (Accessed: 10 September 2014).

United Nations (2011). COP17/CMP7: Effects of Climate Change on South Africa: WHY SHOULD I BE WORRIED ABOUT CLIMATE CHANGE? http://www.cop17-cmp7durban.com/en/south-africa-on-climate-change/effects-of-climate-change-on-south-africa.html (Accessed: 08 June 2015).

UN World Food Programme (2014). Hunger. http://www.wfp.org/hunger/stats (Accessed: 09 September 2014).

USEPA (n.d.). Internet Sources. http://epa.gov (Accessed: 10 July 2014).

US Department of Navy (2005). The mystery of global warming. http://www.greatdreams.com/warming.htm (Accessed: 05 June 2015).

van der Bank, CM. (2014). The Fulfilment of South Africa's Environmental Right: Sustainable Development the Fundamental Building Block. *Mediterranean Journal of Social Sciences,* 5 (25):28-35.

Virgilio, N.R., Marshall,S., Zerbock, O. & Holmes, C. (2013). Reducing emissions *from* deforestation *and* degradation (REDD): A casebook of on the ground experience. http://www.nature.org/media/climatechange/redd-casebook-tnc-ci-wcs.pdf (Accessed: 09 September 2014).

Wallington, T.J., Srinivasan,J., Nielsen, O.J. & Highwood, E.J. (2013). Environmental and ecological chemistry - *Greenhouse Gases and Global Warming* - http://www.eolss.net/ebooks/sample%20chapters/c06/e6-13-01-01.pdf (Accessed: 08 September 2014).

Wikipedia Internet Source: United Nations Framework Convention on Climate Change. http://en.wikipedia.org/wiki/United_Nations_Framework_Convention_on_Climate_Change (Accessed: 08 June 2015).

Wikipedia. Avoiding dangerous climate change. http://en.wikipedia.org/wiki/Avoiding_dangerous_climate_change (Accessed: 08 June 2015).

Wind in the Bush (2014). Greenhouse/Climate Change and Australia. http://ramblingsdc.net/Australia/Greenhouse.html (Accessed: 08 June 2015).

Wits Communications (2011). Climate change and South Africa: Economic stats & facts. An unpublished document prepared by Wits Communications in 2011. http://www.sabc.co.za/wps/wcm/connect/1a256c8048fbb493a82dbc71679ad05f/Stats

+and+Facts.docx?MOD=AJPERES&CACHEID=1a256c8048fbb493a82dbc71679ad05f. (Accessed: 05 June 2015).

World Bank (2011). Gas Flaring Down for Fifth Consecutive Year, The News Flare, Issue No. 12. March - October 2011. http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2012/01/18/000333037_20120118235052/Rendered/PDF/662720NEWS0Box0er0March0October2011.pdf (accessed: 08 September 2014).

World Commission on Environment and Development. (1987). *Our Common Future*. New York: Oxford University Press.

World Nuclear Association (2013). Climate Change – The Science. http://www.world-nuclear.org/info/energy-and-environment/climate-change---the-science/ (Accessed: 08 September 2014).

World Watch Institute (2006). Indonesian Tsunami Kills Hundreds as No Warnings Given. http://www.worldwatch.org/node/4428 (Accessed: 10 September 2014).

Promotion of Clean Emissions Charcoal Production by cost effective technologies at field scale level: Use of Biochar in kitchen garden

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Abstract

The surging demand of a growing and increasingly affluent world population for food and energy is confronting the earth's terrestrial ecosystems with mounting pressures. Changes in the global land system are a pervasive driver of global environmental change. At present scenario, land use is degrading the ability of ecosystems to deliver vital services to humanity. Land-use change often leads to biodiversity loss, changes in runoff, buffering capacities of ecosystems, greenhouse gas (GHG) emissions, soil and ecosystem degradation, and other adverse effects. Moreover, the population growth, limited access to resources for agriculture, degradation / acidity/ alkalinity / impaction of soils, food security, climate change and global warming are the various concerns. Biochar may play a role for the solution for many of the above aspects.

Crop production in Home Gardens (HGs) through the use of residues from the Improved Cook stoves (ICS) and semi gasifer technology have shown promising results under Alleviating Poverty and Malnutrition (APM) project in Agrobiodiversity Hotspot (UNESCO certified for Paddy) in India. Residues blending with compost -BioC+- had performed better on staple and root crops.

The research study concludes that: (i) gender implications & health, (ii) time saving, (iii) enhancing well-being, (iv) environmental benefits and (v) a policy perspective.

Study highlights that there is an emerging need to create large scale awareness among the farmers to continue traditional best practices including biochar application for improving the health of the soils and their sustainability.

1. Introduction

Worldwide, there is an increasing interest in using biochar in agriculture to help mitigate global warming and improve crop productivity. Biochar is recently living plant-derived biomass that, by a process of charring, has been converted into a form which is essentially non-degradable, and which is created for the purpose of its addition to agricultural soil. In addition to storing plant-derived carbon, biochar appears to offer benefits to soil performance, crop nutrient use efficiency and control of plant disease propagation or transference. It can also be a way of converting unwanted organic residues into a product that sequesters carbon and is good for the soil/future productivity (Zhao et. al 2012).The Biochar application is useful as a means of carbon sequestration and mitigating global warming issues too. Nearly 800 million tones of crop residue is generated by farmers in parts of India. Most of which can be converted into compost for soil carbon and Biochar.
In India threats such as climate change, poverty, declining agricultural production, scarcity of water, fertilizer shortage and the resulting social and political unrest seem overwhelming (Lehmann and Joseph 2009). The urgency to address these threats creates an ever increasing demand for solutions that can be implemented now or at least in the near future. These solutions need to be widely implemented both locally by individuals and through large programmes in order to produce effects on a global scale. This is a daunting and urgent task that cannot be achieved by any single technology, but requires many different approaches (Lehmann and Joseph 2009).

The soil is a very crucial factor in nutritious food production. Negative impacts on soil can lead in food crises. The most important problem of tropical agriculture is the inability of the land to sustain annual food crop for more than a few years at a time. There has been much recent interest in biochar as a way of stabilizing photosynthetic carbon, usually with associated energy by-products (syngas, bio-liquids and/or heat) (Lehmann and Joseph 2009; Shackley and Sohi 2010; Sohi et al 2010; Verheijen et al 2010). Biochar has been defined as 'the porous carbonaceous solid produced by thermochemical conversion of organic materials in an oxygen depleted atmosphere which has physiochemical properties suitable for the safe and long-term storage of carbon in the environment and, potentially, soil improvement' (Shackley and Sohi 2010). Apart from positive effects in both reducing emissions and increasing the sequestration of greenhouse gases, the production of biochar and its application to soil will deliver immediate benefits through improved soil fertility and increased crop production (Lehman et al 2006). Moreover, some researchers claim that biochar may be an immediate solution to reducing the global impact of farming (and in reducing the impact from burning of agricultural waste). It has been shown that biochar has multiple uses. When added to soil it can significantly improve soil fertility and also act as a sink for carbon (Lehmann 2007; Lehmann and Joseph 2009). In this way, the carbon is removed from the atmosphere in a process called sequestration (Zwietenoe 2006; Davies 2007).

Increases in crop yield with biochar application has been reported for crops such as cowpea (Yamato et al 2006), soybean (Tagoe et al 2008), maize (Yamato et al 2006; Rodríguez et al 2009), upland rice (Asai et al 2009), paddy rice (Shackley et al 2011; Sokchea et al 2012) and

water spinach (Sisomphone et al 2012a; Sisomphone et al 2012b; Sisomphone et al 2012c). Haefele (2007) and Haefele et al (2008) discussed the possibility of biochar applications for rice-based cropping systems. Reichenauer et al (2009) applied biochar in tsunami-affected paddy fields in Sri Lanka, and the experimental results showed that the application of 2 tonnes rice-husk-biochar per ha increased the grain yield from less than 4 tonnes per ha for the control treatment to more than 5 tonnes per ha for the biochar treatment. Boun Suy Tan (unpublished data) has also indicated that applying biochar (from a downdraft gasifier) to the soil at 40 tonnes/ha in combination with compost could triple the yield of rice from 1.25 to 3.76 tonnes/ha.

It is believed that biochar acts as a soil conditioner enhancing plant growth by retaining nutrients and by providing other services such as improving soil physical and biological properties (Glaser et al 2002; Lehmann and Glaser 2003; Lehmann and Rondon 2005).

Leafy vegetable - Spinach (Ipomoea aquatica), coriander, Staple crop - paddy, millet and Horticulture crop- tomato, lady finger and cluster beans that is consumed by people in India, particularly in study region Odisha; it has a short to long growth period, is resistant to common insect pests and can be cultivated in dry soils. Moreover, it has been found that all crop has a high potential to know more about trend of biodigester effluent into edible biomass with high protein content, specifically leafy vegetable (Kean Sophea and Preston 2001). This tested crop may attract small-holder farmers in this region to provide enough food and nutrition, due to the possibility to get higher yield than usual practice that particularly leafy vegetable is easy to grow and needs no processing.

It is advisable the pH of biochar produced by gasification of rice husks, and by earth kiln of prosopis julifora is less than 9 and 9.5 respectively and biochar produced from rice husk and other fuel wood by gasifier stove is 8.5. As these soil conditioners have high pH value, they should be used in the low pH soil (acid soil) because they can increase the pH of the soil (Southavong and Preston 2011; Sokchea and Preston 2011; Zhang et al 2012) and thus increase the yield of acid sensitive crops (Lickacz 2002; FFTC 2008). Positive results from application of biochar to acid (pH 4.5) soils in Colombia were reported by Rodríguez et al (2009). Of special importance in this study was the apparent interaction between biodigester effluent and biochar especially in very poor soil.

BioC+ (Inoculated mixture of Biochar, Jagery, native soil, vermicompsot), applied to vegetables and plants, it can lead to increases in biomass yield and a higher content of crude protein. Examples of these effects were observed in 10 vegetables and crop such as tomato, onion, cauliflower, cluster beans, spinach, finger millet.

Charcoal is a black substance that resembles coal and generally is made from wood that has been burned, or charred, in a reduced flow of oxygen so that what is left is an impure carbon residue. Charcoal is reported to have beneficial effects in soil by helping to clean the soil of pollutants; it also acts as a soil conditioner http://www.wisegeek.com/what-is-charcoal.htm. It is used as a top dressing for gardens, bowling greens and lawns, and as a substitute for lime in soil additives because of the potash content (http://www.buyactivatedcharcoal.com/natural_fertilizer). Ogawa (1987) reported that charcoal applied to the soil could stimulate the activity of soil microorganisms and promote the formation of root nodules and vesicular-arbuscular mycorrhizae in soybean roots.

2. The research problem:

The surging demand of a growing and increasingly affluent world population for food and energy is confronting the earth's terrestrial ecosystems with mounting pressures. Changes in the global land system are a pervasive driver of global environmental change [Global land project, (2005) and Turner et. al.(2007)]. At present scenario, land use is degrading the ability of ecosystems to deliver vital services to humanity [Millenium ecosystem Assessment (2005)]. Land-use change often leads to biodiversity loss, changes in runoff, buffering capacities of ecosystems, greenhouse gas (GHG) emissions, soil and ecosystem degradation, and other adverse effects [Foley et.al. (2005)]. Moreover, the population growth, limited access to resources for agriculture, degradation / alkalinity / hardening of soils, food security, climate change and global warming are the various concerns. Biochar is a part of the solution for the above aspects. There is a need to create large scale awareness among the farmers to continue traditional best practices of Biochar application and also adopt appropriate best technologies for improving the fertility of the soils and their sustainability.

The proposed research will be aimed to develop and test an integrated tool and framework for assessing the suitability and feasibility of different Biochars (feedstock) and application method to specific biophysical, biochemical of soil properties and socio-economic situations. This research is required as, despite the claims of widespread relevance of Biochar to study area in India. There is currently little understanding of the Biochar in farming systems and livelihoods-related constraints that undoubtedly limit its usefulness in many areas [Lehman et al. (2009a.); Lehman et. al. (2009b), Saran et. al. (2009) and Hammes (2007)]. The work will build on existing, largely technical, knowledge of Biochar and on work that has already gone into developing a purposeful selection tool. It will take a strongly comparative approach and will systematically examine a number of contrasting application environments in order to deliver a comprehensive assessment of where Biochar-related applications have potential and where they do not.

2.1 An overview on Biochar

Biochar is recently living plant-derived biomass that, by a process (Earthkiln, Gasifier Cookstove, Industrial gasifier) of charring, has been converted into a form which is essentially non-degradable. In addition to storing plant-derived carbon; Biochar has been shown to offer benefits to soil performance, crop nutrient use efficiency and control of plant disease propagation or transference. In constrained systems these effects can be manifest in enhanced crop yield. Biochar can be produced as the sole product or a by product of a range of pyrolysis or gasification technologies.

Biochar-related research has so far been dominated by technical studies that document the impact of biochar on soil properties, productivity and contributions to carbon sequestration etc. [Lehman et al. (2006) and Sohi et.al. (2010)]. Soil and productivity impacts are variable but it is often difficult to compare across studies due to differences in biochar source material (feed-stock), production method, application, soil properties etc. The UK Biochar Research Centre

(UKBRC) is developing an approach ("purposeful selection") that attempts to match Biochar type and application method with soil and production constraint. One of the objectives of their proposed research is to apply, test and refine this systematic, purposeful selection approach. Claims and projections of the relevance and potential global impact of Biochar, particularly as a mechanism for sequestering carbon, are impressive [Lal (2008), Lal (2009), Lenton et.al. (2009) and wolf et. al. (2010)].

The study of Biochar use in soil is just beginning, the possibilities are numerous, and the research work yet to be done is enormous. However the following benefits are identified with additions of charcoal and other additives: Enhanced plant growth, reduced fertilizer requirement, reduced leaching of nutrients, stored carbon in a long term stable sink – carbon sequestration, improved soil water handling characteristics, increased soil microbial biomass and increased arbuscular mycorrhyzal fungi.

The potential of organic agriculture to feed the world sustainably was a point of discussion in 2013 (Holger, 2013). Holger argued that organic yields are between 25 and 50 percent lower than yield from synthetic fertilizer, also depending on whether the organic system has access to animal manure. Moreover, the demand for organic products is gaining but it is limited and mainly concentrated in North America and Europe- which account for 96 percent of global revenues in the sector- and in some rich countries in Asia such as Japan, Singapore, South Korea, and Taiwan. Currently most consumers in poor countries are not willing to pay a premium price for organic products. Organic production in developing countries in Africa, Asia and Latin America is mainly export driven.

IDRC, Alleviating Poverty and Malnutrition (APM) project has contributed a subject to serve supply side constraint and nutrient crop through KKK concept. Biochar produce from home and apply to homestead garden is a step towards that. Biochar incorporated into the soil can influence it physically, chemically and biologically and potentially benefit plant growth [IBI 2010, Lehmann 2007] (see Figure 3). It can improve water retention; Chan et al (2007) observed improvements to hardsetting soil including tensile strength reduction, increases in field capacity and a higher pH when over 10 t ha^{-1} biochar was added. Biochar is typically alkaline, a useful property for addition to acidic soils. Biochar can also reduce the soil albedo (reflectance) [Grieshop et al (2009)], thus warming it, has not measured it. Certain nutrients are directly available through the solubilisation of ash contained within the biochar and microbial use of the labile carbon will lead to more plant available nutrients [Shackley & Sohi 2010]. Biochar retains cations better than other forms of soil organic matter and this ability increases as it ages in the soil [Lehmann (2007)], owing to its high CEC [Sohi et al 2010]. As it ages and particle size decreases, CEC may also increase [Shackley & Sohi (2010) and Lehmann (2007)]. Chan et al (2007) showed that biochar addition with fertiliser increased radish production, although biochar amendment alone did not. Asai et al (2009) found that the impact of biochar's addition in field trials depended on the presence of available nutrients from fertiliser (synthetic or organic). They suggested that the lack of available nitrogen in the soil led to decreased yields of paddy, millet, vegetable crop, after biochar addition, probably because of adsorption of available soil nitrogen onto the biochar's surface. The addition of biochar with no fertiliser, on the other hand, saw positive results for plant germination in Nursery, plant growth and crop yield. Experiments

carried out in Odisha found varied responses, including that in some cases, biochar alone led to significant plant growth (Karve et al. 2010).

The effect of biochar on soil and crop growth will also depend on the interactions with the soil type and microbes [Rondon et al (2007) and Warnock et al (2010)]. The receiving soil will also influence the longevity of the biochar, since even a recalcitrant fraction of biochar will eventually degrade in the soil and oxidise [Novak et al (2010)]. There are two main carbon fractions in biochar: the recalcitrant fraction which is frequently stable over hundreds of years and the labile fraction, which is mineralised in the short term (days to a few years) and returns to the atmosphere. Biochar can degrade abiotically and biotically, but the turnover in the soil is much slower than for plant litter [Glaser (2002)]. The exact length of time biochar will stay in the soil is debated, but 1000-1500 years has been predicted for the recalcitrant fraction (Lehmann & Joseph 2009). Biochar persists in the soil, since its aromatic structure renders it resistant to the usual process of microbial degradation of biomass in the soil [Baldock & Smernik (2002)]. Biochar which has been incorporated into agricultural soils can also potentially be 'lost' (or rather displaced) as it can move with eroded soil away from the site and enter river systems (Forbes et al 2006), though it will continue to store carbon. The long-term stability of biochar in the soil is important since stable carbon can potentially attract carbon finance.



Fig1. Traditional practice of biochar



Fig2. Biochar preparation



Fig3. Biochar demo plot in kitchenGarden

3. Objective:

1. Design a framework and tool(s) for assessing the site-specific relevance of biochar related technologies and selecting/designing these technologies to fit with the specific biophysical and socio-economic environment.
2. An understanding of the broader relevance of biochar in India provided from applying the tool to case studies.

Sub objective:

3. Is all biochar (different agri residues) the same?
4. How stable (mean residence time) is biochar in soil?
5. Is biochar/biochar compost (Clean/ contaminated) safe to use in Alkaline/Acidic soil?
6. What are the agronomic benefits (crop productivity through increased nutrient use efficiency, microbial load, increased water-holding capacity and decreased bulk density)?

4. Study Area:

Jeypore, Odisha already named in UNESCO agro biodiversity hotspots. Therefore it is more essential to the foundation through small and smart initiatives the forest conservation has been taken place.



Fig4. Study Area

To link up above and knowing tribal population irrespective of their economic status is forced to use fuel wood as main supply. The firewood in this region is mainly collected from the forests leading to an acute problem of deforestation in the entire region. Hence a fuel efficient cooking stove is the real need of the hour for the people habituating the region.

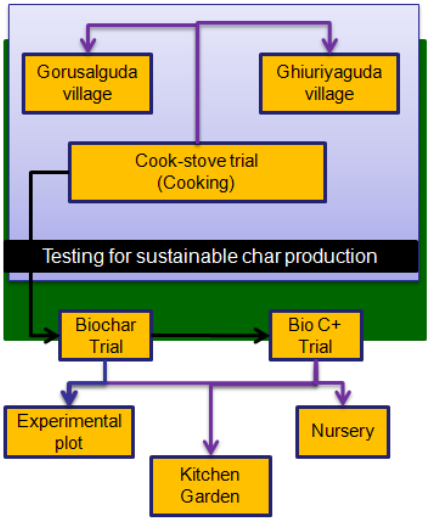


Fig5. Project Village & Experiment design

The project will therefore distribute a TLUD Gasifier Biomass Cookstove (in the following referred to as TLUD – "top lid up draft") to the households of Sundarbans at subsidized cost. The project will use carbon revenues to subsidize the purchase of these efficient stoves, and thus make them available for poor people.

4.1. Adopted Technology for Biochar research

The Top-Lit Up-Draft (TLUD) technology, redesigned by Servals group, local manufacture in Tamilnadu, dry biomass fuel is ignited on the top of a vertical container, starting the process of pyrolysis. While a pyrolysis front move downwards, the produced wood gas moves upward and as it exits the stove it is combusted in a flame appropriate for cooking. The TLUD allows for significant savings of firewood compared to traditional stoves and additional generates charcoal. The TLUD is especially suitable for the cooking habits of the people in the target region, since rice is the basic dish. Its design ensures efficient combustion of fuel and cleaner fire therefore uses considerably less fuel as



Fig6. TLUD Cookstove

compare to traditional stoves. This means speedy cooking, time and fuel savings, cleaner pans, kitchen walls and indoor atmosphere.

The key benefits of the TLUD are as follows:

1) It works on the pyrolysis technology and hence represents an improved biomass stove that generates a flame comparable to an LPG burner. It is simple to operate.
2) It results in significant saving of cooking fuel and thereby reduces the time and monetary cost of obtaining cooking fuel.
3) It requires low maintenance since it is made of stainless steel, durable and easy to clean.
4) It allows for faster cooking due to high fire power; there is no need to monitor the flame during the cooking session.
5) It reduces indoor air pollution and hence improves health for women and children.
6) It creates charcoal which is collected for multiple commercial applications at the end of combustion.
7) It is particularly suitable for the local cooking habits as the latter entails a lot of boiling (i.e. cooking rice, dals, vegetables, meat, etc.)

Apart from the direct benefits to the users, there are additional benefits to the community since the project will catalyze economic activity:

- Produce charcoal has been used to improve soil fertility in two methods; (1) Charcoal alone (ii) Charcoal with vermicompost, Jaggery and local soil.
- The use of remaining charcoal will also offer income and employment to locals. The project will establish a collection chain for the use of charcoal.

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	Cooking on traditional stoves with fuelwood	CO_2	Yes	Important source of emissions
		CH_4	No	Important source of emissions, but excluded for the sake of conservativeness, according to AMS-II.G
		N_2O	No	Excluded for the sake of conservativeness, according to AMS-II.G
	Use and production of conventional charcoal	CO_2	Yes	Important source of emissions
		CH_4	No	Important source of emissions, particularly for charcoal production, but excluded for the sake of conservativeness, according to AMS-I.E
		N_2O	No	Excluded for the sake of conservativeness, according to AMS-I.E
Project scenario	Cooking on traditional stoves with fuelwood	CO_2	Yes	Important source of emissions
		CH_4	No	Less relevant than in the baseline scenario, where it is also excluded
		N_2O	No	Less relevant than in the baseline scenario, where it is also excluded
	Use and	CO_2	Yes	Important source of emissions

	production of conventional charcoal	CH_4	No	Less relevant than in the baseline scenario, where it is also excluded
		N_2O	No	Less relevant than in the baseline scenario, where it is also excluded

Table1. Cookstove and GHG emission in baseline and project scenario (Source: www.cdmgoldstandard.org)

5. Project milestones

The study framework was designed to reach following milestone to understand the opportunities and challenges between Biochar – Gender, Biochar – Livelihood, Biochar – Soil Health and Food security. The framework has touched upon the critical element where research projects generally failed to cope up such policy implication, socio-economic issues, Lab- Lab, Lab-Field and Field to Lab Conditions. The study was also focuses and critical about the result outputs, market linkage, increase farm/ kitchen garden production, per crop income, reclamation of degraded soil, biochar marketing and upscalling. In small span, project was touched upon largely all aspects and results are broadly shared in result and discussion section.

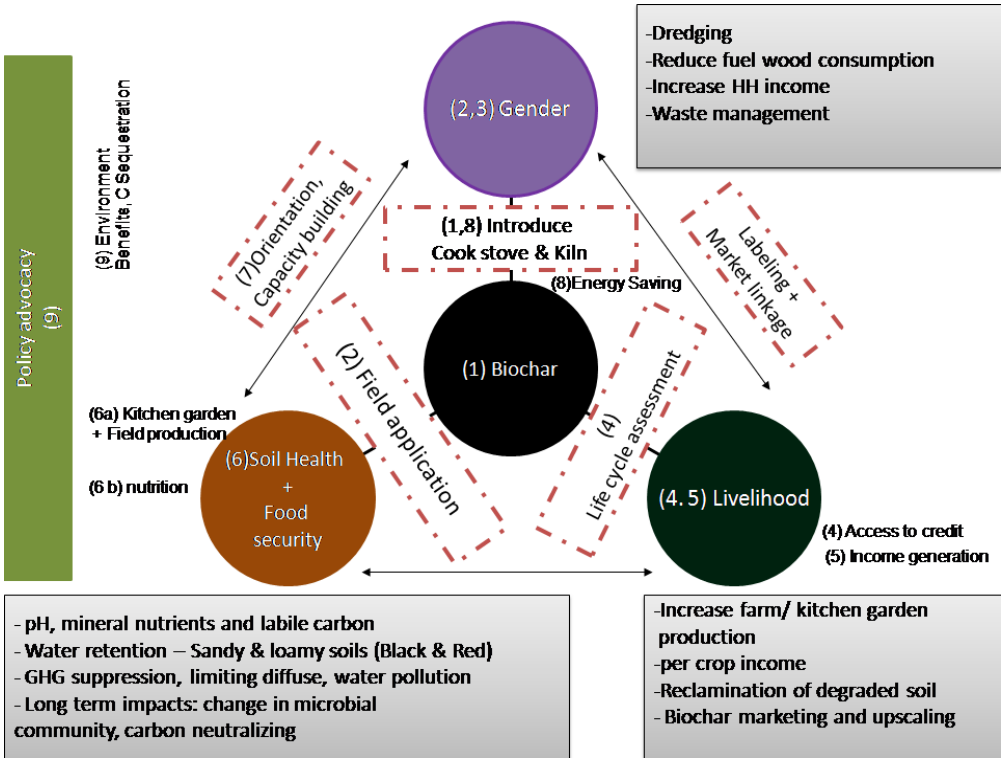


Fig7. Biochar study framework

1. Developing and deploying location specific, socially inclusive innovative char application to increase productivity in farm agriculture
2. Harnessing the strength the women and men in working together, their skill in processing of farm produces and their readiness to get out of drudgery in processing

3. Relative ease in promotion of local food for cultivation, consumption and value addition analysis, nutrition and income
4. Developing value chain for farm produces, involving network of women SHGs and supported by skill development, access to char credit, market linkage, and also char advocacy (no chemical fertilizers)
5. The potential of off farm livelihood option for employment and income generation particularly to women and landless labourers
6. Improved food and nutritional security with diversity in food basket and choice of crops to address chronic and hidden hunger
7. Sustaining the change through its institutionalization and training and capacity building of all stakeholders
8. Project management with built in mechanism for periodic assessment of the outcome/ effectiveness of project interventions, course corrections in sync calibrated social altitude to technology.
9. Holistic integration of crop farming, better management of natural resources (Land, water and biodiversity), improve char recycling, increase carbon sequestration, and need based, regulated use of agro chemical for pro nature sustainable change.

6. Methodology

The below step were taken to reaching the milestone:

6.A. Experiments (Lab-Lab)

a. Biochar – All biochar quality tests, germination and petri dish test were conducted in MSSRF Lab.

6.B. Experiments (Lab-Field, Field-Field)

b. Experimental plot – It was carried out in the integrated farming demonstration in kitchen garden of tribal families, Jeypore, Odisha, in the time period of September 2013 to June 2014, the mean air temperature variance is 4°C to 44°C and average annual rainfall 1500 mm/year in Odisha.

c. Experimental design - Experimental design ten treatments in Odisha were arranged in a randomized complete block design (RCBD) as a 3*2 factorial with 3 replications.

d. The factors of field were:

- Addition of biochar: @ different rate 2,4,8,10 kg/ha
- Plot size for crops: 1x1 m (Leafy Vegetable), 2x2m (Leafy Vegetable), 3x1.5m (Horticulture crop) and 3 x1.5m, 5 x5 m (Staple crops)
- Soil amender: T1 - Control – FYM, T2- Vermicompost, T3,T4,T5,T6 – Char and T7,T8,T9,T10- BioC+ at rate given in below tables.

Total HH : 50
Experimental plot: 2 (10 treatment x 3 replication)

Kitchen garden : 30
Nursery bed : 50
Crop tested in Sesson I : Amranthus, lady finger, Finger millet, paddy, onion, tomato
Crop tested in Season II: Cauliflower, Pumpkin, Beans, Onion, Tomato, Colocasia, Lady finger

Rate of application in kg/ha	Plots			
	Biochar	$BioC^+$	Control (FYM)	Vermi-compost
2	T3	T4		
4	T5	T6		
8	T7	T8		
10	T9	T10		
5			T1	
5				T2

Fig8. Plots wise rate of Biochar, $BioC^+$, Control (FYM), Vermi-compost application

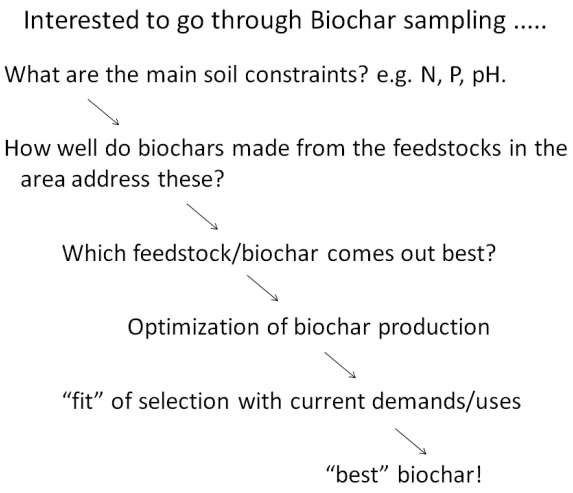
T2 VC	T3 C	T4 C	T5 C	T6 C	T7 C^+	T8 BC^+	T9 BC^+	T10 BC^+
T4 C	T7 BC^+	T1 C	T10 BC^+	T2 VC	T9 BC^+	T5 C	T6 C	T3 C
T9 C^+	T6 C	T2 VC	T8 BC^+	T3 C	T10 BC^+	T7 BC^+	T4 C	T1 C

Fig9. Randomized Complete Block Design (RCBD)

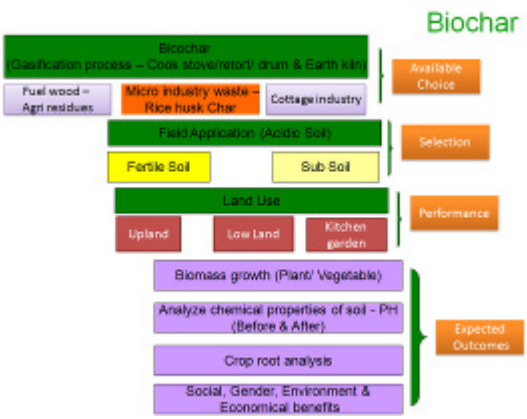


Fig10. Experimental view of Randomized Complete Block Design (RCBD)

6.C. Biochar characteristics



(a)





(b) **(c)**

Fig11. (a)- Know how of biochar in different biophysical condition, (b) Study framework of biochar and their expected outcome (c) Technology adopted to produce char

6.D. Materials

The biochar was derived from agro residues using updraft (TLUD) biomass gasifier at Kitchen garden. Farm yard manure, Jaggery was bought locally and healthy soils are collected from the adjacent field farmer. These material are taken in ratios 50% biochar, 50% vermicompost and 1 % Jaggery and 1 % soil and kept in sunlight for inculation for 15 days. Amranthus and Lady

finger (Okra) seeds were bought locally from the market. The below table is an example of crops tested. Annexure 2. has given list of crop tested in the field in different agro climatic zone.

7. Result and Discussion

7.1. Field test

The initial study has been carried out to understand how different types of biochar (Rice husk, Prosopis Julifora and mixed fuelwood) work in homestead garden in tribal household in Jeypore, Odisha. Biochars have been adopted and prepared from industrial and homestead gasifier (TLUD cookstove), respectively (Fig.12). The concept of Kitchen - Kitchen garden – Kitchen (KKK) has slow but effective acceptance in farmer community in Jeypore, Odisha. It has demonstrated how to cook food and make biochar at the same time, using a small Champion TLUD (Top Lit Up Draft) gasifier. Basic history of biochar and gasifiers cook stove has been given in addition to a live demonstration to community of creating high-quality of biochar and preparation of Bio C^+ from their home. Bio C^+ is a mixed of biochar, vermicopost/FYM, Jaggery and local soil and inoculated it for 15 days. The test has been carried out in four phases (1) Performance of different rate of Biochar and BioC^+ in experimental plot, (2) Performance in BioC^+ in farmland (3) Performance of BioC^+ in Nursery bed and (4) Performance of Biochar and BioC^+ in pot assay in foundation, Tamilnadu. So far five crops had been tested (1) Finger millet, (2) Radish, (3) Tomato (4) Cluster beans and (5) Chickpea and it has sown progressive results.

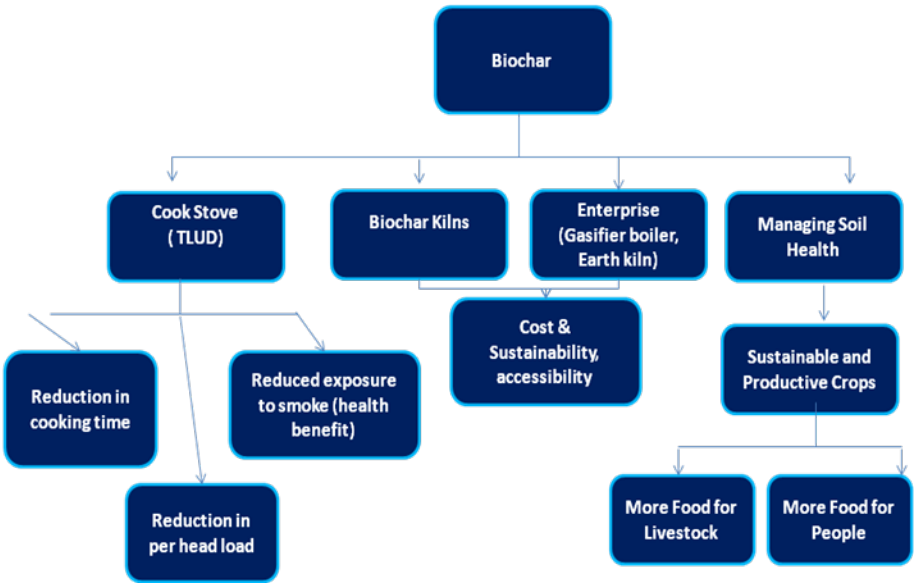


Fig12. Biochar Outline

7.2. Transforming the Homestead Outcome on Environmental Goods into a broader Sustainable Energy and Enhancing soil health and productivity: Can biochar be an option?

The term "biochar" in study is specifically used to designate pyrolysis char that is intentionally applied to soil in order to enhance its structure and fertility. Biochar applications are often also motivated by the objective of climate change mitigation. So far, two main disadvantages for the economic feasibility of biochar applications have been discerned. Firstly, carbon sequestration in agricultural crops and soils is not yet eligible under the Clean Development Mechanism. Secondly, the impact of biochar on crop productivity is unclear.

Economics of biochar - APM project has observed, per HH can generate, minimum 6-10Kgs char monthly, after two times cooking a day using TLUD-Servals gasifier cookstove, has cost Rs.2000/- (including product, transportation and training). Two and half months cooking with less smoke is more than enough to generate char for application in rate of 10 ton/hectare in size of 10 x 10 m^2 area of homestead garden, worth of Rs. 120/- per HH, at the rate of Rs.6/kg of BioC^+ (Char + vermicompost) at village level, where at district headquarter it reaches to Rs. 20/kg (Existing market price). Our understanding on two crop seasons with variety of agronomic or horticulture purposes, char as soil amendments, have been shown to increase soil fertility by improving nutrient and water retention, lowering soil acidity and density, and increasing microbial activity (Table 3 & Table 4). In addition, energy production from biomass that stores carbon as biochar can be considered carbon negative due to biochar's high recalcitrance (Table 1).

Types of biochars - Chars from, fast pyrolysis and gasification of rice husk, prospois julifora, oak, cassava and mixed wood were studied (Table 3) first as a baseline for homestead-producible biochars. Compared to traditional wood char (charcoal), these chars have high ash content, which may provide a liming affect on soil. Surface area and char aromaticity increase with process temperature, albeit with lower char yields.

Bio-C^+: Agricultural residues can potentially be converted into char through the process of pyrolysis. This char then can be converted to Bio-C^+ by incorporating any form of compost with it. Application of this Bio-C^+ in cultivated lands provides multiple environmental, economic and social benefits. It acts as a source of carbon sink, reduces emission of nitrogen dioxide from soils and enhances soil health. It increases water retention capacities of soils, enhances soil fertility and aids crop productivity. Further, use of energy efficient and modified cook stoves produces char, reduces the use of firewood, related drudgery of collecting firewood, reduces smoke and indoor pollution. Produced char can also be used profitably. Thus bio char can have an overall beneficial impact.

Results: Multiple physical, chemical and soil analyses are used to characterize the chars (Rice husk and mixed agro residues char-Odisha) to better understand how production conditions relate to end product biochar properties. After characterization, various lab, pot and field trials, conducted in collaboration with agronomists (MSSRF and Outside), has determine the performance of biochars as soil amendments in acidic red soils in two different homestead gardnen (45 Nos.) with crop responses. Chars from slow pyrolysis (Earth kiln), fast pyrolysis and gasification in small enterprises (rice husk) and household (mixed wood) were studied first as a baseline for locally-available/ producible biochars. As we were aware, compared to

traditional wood char (charcoal), these chars have high ash content, which may provide a liming affect on soil the dosage has given less which might affect the desired yield and secondly no to artificial fertilizer. Instead of artificial fertilizer, nutrient requirement has been compensated by Jeeva Amrit (Organic compost), has given less (-7 %) to high (20%) production as control plots (Table 2). **Yield enhancement**, Increases in yield approaching have been reported for crops such as leafy vegetable, horticulture crop and staple crop compare to control plot. **Increased water holding capacity**, biochar helps soils retain moisture, reducing the need for irrigation and alleviating water stress. Increased nitrogen fixation, Reported increases in biological nitrogen fixation in response to biochar application has been attributed to increased availability of minerals. **Reduced fertilizer run-off**, Increased fertilizer retention and utilisation result in less negative environmental impact from agriculture. **pH correction**, Biochar is generally alkaline; its application can increase soil pH and availability of phosphorous but we have observed negative effect in both field and lab condition.

APM Second phase: biochars initiatives will then be engineered from a wide range of biomass feedstocks using optimized thermochemical processing conditions for additional pot and field trials. This implementation cum study can be linked with largest and most elaborate carbon market segment (Table 1), which is the Clean Development Mechanism (CDM), which allows APM projects on Improved cookstove and biochar application to generate emission credits (Certified Emission Reductions, CERs) that can be bought by industrialized countries and used to fulfil their emission commitments under the Kyoto Protocol and the European Emission Trading Schme (EU-ETS). With the approval in February 2008 of AMS II.G, the first small scale methodology under the CDM to assess baseline and monitoring for activities promoting energy efficiency in biomass use, recognition of the carbo market potential of improved cooking stoves began to grow, especially in ters of a programmatic approach. In June 2008, the approval of a methodology for large scale projects on the voluntary market by Gold Standard (GS), a premium carbon credit labelling organization, once again focused the attention of the carbon market community on activities to promote improved cooking stoves connecting with food and nutrition angle. Similarly, other initiatives (Ex. Kitchen garden- Plantation – towards carbon bio village) can also be include under gold standard scheme registration.

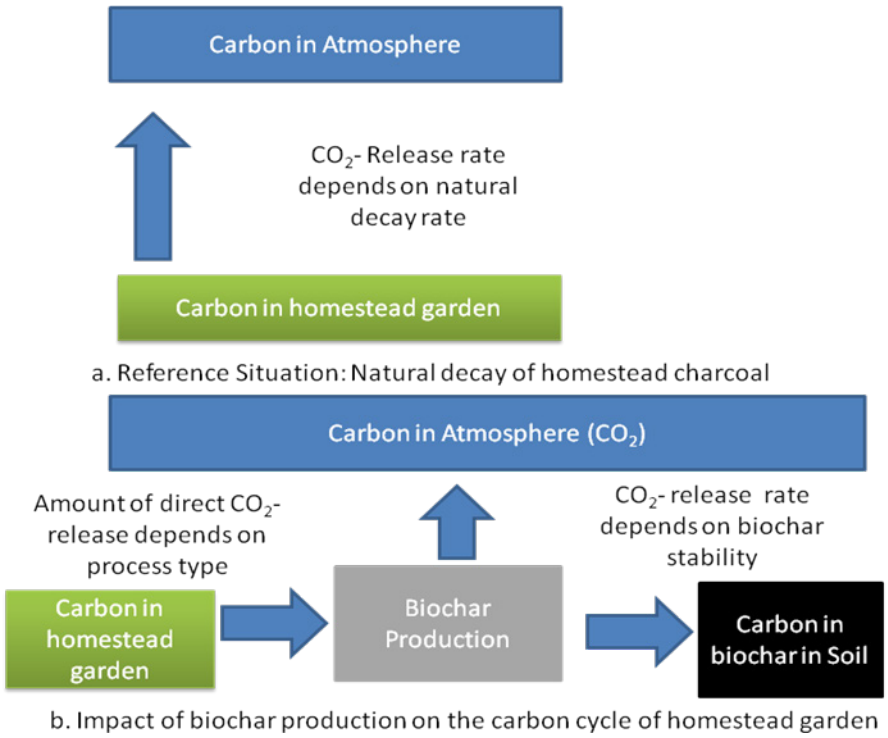


Fig 13. Carbon neutralization concept (Source: modified Meyer (2005) map)

7.3. Greenhouse gas (GHG) balance of biochar production and application

The production of char is in most cases slowing down the carbon cycling of the charred fraction of the feedstock (as compared to refrence situation with the natural decay of, e.g., forest residues or agricultural residues), the release of CO2 from the biomass conversion process will speed up the carbon cycle of the uncharred feedstock fraction compared to the reference situation. For a detailed discussion of this effect in the context of bionergy and biochar use and the supplementary information can be seen in the research briefs and posters and following tables.

Composition estimation - Odisha											
	Physical						Chemical				
	pH	EC	BD	PD	WHC	Po	P	N		pH	EC
FYM	6.87	0.02	0.76	1.4	75.8	57.6	2.64	7	Rice Husk	8.78	0.05
Vermi compost	7.08	5.85	0.63	0.5	108.6	36.9	8.6	14	Rice straw	9.62	0.27
charcol	7.3	5.85	0.24	0.6	307.3	104.4	3.96	23.8	Rice pellet	9.63	0.04
plain soil	6.04	0.7	1.14	1.8	44.1	48.1	6.6	49			
Bio C+	7.44	0.02	0.42	0.9	178.2	67.8	5.28	9.8			

(Rice husk)								
Rice Husk	8.78	0.05						

Table 2- Available organic fertilizer, Biochar, Biochar composition estimation [N-Nitrogen(kg/ha), P-Phosphorus (kg/ha), BD- Bulk density (g/cc), PD- Particle density (g/cc), WHC- Water Holding Capacity(%), Po –Porosity (%), EC- Electrical Conductivity (m.mhos/cm)]

<table>
<tr><th>Parameters</th><th>Trial duration in days</th><th>Source of Char</th><th>Trials (Control Vs. BioC+)

Leafy vegetable (E.g. Amranthus, Coriander), Horticulture Crop (Lady Finger, Tomato etc.), Staple Crop (Paddy, Millet)</th></tr>
<tr><td rowspan="2">Crop Performance</td><td>0-140</td><td>Prosopis Julifora

(Earth Kiln)

Rice Husk (Gasifier kiln)

Mixed Fuel wood

(Cookstove)</td><td>*Farmers practice vs BioC+ (Rate of Application 10 ton/ha)

<table>
<tr><th rowspan="2">Crop</th><th colspan="2">Shoot Length (cm)</th><th colspan="2">Straw yield (Kg/1m2)</th><th colspan="2">Biomass Weight (Kg/m2)</th></tr>
<tr><th>B</th><th>C</th><th>B</th><th>C</th><th>B</th><th>C</th></tr>
<tr><td>Millet</td><td>53</td><td>54</td><td>107</td><td>73</td><td>47</td><td>31</td></tr>
<tr><th></th><th colspan="2">Shoot Length (cm)</th><th colspan="2">Straw yield (Kg/1m2)</th><th colspan="2">Biomass Weight (Kg/1m2)</th></tr>
<tr><td>Amranthus Season I</td><td>5.3</td><td>16.9</td><td>1.2</td><td>4</td><td>0.034</td><td>0.15</td></tr>
<tr><td>Amranthus Season II</td><td>23.4</td><td>31.4</td><td>2.3</td><td>2.9</td><td>1.2</td><td>0.9</td></tr>
</table>
*B- BioC+, C- Control</td></tr>
<tr><td>0-140</td><td>Rice Husk (Gasifier kiln)

Extension Trial

10 ton/ha</td><td>
<table>
<tr><th rowspan="2">Crop</th><th colspan="2">Shoot Length (cm)</th><th colspan="2">Root Length (cm)</th><th colspan="2">Fruit Weight (Kg/m2)</th><th colspan="2">Biomass Weight (Kg/m2)</th><th rowspan="2">Variety</th></tr>
<tr><th>B</th><th>C</th><th>B</th><th>C</th><th>B</th><th>C</th><th>B</th><th>C</th></tr>
<tr><td>Lady Finger</td><td>51.2</td><td>47.8</td><td>17.6</td><td>15.2</td><td>1.3</td><td>1.1</td><td>1.3</td><td>1.2</td><td>Bejo</td></tr>
<tr><td>Cauliflo</td><td>45.</td><td>45.5</td><td>8.4</td><td>8.3</td><td></td><td></td><td>11.5</td><td>12.0</td><td>Barka, Pusa</td></tr>
</table>
</td></tr>
</table>

		[Odisha]	wer	1							
			Onion	3.7	3.7	20.2	20.2	3.5	3.5	1.9	1.8	Durga, Shakti
			Tomato	37.0	36.9	9.8	9.8	10.0	9.9	3.2	3.1	Pusa ruby, Utkal kumari
			Beans	42.5	43.8	14.8	15.1	18.4	19.7	2.0	2.2	Durga
			Brinjal (2 M,3H)	33.5	32.7	12.3	11.9	13.7	12.8	7.2	7.1	Blue Star
			Colcosia	42.5	42.3	16.7	15.9	14.1	13.9	2.9	2.7	Bada Suru
			Pumpkin					40	40			Baidyabati
			*B- BioC+, C- Control, Root (-3 to 6%), Shoot (-2 to 13%), Fruit weight (-7 to 15%), Biomass (- 4 to 7%)									
	0-120	*Rice Husk (Gasifier kiln)* Mixed Fuel wood *(Cookstove)*	Kitchen Garden 0- 10 ton/ha **[Odisha]**								

	Yield in Kgs (5x5m plot)	
Dose/sq. meter	Lady Finger	Amranthus
8	12.7	20.0
Control	8	15
1	11.5	22.1
Control	10	15

	0-30	*Rice Husk (Gasifier kiln)*	Kitchen garden Farmers's practice (Soil: FYM) (25:75/ 30: 70/ 40:60) vs. 10 ton/ha **[Odisha]**	**Season I** **Onion** Root (C/B) – 8/7.9, Shoot (C/B) – 20.3/20, Germination (C/B) – 70.2/69 **Tomato** Root (C/B) – 5.8/6, Shoot (C/B)- 18.2/ 17.3, Germination(C/B)- 71/69 **Season II** **Onion**

<table>
<tr><td></td><td></td><td></td><td></td><td>Root (C/B) – 8.3/8.4, Shoot (C/B) – 19.7/20.6, Germination (C/B) – 70.1/70.8

Tomato

Root (C/B) – 6.9/7.2, Shoot (C/B)- 16.6/ 19.6, Germination (C/B) – 70.1/70.9</td></tr>
<tr><td></td><td>0-180</td><td>Prosopis Julifora

(Earth Kiln)

Rice Husk (Gasifier kiln)</td><td>Pot Assay Trial

0- 10 ton/ha

[MSSRF]</td><td>
<table>
<tr><td colspan="6">Millet (after 55 days)</td></tr>
<tr><td colspan="2">PH</td><td colspan="2">PLC</td><td colspan="2">PW</td></tr>
<tr><td>C</td><td>B</td><td>C</td><td>B</td><td>C</td><td>B</td></tr>
<tr><td>4.2</td><td>7.2</td><td>4</td><td>7</td><td>0.4</td><td>3.7</td></tr>
<tr><td colspan="6">Pegion pea (after 10 days)</td></tr>
<tr><td>7.4</td><td>16.2</td><td>5</td><td>9</td><td></td><td></td></tr>
<tr><td colspan="6">Radish</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="6">Tomato</td></tr>
<tr><td>12.5: 87.5</td><td colspan="2">25:75</td><td colspan="3">50:50</td></tr>
<tr><td>PH- 19</td><td colspan="2">24</td><td colspan="3">22</td></tr>
<tr><td>PLC- 5</td><td colspan="2">6</td><td colspan="3">7</td></tr>
</table>
PH- Plant Height (cm), PLC – Plant Leaf Count(N0.), PW – Plant Weight (milli gram), 12.5 – Soil, 87.5 – BioC+, 25 – Soil, 75 – BioC+, 50 – Soil, 50 –BioC+</td></tr>
<tr><td>Soil Test</td><td colspan="5">Odisha
<table>
<tr><td>Parameter</td><td colspan="2">Amranthus</td><td colspan="2">Beans</td><td colspan="2">Tomato</td></tr>
<tr><td>0-15 cm</td><td>Control</td><td>BioC+</td><td>Control</td><td>BioC+</td><td>Control</td><td>BioC+</td></tr>
<tr><td>pH</td><td>6.77</td><td>6.87</td><td>6.57</td><td>6.58</td><td>6.84</td><td>5.88</td></tr>
<tr><td>organic carbon (%)</td><td>0.39</td><td>0.48</td><td>0.38</td><td>0.47</td><td>0.35</td><td>0.34</td></tr>
<tr><td>Phosporous (K.g/Ha)</td><td>21</td><td>19</td><td>15</td><td>18</td><td>17</td><td>30</td></tr>
<tr><td>Potash(K.g/Ha)</td><td>134</td><td>286</td><td>190</td><td>116</td><td>210</td><td>279</td></tr>
</table></td></tr>
</table>

Table 3- Plant response in different biochar application [*PBTC – Performance better than control, (Units: Root – cm, Shoot – cm, Fruit weight – Kg, Biomass – kg), A- 0-15 cm, B- 15-30cm, Bacteria load- 10^4, Fungi load- 10^2, Treatment- T1- Control (5 t/ha), T2- VC (5t/ha), T3 (2 t/ha), T4(4t/ha),T5(8t/ha),T6 (10t/ha) – Char, T7 (2t/ha),T8(4t/ha),T9(8t/ha),T10(10t/ha)-BioC+]

Lab Test	Compost / Microbial / Trial		VC	FYM	Char	BioC^{+}
	1 day – Petri Dish					
	Bacteria colonies	Odisha	*29*	13.5	8.5	49
		Kolli hills	*36.5*	37	15	78
	2 day – Petri Dish					
	Fungi colonies	Odisha	24	23.5	19	41
		Kolli hills	26.5	6.5	13	18.5
	Germination test (wit h 14 seeds)	Odisha		12	11	13
		Kolli hills		13	12	14
	Germination Test					
	1 week	Root	Shoot	Leaf	Germination rate	
	BioC^{+}	11	14	3	100	
	Char	9	6	2	40	
	FYN	12	11	3	40	
	VC	16	13	4	60	

Table4 – Lab test results

7.4. Performance of Biochar

The experimental results of biochar made from rice husk in Odisha and prosopis julifora grown in acid soil without any fertilizer application significantly improve some properties of the acid soil namely: decreasing soil bulk density, and increasing soil pH, soil organic matter, total P. The improvement of soil properties with organic soil amendment applications resulted in an improvement of finger millet, radish growth as shown by an increase in plant height, number of tillers, and dry biomass. A significant negative correlation occurred between dry biomass and soil texture; and a significant positive correlation occurred between dry biomass, soil organic matter, and total P. Production were low in all cases in both the sites during first season.

Sample	ST	BD	PD	WHC	P	pH	EC	Po	N	FL	BL
	Finger Millet (Sandy loam)										
1	Control	1.2	2.7	45.5	31.3	5.5	0.13	6.6	245.0	19.5	5.5
2	Biochar	1.6	2.7	44.5	42.4	5.6	0.12	2.6	189.0	57.0	30

Table5 –Soil Analyis control vs. Biochar in Finger millet field (Average of five samples) [(N-Nitrogen(kg/ha), P-Phosphorus (kg/ha), BD- Bulk density (g/cc), PD- Particle density (g/cc), WHC- Water Holding Capacity(%), Po –Porosity (%), EC- Electrical Conductivity (m.mhos/cm), N- Nitrogen (Kg/Acre) FL-Fungal load (cfu/µl), BL- Bacterial Load (cfu/µl)]

Performance based on 100 % acceptance of TLUD for Cooking and boiling water	
Parameters	**Odisha**
HH Cooking in a day	2
50% efficient cooking – char can receive after each cooking (100 grams/ canister)	300 (3-4 times)
50 cookstove can produce in kg per month	450
Per annum production of Char in Tons	5.4
Income by selling charcoal	>4 years
Requirement of biochar for 50 kitchen garden (size 25 sqm)@ 10 tons per hectares for two crop season	1.25 ton

Table 6. Sustainable source of Biochar and Income generation by using ICS

Cook stove	Time to Boil (minutes)	Fuel Use (gram)	CO emission	PM Emission
3 – stone	38	1253	65	2363
TLUD	27	737	18	255
Reduction	11	41%	72 %	89 %

Table 7. Emission reduction

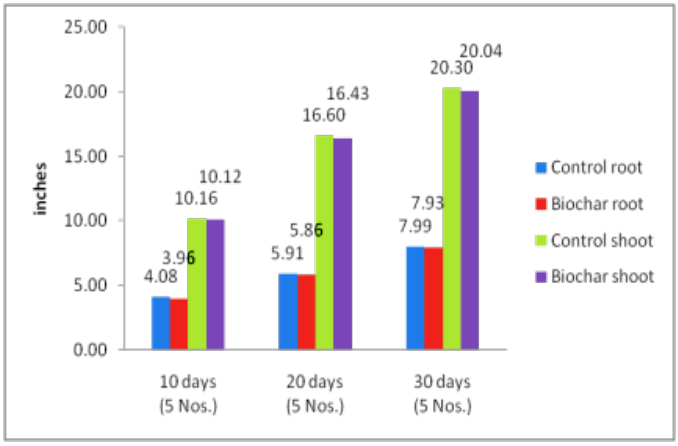


Fig14. Root growths observation in short time span (Average of 15 observations)

7.5. Can biochar perform under carbon revenues help transform household energy, markets, soil and food security?

Biochar is made through a process called pyrolysis. Feedstock, which is a form of biomass, is heated with little or no oxygen to temperatures of 350° C to 700° C. The type of biochar made depends on two variables: the type of biomass being used and the temperature and speed at which it is being heated. For example, a higher, faster heating of the biomass (fast pyrolysis) will result in biochar with less microorganisms, smaller pore size and more liquid and gas components. Biochar made at a slower and lower temperature (slow pyrolysis) will have more microorganisms, a bigger pore size, and more solids, thus more biochar produced. Biochar can be made by people using homemade pyrolysis devices (cookstove) however it is also being made on a large scale basis by industries (Parabolised rice and Cashew factory) as by product.

Biochar has been used for many purposes such as activated carbon, water purification, beauty products but in MSSRF experiment, it has used as a soil conditioner. Biochar is under investigation as an approach to carbon sequestration to produce negative carbon dioxide emissions. Biochar thus has the potential to help mitigate climate change, via carbon sequestration. Independently, biochar can increase soil fertility, increase agricultural productivity, and provide protection against some foliar and soil-borne diseases.

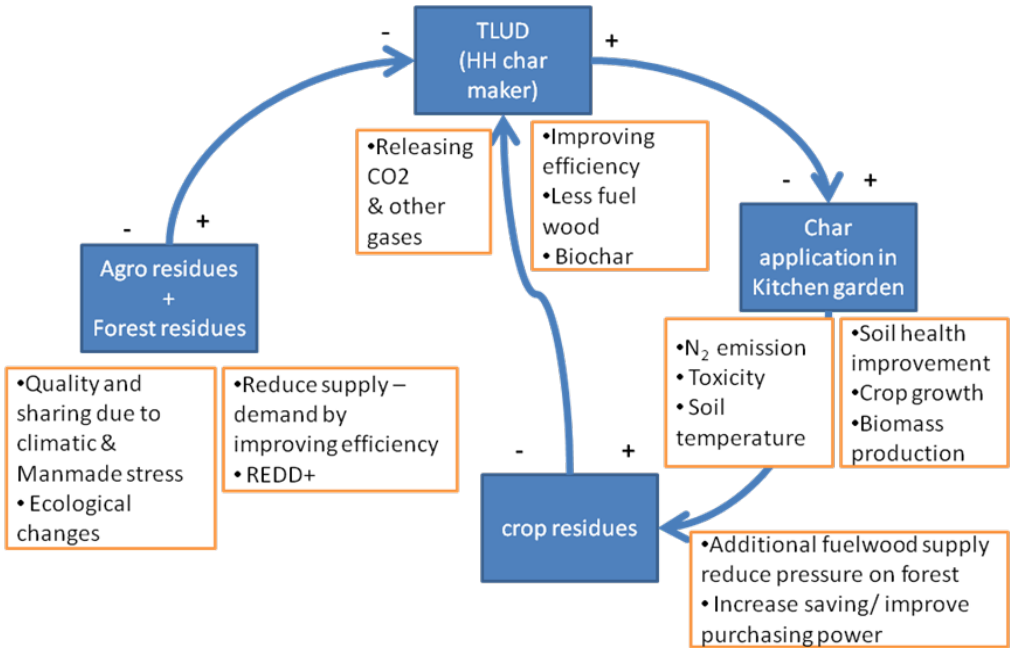


Fig15. Sustainable approach for human/nature wellbeing

7.6. Opportunity by using Technology (Cookstove & Semi gasifier technology)

Carbon credits from cookstove programmes: an emerging market, four offset programmes have methodologies to credit cookstove projects: the Clean Development Mechanism (CDM), the Gold Standard, the American Carbon Registry (ACR), and Verified Carbon Standard (VCS). To date projects have been developed primarily through the CDM and the Gold Standard, with a handful of projects under the VCS. A total of 96 cookstove projects have been registered in the carbon market, 61 under the CDM, 32 under the Gold Standard and three under the VCS (UNEP). The similar concept can be modified and tested for our stoves to reduce cost and improve access of modern cookstove to community.

7.7. Policy discussion

A consensus is emerging among policy-makers and donors that a market-based approach is needed to scale-up Kitchen- Kitchen garden – Kitchen (KKK) initiatives and ensure their long-term sustainability. The finding on cookstove initiatives and growth rate and soil result after first and second season research suggest that projects face two key challenges: motivating households to adopt and use the new stoves, and securing adequate resources for project implementation, including startup costs, market research, product development, outreach and promotion, finance for users (e.g. microloans), and after-sales support and monitoring. Our analysis focuses on how carbon finance might help or hinder projects in meeting those challenges. Centre 2014; Markit Financial Information Services 2013).

7.8. Does improve cookstove cum biochar initiatives projects deliver high-quality carbon offsets for India or South East Asia?

Improved cookstove with multipurpose benefits projects need to be able to demonstrate that they offer credible and scientifically robust methodologies for estimating, monitoring, and verifying emissions reductions. In prior work, It has been reviewed existing carbon market methodologies for improved cookstove projects, only based on cooking efficiency, fuel & drudgery reduction and Indoor Air Pollution (IAP) under CDM and the Gold Standard (Lee et al. 2013). MSSRF initiative found that there is considerable room for improvement in how climate benefits from improved cookstove projects can be estimated and accounted for fuelwood and drudgery reduction in forest area, IAP and kitchen garden together. We recommended, for example, requiring accounting of uncertainty, reviewing the integrity of default factors for the fraction of biomass used that is non-renewable, and evaluating the use of fossil fuel CO2 emission factors as surrogates for biomass combustion.

7.9. Is carbon finance suitable for improved cookstove interventions that aim to achieve a market transformation?

Learning from Stockholm Environment Institute, Project Report 2014-01 shows that carbon finance can be valuable to support further dissemination of improved cookstoves cum biochar initiative. It can help build an increasingly vital market for improved cookstoves cum biochar compost, attract international actors and technologies, help establish standards for monitoring stoves, and facilitate better follow-up and support to end users. Although our research underscores what the literature says about the potential for high-end direct subsidies on stoves to devalue the product in the eyes of the user, and thus damage the wider market for improved cookstoves, a systematic assessment of the impact of carbon-financed price subsidies was not possible, given that most projects in India are in early stages.

7.10. Areas for further study

There is a clear need to better understand the advantages of introducing a new cookstove cum biochar under “the carbon way”. In particular, further work is needed to understand whether a programme of monitoring, crop yield performance and soil improvement, which is often stipulated in carbon finance interventions, will actually increase end-user uptake of the new technology. The best way to determine this would be to compare an intervention using carbon finance that has monitored use for a longer time period with a “control group- atleast 3 years” of interventions that do not do monitoring and follow-up. This would also shed light on the broader impact of carbon finance on improved cookstove project implementation. An analysis of this kind would be particularly interesting in India, not only for markets but food security through KKK model.



(A)



(B)



(C)



(D)



(E)



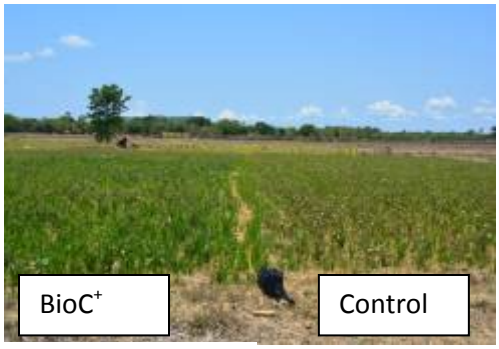
(F)



(G)



(H)



(I)

Fig16. (A) – Cooking Mandiya for Ten people in Odisha (Outside) (B) Cooking rice for five people in Kolli hills, Tamilnadu (C) Byproduct (biohcar) of cookstove made by Mango and Eucalyptus twigs (D) Biochar Collection (E) Prepration of BioC+ (F) Experimental plot - millet (G) & (H) Growth of radish in Control (T1) and $BioC^{+}$ (T10) treatment plots and (I) Pest attack in Control (T1) and $BioC^{+}$ (T10) tomoato plots, where pest effect has less in $BioC^{+}$ plot.

7.11. Fuel wood and Time saving

Six months rigorous survey were conducted to know the cookstove use by each house hold and how much each household were saving fuel wood and time had taken (Fig17 and Table 8) while cooking. One can see that fuel wood saving has increased by each household but it was not matched with the projected fuel wood saving consumption. It has various regions but the most important regions are households still using mud stoves to cook their meal faster and saving leisure time for other work. They engaged slow cooking items (Rice, Mandya (Millet soup)) in TLUD and fried items and vegetables they generally make it in clay stove. Using three stove burners, each of the households can save at least 10-15 minutes which is more than enough to get ready and take the bus for work and almost all (both men and women) are labors and search their odd jobs in nearest city.

Community has well adopted and accepted the ICS (Table 9) which we further surveyed for policy advocacy forum. After all recognitions, still behavior change on saving fuel wood and environment are least in priority. Again it has two main regions, availability of fuel wood (Eucalyptus twigs and leafs) at door step and less educated.

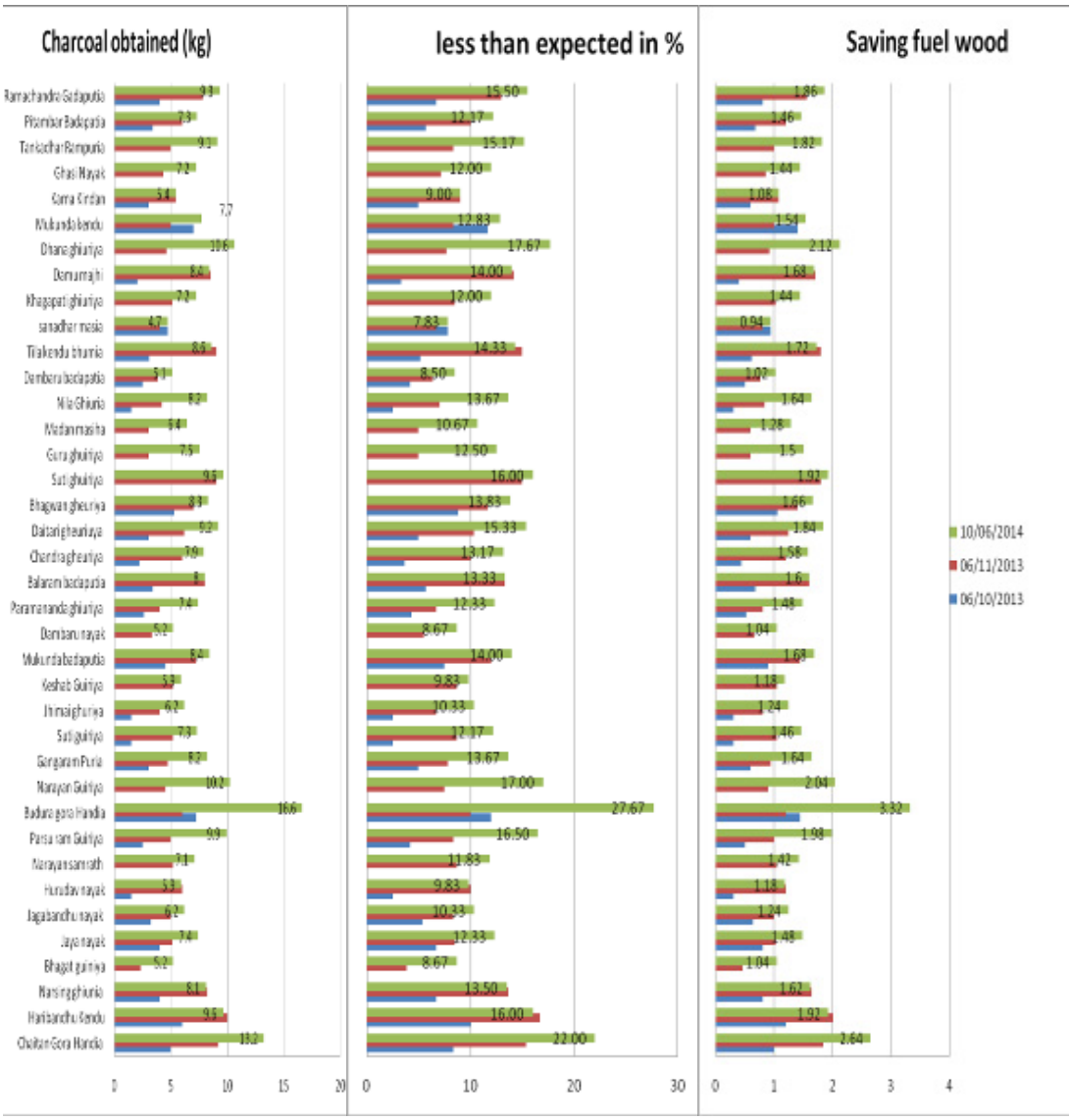


Fig17. Household survey for Cookstove use and biomass reduction

Food items	Amount of fuel wood used (in kg) in clay stove	Timming	Amount of fuel wood used (in kg) in TLUDStove	Timming	Char-coal weight (gram)	Saved fuel wood (%)
Rice	1.41	28.26	0.97	25.52	296.60	45.51
Dalma	0.39	8.28	0.30	7.54	(for cooking	31.33
Mandiya	0.81	16.32	0.56	15.04	three food	45.50
Vegetable	0.24	5.28	0.19	4.54	items)	30.76
Fry	0.27	5.36	0.21	5.18		31.71
Atani	0.37	7.46	0.28	7.12		34.05

Table 8. Comparison of TLUD vs. Clay stove – time taken while cooking different dishes and fuel wood saving

Policy Advocacy – Tested with 50 HH in Odisha	Percentage	
	Yes	No
Is it useful product?	100	0
Will you suggest to your friend & family?	98	2
Can it save cost? If biomass is not freely available	100	0
Can it reduce drudgery? Reduce time taken to gather fuelwood	100	0
Reduce the consumption of fuelwood	100	0
Ease of Use	100	0
Ease of Maintenance	80	20
Ease of size fuelwood to put in canister	100	0
Durability of Stove	100	0
Ability to withstand rough handling	40	60
Ease of working with the flame (starting it, controlling the flame, extinguishing the flame etc.)	34	66
Ability to cater to my cooking requirement	82	18
Provide adequate cooking duration	56	44
Provide adequate flame power	70	30
Reduce smoke	80	20
Enables faster cooking	100	0
Free time for other activities	98	2
Does not require constant supervision	0	100
TLUD being suitable to all my cooking vessel	84	16

Table 9. User performance analysis (Average of 50 HHs)

7.12. Biochar and BioC^{+}

Initial result, need to be further strengthen to adopt management strategies to cope with climate change

- Shift in planting dates after using biochar and BioC^{+} (fine tuning for before and after rain) - germination was low due to delay sowing in the field but rate of survival was high in BioC^{+} treated plots.
- Improving fertilizer use efficiency and reducing volatilization / emission – University practice (adopted from TNAU website) with or without biochar and has also been tested; residual effect of fertilizer has seen while applying no biochar in second season in same plot, which has also produced high yield compared to other treatments such as rate of biochar alone (2, 4, 8 and 10 ton/ha) and BioC^{+} (2, 4, 8 and 10 ton/ha).
- Less nitrogen fertilizer, may contributes in the reduction of Nitrous oxide emission. (Residual effect has been seen in case of Radish and Chick pea plant in university practice with Biochar)
- Organic fertilizer (Cost of reduction of fertilizer making (BioC^{+}) has calculated in case of Odisha, while using Industrial waste such as rice husk char, for kitchen garden it is absolute free.)
- Crop/ vegetable waste management (Seeing better performance of Biochar + Farm yard manure mix, it has also been observed that rate of compost production in small pit is faster compare to normal way of produce)
- Converted agri residues/ waste into high quality combustible fuel for domestic/ microenterprise purposes
- Value addition of the waste can be tested such as activated carbon, cement binder or brick production at a commercial level
- Integrated crop management (after introducing biochar application); can be involved: Focus on environmentally friendly practices, judicious use of pesticide; Bio pesticides; Seed treatment; Cultural practices.

8. Conclusion

The adoption and sustained use of improved cook-stoves has been tested in APN project to eradicate poverty and malnutrition indirectly. The critical performance parameters of the cooking methods and meals preparation time were studied and it clearly indicated that mind set change by stakeholders can address four out of eight millennium development goals. No stove and field technology program can achieve its goals unless people initially accept the stoves and continue using them on a long-term basis where in Odisha acceptance is high but still it is used as a tertiary stove. Indirectly cook stove has given pathways which can deal climate adaptation and mitigation strategies as below:

- Kitchen-Kitchengarden- Kitchen (KKK) concept has provided judicious use of fuel wood and secure nutritious food for the household throughout the year.

- Biochar/ Bio C+ application increased microbial biomass and had a positive impact on soil microbial functional diversity. The results highlight higher microbial activity in soils receiving after initial compost applications.
- Nearly equal production in nursery and Kitchen garden by applying same dosage of FYM (control plot) and BioC+ (Experimental plot) can be looked as a cost reduction in farming system - without considering additional benefits of Carbon sequestration, irrigation reduction and soil texture
- Access to clean water can be a crucial issue for many rural communities in developing countries therefore activated carbon (AC) can be considered as technology for the removal of synthetic organic compounds (SOCs) in poorly managed water in rural areas.
- An option Biochar carbon offset protocol for carbon markets through carbon neutral village can provide an additional revenue stream to projects delivering greenhouse gas emissions reductions through soil carbon sequestration.

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9. References

[1]Baldock, J.A., Smernik, R.J., 2002. Chemical composition and bioavailability of thermally, altered Pinus resinosa Red Pine wood. Org. Geochem. 33, 1093–1109.

[2] Barnes A, D.F, Openshaw, K, Smith, K.R. and van der Plas, R., 1994. What Makes People Cook with Improved Biomass Stoves?, 1994

[3] Chan, K.Y., Xu, Z., 2009. Biochar: nutrient properties and their enhancement. In: Lehmann, J., Joseph, S. (Eds.), Biochar for Environmental Management. Earthscan, London, pp. 67–84.

[4] Carter, S. & Shackley, S., 2011. Participative Distributed Innovation Process and Biochar: Smoke reduction, sustainable agriculture and soil management. Final Technical Report - in press. University of Edinburgh. Asian Institute of Technology.

[5] Energy Series. May 1994.

[6] Foley J.A., DeFries R., Asner G.P., Barford C., Bonan G. and Carpenter S.R. *et al.*, 2005, Global consequences of land use, *Science* **309** , pp. 570–574.

[7]Glaser, B., J. Lehmann, and W. Zech. 2002. Ameliorating physical and chemical properties of highly weathered soils in the tropics with charcoal—a review. Biology and Fertility of Soils 35:219–230.

[8] Global Land Project (GLP), 2005, Science plan and implementation strategy, IGBP Secretariat, Stockholm.

[9] Hammes K., Schmidt M.W.I., Smernik R.J., Currie L.A., Ball W.P., and Nguyen T.H. *et al.*., 2007. Comparison of quantification methods to measure fire-derived (black/elemental) carbon in soils and sediments using reference materials from soil, water, sediment and the atmosphere. Global Biogeochemical Cycles 21, 1-18.

[10] IPCC 2000, Land use, Land-use change and Forestry. IPCC Special Report. Cambridge University Press: Cambridge. 375 pp.

[11] IPCC 2006, Intergovernmental Panel of Climate Change. Revised IPCC Guidelines for National Greenhouse Gas Inventories. World Book (Vol. 2), Module 4, Agriculture.

[12] IPCC 2007, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[13] IPCC 2007, Climate Change-Impacts, adaptation and Vulnerability. Contribution of working group II to the fourth assessment report of the IPCC, Cambridge University Press, Cambridge.

[14] Lehmann C.J. and Joseph S., 2009a. Biochar systems. In: Lehmann, C.J., Joseph, S.(Eds.), Biochar for environmental management: science and technology. Earthscan.

[15] Lehmann J. and Joseph S., 2009b. Biochar for environmental management: science and technology. In: Earthscan, London.

[16] Lehmann J., Gaunt J. and Rondon M., 2006 Bio-char Sequestration in Terrestrial Ecosystems – A Review Mitigation and Adaptation Strategies for Global Change 11: 403–427 DOI: 10.1007/s11027-005-9006-5

[17] Lehmann & Joseph, 2009. Biochar for Environmental Management Science & Technology. Earthscan, London.

[18] Lal R., 2008. Carbon sequestration, Phil. Trans. R. Soc. B 363: 815–830

[19] Lal R, 2009. The Potential for Carbon Sequestration, Brief 5 in International Food Policy Research Institute Focus

[20] Lenton T.M., and Vaughan N.E., 2009. The radiative forcing potential of different climate geoengineering options, Atmospheric Chemical Physical Discussion 9: 2559-2608

[21] Millennium Ecosystem Assessment,2005, Ecosystems and human well-being - our human Planet, Island Press, Washington, D.C. (2005).

[22] Saran S, Elisa C, Evelyn K and Roland B, 2009. Biochar, climate change and soil: A review to guide future research: Evelyn Krull CSIRO Land and Water Science Report 05/09

[23] Shackley, S.J., Carter, S., Sims, K., Sohi, S., 2010. Expert Perceptions of the Role of Biochar as a Carbon Abatement Option with Ancillary Agronomic and Soil-related Benefits. Energy and Environment. (Manuscript accepted).

[24] Sisomphone S, Preston T. R, and Ngo V. M., 2012. Effect of biochar and charcoal with. staggered application of biodigester effluent on growth of water spinach (Ipomoea aquatica), Livestock Research for Rural Development 24 (2)

[25] Sohi S. P., Krull E., Lopez-Capel E. and Bol R., 2010. A Review of Biochar and Its Use and Function in Soil. Advances in Agronomy 105: 47-82.

[26] Turner B.L., Lambin E.F. and Reenberg A., 2007, The emergence of land change science for global environmental change and sustainability, *Proc Natl Acad Sci* **104**, pp. 20666–20671.

[27] Warnock, D.D., Lehmann, J., Kuyper, T.W., Rillig, M.C., 2007. Mycorrhizal responses to biochar in soil – concepts and mechanisms. Plant Soil. 300, 9-20.

[28] World Bank Technical Paper 242.

[29] Woolf D., Amonette J.E., Street-Perrott F.A., Lehmann J. and Joseph S., 2010. Sustainable biochar to mitigate climate change. DOI: 10.1038/ncomms1053

[30] Zhao F, Yang W, Zeng Z, Li H, Yang X, He Z, Gu B, Rafiq MT, Peng H. 2012. Nutrient removal efficiency and biomass production of different bioenergy plants in hypereutrophic water. Biomass Bioenergy. 2012;42:212–218. doi: 10.1016/j.biombioe.2012.04.003.

Annexure I

Earning 4300/- Per month

Earning 4000/- Per month



Opportunity came to our door place. Earning 3900/- Per month

One Canister is enough???



Wow, Mandiya is ready for ten people in just one canister, less than 1.5 Kgs wood and got 300 gram valuable char.



Am ready to consume different size of woods and provide different size of charcoal


Two months cooking is enough for homestead garden and what else can we do with this char?

REMUNERATIVE INVESTMENT POTENTIALS IN NIGERIA ELECTRIFICATION BY RENEWABLE ENERGY

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Abstract

Energy is one of the major challenges that Nigeria is faced with as a country. It has dreadfully affected the economic, social, educational and technological development of the nation. Small and medium scale enterprises are going bankrupt on a daily basis because they could not survive such an infrastructural challenge. Even large scale enterprises are not spared in this industrial holocaust, this has contributed to the high rate of unemployment which in turn has led to increase in crime rate. Domestic home users of energy have also suffered mishaps as a result of the risk of using gasoline and diesel generators due to epileptic energy supply caused by dysfunction of the energy sector in Nigeria. The study employed the use of secondary data gathered from the Energy Commission of Nigeria, the KPMG and the Price Water Coopers. This study shows the environmental potentials for renewable energy system in Nigeria coupled with the fact that the country is a tropical region. A good example is the extreme maximum temperature between Monday 19th and Sunday 25th May, 2014 which was between 31o C and 41oC across Nigeria (Nigerian Metrological Agency Climate Review Bulletin 19th – 25th May, 2014). This study also presents renewable energy as a potential investment opportunity in Nigeria. There is no doubt that Africa's most populous country with a population of over 170 million is a good hub for investment in renewable energy.

Keywords: Industrial Holocaust, Renewable Energy, Epileptic Energy Supply, Environmental Potentials.

1.0 Introduction

The importance of electrical energy as an essential precondition for the development of every society cannot be over emphasized. Nigeria just celebrated 4600 MW of energy generation which is a far cry from the amount of energy required. The required energy demand in Nigeria is about 20,000MW to 25,000 MW [1] to support economic growth and development. Renewable energy such as hydroelectricity, wind energy, biomass and waste, solar and geothermal can be harnessed to put an end to the scanty energy generation we are currently experiencing in Nigeria. Nigeria is generating 0.55 to 0.58 kg of municipal solid waste per person per day [2]; this environmental impediment can be utilized for energy generation in the country. However with the new emanating waste management system being initiated by some cities in Nigeria, it will be much easier to accumulate and manage solid wastes for energy generation. Considering the enormous oversight of the federal and state governments and their passable experience in waste management, private sector participation is much needed to be able to utilize the tremendous potentials in waste-energy generation. A daily production of over 3, 000 tonnes of solid waste, most of which could not be disposed properly are generated in Abuja Nigeria's Federal Capital Territory. Consequently, some of these have been accumulating, causing serious health and environmental damages [3] in spite of all efforts being made by the government to manage and control solid waste. Currently four hydroelectric energy stations are functional as against thirty one potential hydro energy sites in Nigeria whereas twenty two fossil fuel energy stations are functional and one coal energy station at Itobe Kogi State Nigeria. This describes the nonchalant attitude of the nation towards renewable energy and avoidance of greenhouse gas emissions. Hydroelectric energy plant is the use of falling water to turn a turbine which consequently turns a metal shaft in an electric generator which produces electricity. This system of energy generation does not emit any of the standard atmospheric pollutants such as carbon dioxide or sulphur dioxide unlike the fossil-fuel-fired energy plants which makes it an environmentally clean and safe method of producing energy.

The Installed capacity of hydropower in Canada is 75.1GW and a production rate of 29.9Mtoe per year [4] with a population of 35.16million while the installed capacity of hydropower in Nigeria is 1.94GW [5] with a population of 173.6million. Taking into consideration the population of Nigeria, the industrial demand and domestic clamour for energy supply, it is a far cry from what is required for industrialization and national development. Therefore, in order to meet the demand, the rate of hydropower production need to be increased in which Nigeria has the capacity of producing, with many drainage basins and their tributaries the potentials of hydroelectric energy can be harnessed.

Nigeria is found in the tropics which makes the country experience almost constant temperature throughout the year in fact a city like Maiduguri experiences a temperature as high as 48°C which makes the climate of Nigeria suitable for solar energy generation. Hydro resources are estimated at 14,750 Megawatts. Solar radiation is estimated at 3.5 - 7.0 Kilowatt hour/m2 per day, wind speed 2.0 - 4.0 m/s, wind energy at 150,000 Terra Joule per year and biomass at 144 million tons per year [6]. The favourable location of Nigeria makes it a duck soup for the country to generate power using renewable energy but perhaps the government lacks the will and human capital to actualize it. This study shows the environmental potentials for renewable energy system in Nigeria and also presents renewable energy as potential investment opportunity in Nigeria.

2.0 Overview of the Energy Sector in Nigeria

2.1 History

The first energy generating plant in Nigeria was stationed in Lagos in 1898 by the colonial masters generating few kilowatts of energy. The Electricity Co-operation of Nigeria was established in 1951 and thereafter, Nigeria began to develop a hydroelectric power station which was done by Niger Dams Authority in 1962 which was merged with Electricity Co-operation of Nigeria (ECN) in 1972. The National Electric Power Authority (NEPA) was established in the same year and it was a combination of Niger Dams Authority and the Electricity Co-operation of Nigeria. It was so obvious that NEPA could not meet the energy requirement of Nigeria and its outcome was an epileptic energy supply being experienced by the whole nation. The National Electric Power Authority was later privatized and became the Power Holding Company of Nigeria which was later non-functioning and it was split into sub-sectors. But due to recent development in the power sector of Nigeria the government has shown concern. It was published on 23rd September, 2011 that Nigeria needs U.S. $10bn annually over the next ten years to achieve 40,000 MW [6] which is the minimum amount of energy generation needed for a population of 160million people. Nigeria's Minister of Power at that time, Prof. Bath Nnaji, however, explained that government did not have such money and said that underscored the need for the Federal Government to partner the private sector to achieve this feat.

2.2 Energy Subsectors in Nigeria

The energy sector is divided into three subsectors; energy generation, energy distribution and energy transmission. The energy generation is the inception and predominant stage, here we have the power stations but majorly in Nigeria are the hydroelectric power stations and Fossil fuel power stations where fossil fuel power stations are more than the hydroelectric. The energy transmission is the stage where energy is transferred from the power stations to the energy substations. Nigeria has six power generation companies and eleven distribution companies with one Transmission Company which is the Transmission Company of Nigeria owned by the government but managed by a private firm [6]. The energy distribution stage is the final stage in the National Grid which transmits energy from the substations to final consumers. With eleven energy distribution companies in Nigeria all over 36states,
energy distribution has being eased.

2.2.1 Generation

Nigeria currently has six energy generating companies Afam Power Plc, Egbin Power Plc, Kainji Hydro Electric Plc, Sapele Power Plc, Shiroro Hydro Electric Plc and Ughelli Power Plc generating 987.2MW, 1320MW, 760MW, 1020MW, 600MW, 942MW respectively [7] Figures released by the Federal Ministry of Power showed that the country's peak generation as of October 15, 2014 was 3,513.5MW, against a peak demand of 12,800MW. It, therefore, means that the country is currently generating about 2,500MW [8]. It is so certain that this amount of energy being generated is ridiculously low for a demand of 12,800MW.

2.2.2 Transmission

The Transmission Company of Nigeria (TCN) is the company responsible for energy transmission and it is divided into two departments namely: System Operator and Market Operator. The transmission capacity is made up of about 5523.8 KM of 330 KV lines and 6801.49 KM of 132 KV lines [9].

2.2.3 Distribution

Nigeria Currently has eleven energy distribution companies and they are located in different regions of the country. The distribution companies are listed Table1 below together with the regions they serve: [7]

Name	Regions They Serve	%Load Allocation
Abuja Electricity Distribution Company Plc	Garki, Lafia, Lokoja, Minna	11%
Benin Electricity Distribution Company Plc	Ado-Ekiti, Akpakpava, Aku	9%
Eko Electricity Distribution Company Plc	Festac, Ijora, Islands	11%
Enugu Electricity Distribution Company Plc	Aba, Abakaliki, Awka, Aba	9%
Ibadan Electricity Distribution Company Plc	Abeokuta, Dugbe, Ijebu-Ode	13%
Ikeja Electricity Distribution Company Plc	Alimosho, Ikeja, Ikorodu,	15%
Kaduna Distribution Company Plc	Zaria, Kaduna	8%
Jos Electricity Distribution Company Plc	Bauchi, Gombe, Jos, Makurdi	5.5%
Kano Electricity Distribution Company	Dala, Dutse, Funtua, Kati	8%
Port Harcourt Electricity Distribution Company Plc	Borokiri, Calabar, Diobu,	6.5%
Yola Electricity Distribution Company Plc	Damaturu, Jalingo, Maiduguri	11.5%

National Electricity Regulatory Commission

Table1: Energy Distribution Companies and Load Allocations

2.3 Underutilization of Renewable Energy in Nigeria

Despite the environmental potentials of renewable energy in Nigeria, it is so bizarre that the country has not being able to harness the potentials. All renewable energy sources can be functional in Nigeria considering the geographical location and other factors. These includes: Solar energy, wind energy, geothermal energy, bioenegy, hydropower energy, ocean energy, hydrogen and fuel cells and Green power. Every city in Nigeria has the ability and potentials to generate renewable energy considering the environmental potentials of each city.

2.4 Aims and Objective

This study evaluate, analyze and criticize Nigeria's renewable energy master plan 2005 and presents an integration plan which is a designed approach to renewable energy investment in Nigeria; the design approach is a synergy between stakeholders involved such as the private sector (experts and financial institutions) and the public sector (government) in other to achieve this aim.

2.5 Methodology

The item of information used in this research was gathered from the Energy Commission of Nigeria, the KPMG and the Price Water Coopers. The research instruments under review are the Renewable Energy Master Plan (REMP) developed by the Energy Commission of Nigeria (ECN), the United Nations Development Programme and a group of experts, a guide to the Nigerian Power Sector developed by KPMG and Privatization in the power sector developed by Price Water Coopers was reviewed. Nigeria's vision of achieving sustainable development by renewable energy is expressed in the REMP. The PWC and the KPMG are two of the world's largest big four auditors along with Delloite and Ernest Young.

3.0 Designed Technique

The integration plan put forward by this research is divided into three which are; pre integration, integration and post integration.

3.1 Pre Integration

3.1.1 Adoption of Structural Adjustment Programme for Renewable Energy Generation

Structural adjustment programs (SAPs) consist of loans provided by the International Monetary Fund (IMF) and the World Bank (WB) to countries that experienced economic crises [12] and these loans can be channeled towards economic growth and sustainable development. In the condition attached to the loans for long-term adjustment policies usually includes: creating new financial institutions, improving governance and fighting corruption, enhancing the rights of foreign investors etc. these is a pre - integration plan that should be adopted fundamentally to improve the renewable energy generation in Nigeria. The loans should be channeled towards renewable energy development considering the fact that Nigeria already has the environmental potentials for renewable energy. This is important because according to [6] Nigeria needs 10 billion US dollars annually for the next ten years to be able to achieve the required 40,000MW and for this to be achieved, long-term structural adjustment programs need to be adopted for the benefit of foreign investors in renewable energy and also for the government to concentrate on reviving the manufacturing industries that stopped production as a result of the energy problem.

3.1.2 Involvement of Banks and other Financial Agencies in the Renewable Energy Master plan

Lending to energy generation and distribution companies will increase the potentials and capacity of energy generation and distribution. Loans should be made available to local and foreign investors who are interested in investing in renewable energy. Special funds should also be made available.

3.2 Integration

3.2.1 Integrating Renewable Energy into Nigeria's Energy Grid

In the Nigerian Energy Supply Industry (NESI), there are presently 6 successor generating companies with 23-grid connected generating plants in operation.[9] and they are as shown in table 2 below:

S/N	Generation Companies	Plant Type	Capacity Megawatts
1	Afam Power Plc (1-V)	Thermal	987.2
2	Egbin Power Plc	Thermal	1,320
3	Kainji/Jebba Hydro Electric Plc	Hydro	1,330
4	Sapele Power Plc	Thermal	1,020
5	Shiroro Hydro Electric Plc	Hydro	600
6	Ughelli Power Plc	Thermal	942

Table2: Present Energy Generation Companies, Plant Type and Capacity.

It is clearly seen from the table above that there are just two major plant type in Nigeria by the 6 generation companies namely hydro and thermal. The other renewable energy sources such as wind energy generation, solar energy generation etc. have not been accessed. Figure 1 below shows the diagram of a wind farm connected to the power grid.

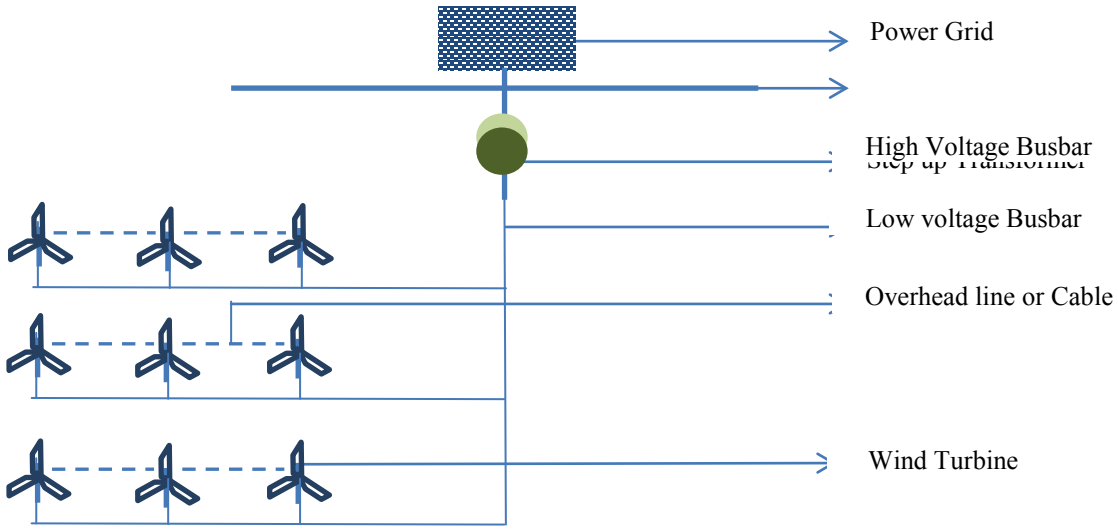


Figure 1: Wind Farm Connected to the Power Grid

From figure 1 above the transformer steps up the low voltage generated by the wind turbines to high voltage for power line transmission. Such mechanism can easily be integrated into the National Grid and this mechanism as well is applicable for other renewable energy sources.

3.2.2 Integration of Stakeholders

For renewable energy companies (licensee), a generation license authorises the licensee to construct, own, operate and maintain a generation station for purposes of generation and supply of electricity in accordance with the Electric Power Sector Reform Act, 2005. Subject to this Act, the holder of a generation license may sell power or ancillary services to any of the classes of persons specified in the license. An electricity generation license is needed for any power generation activity beyond 1MW [9]. Consequently it is reform gives all stakeholders involved the liberty such that target consumers can be decided either the communities, companies including multinationals. Four years ago (2011) the energy generated was 4,842MW [10] considering the projected energy demand for 2015 as shown in Table 3, the current peak energy generation as at February, 2015 is 4015MW [11] which is lesser than what was being generated in 2011. Now considering the fact that four years ago it was published that Nigeria needed 10 billion US dollars annually over the next ten years to achieve 40,000MW [6] and ever since the energy generation has not improved. It is therefore apparent that the approach and the conventional power supply currently being used in Nigeria cannot solve the energy problem. For this reason this study has proposed a synergy which involves financial institutions such as banks, insurance companies, trust companies etc. such financial institutions needs to be involved in as (stakeholders) in the renewable energy master plan in other to encourage interested investors.

Scenario	2005	2010	2015	2020	2025	2030
Reference (7%)	5746	15730	28360	50820	77450	119200
High Growth (10%)	5746	15920	30210	58180	107220	119200
Optimistic (11.5%)	5746	16,000	31240	70760	137370	250000
Optimistic (13%)	5746	33250	64200	107600	172900	287900

The Renewable Energy Master Plan 2005

Table 3: Projected Electricity Demand

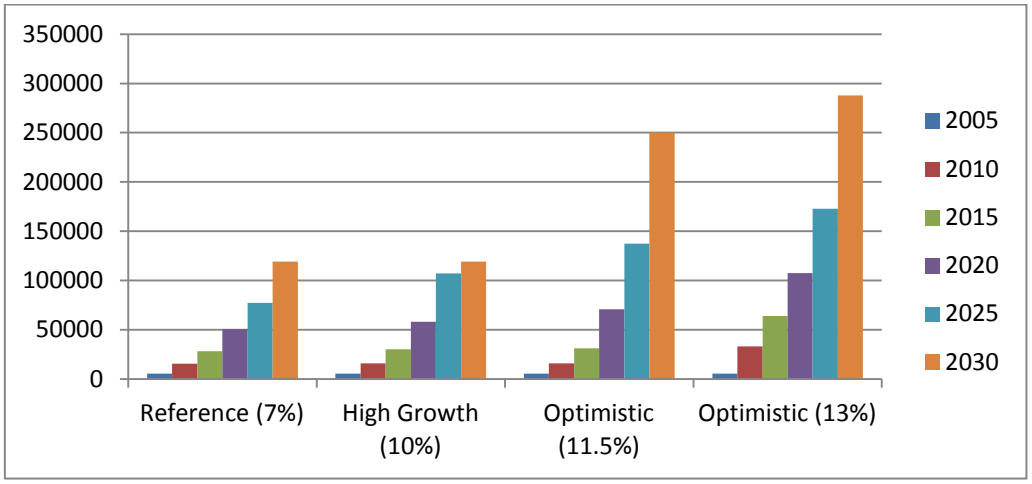


Figure 2. Projected Electricity Demand

There has to be policies in place that will foster the and encourage the performance of the synergy because as shown in Table 4 below in the short term, medium term and long term Nigeria needs an investment of 6.975billion naira in solar energy, 581Trillion naira in wind turbine and many more as shown below according to the renewable energy master plan to ba able to achieve the required energy generation. Without involving financial institutions, this might be unfeasible.

Activity Short Term (Nm) Activities	Short Term (Nm)	Medium Term (Nm)	Long Term (Nm)	Total (Nm)
Programme and Activity	170	430	322	922
Biomass	1793	3231	11353	16377
Solar Energy	1240	2525	3210	6975
Small Hydro	134	1244	1726	3104
Wind Energy	920	170200	410640	581760
Total	4257	177630	427251	609138

3.3

Table 4: Estimated Cost for Renewable Energy Investment

3.3 Post Integration

3.3.1 Adopting Vigilance and Project Management Tools for Energy Distribution Companies in Nigeria after the Integration

Rate of energy consumption should be diligently monitored and due to the scale and complexities of energy distribution, project management tools should be employed and also efficient project managers should be hired. Discos need to use an Oracle based vigilance tool called High Value Consumer Management System (HVCMS). Magnetic Resonance Imaging downloads of all the consumers will be fed into the application (HVCMS), and based on that information, the management of the utility can run multiple queries that give an insight into the consumption patterns of the consumers. This will help the energy distribution companies to monitor the rate of consumption of energy, energy demand growth rate, rate of energy demand by regions etc. as one of the post integration technique such vigilance tool will decrease the rate at which overloading occurs; once there is proper vigilance all forms of increase in the energy demand rate will be predicted. Any form of irregular billing pattern is easily discovered since the consumption pattern is already understood additionally, all forms of disruption in the network is clearly seen and fixed.
Considering the scale and complexities of energy distribution, a proper and efficient project management framework which will ensure adherence and coherence to proper management technique which will consequently produce an optimum profit is needed.

3.3.2 Financial Control and Supervision by Financial Institutions Involved

Involvement of financial institutions in this integration plan will assist in the financial control and supervision of the project. Since the financial institutions made funds available for the execution of the project, they have a stake in it. Therefore, there is need for proper monitoring of how funds are being disbursed and utilized for various purposes considering one of the factors affecting the energy sector in Nigeria which is corruption and reckless spending, the integration plan we have suggested in this paper which involves three major players; private sector, the government and the financial institutions where the financial institutions are saddled with the responsibility of overseeing the financial dealings of the companies involved in this project, there is no doubt that proper accountability will be seen. A monthly financial statement of the companies will be reviewed and monitored by the financial institutions involved and financial advice will be given from time to time on how these companies can be more prudent in their financial conduct.

4.0 Conclusion

Nigeria has huge environmental potentials to generate energy via solar, wind, biomass etc. and if these resources can be harnessed and converted to provide sustainable energy development for the economy, epileptic energy supply will be resolved in Nigeria. The government needs to put proper and attractive policies in place that will entice investors together with the acquisition of the right technologies and skilled man power plus equally adopting the integration plan in this paper, epileptic power supply will be bygone in Nigeria. Renewable energy projects, just like any other project needs careful financial planning and financial control in order to be successful as suggested by this paper and the integration plan put forward by this paper will increase the energy generation capacity of Nigeria through the use of renewable energy.

Reference

[1] Adejumobi I.A. Adebisi O.I. & Oyejide S.A. Developing Small Hydropower Potentials for Rural Electrification. International Journal on Research and Review in Applied Science (2013) 17 (1) 107 - 110

[2] Babayemi J.O, Dauda K.T: Evaluation of solid waste generation, categories and disposal options in developing countries: a case study of Nigeria. Journal of Applied Sciences & Environmental Management (2009) 13 (3). 83 - 88

[3] Oyeniyi, Bukola Adeyemi. Waste Management in Contemporary Nigeria: The Abuja Example. International Journal of Politics and Good Governance (2011) 2 (2)

[4] World Energy Resource 2013 Survey http://www.worldenergy.org/data/resources/country/china/hydropower

[5] Dr. Salami. A. Wahab Global Trends in Hydropower Generation and Utilization: Nigeria perspective in achieving vision 20:2020. Proceedings of the 2nd National Engineering Conference Federal Polytechnic, Offa. (2010) 5 - 19

[6] Akin Iwayemi. Nigeria's Dual Energy Problems: Policy Issues and Challenges International Association for Energy Economics (2008) 17 – 21

[6] News Article: "Nigeria Needs $10bn Annually to Achieve 40,000 MW– Minister of Power, Prof. Bath Nnaji," September 23, 2011. http://www.thisdaylive.com/articles/nigeria-needs-10bn-annually-to-achieve-40-000-mw/99070/

[7] National Electricity Regulatory Commission http://www.nercng.org/index.php/industry-operators/licensing-procedures/phcn-sucessor-companies.

[8] News Article: "Power generation drops by 1,000MW to 2,513MW" Minister of Power, Prof. Chinedu Nebo, "October 21, 2014" http://www.punchng.com/news/power-generation-drops-by-1000mw-to-2513mw/

[9] KPMG Nigeria: A Guide to the Nigerian Power Sector, December 2013.

[10] Power Generation Status and Outlook. Electric Power Investor's Forum by Bureau for Public Enterprises. Abuja (2011).

[11] Federal Ministry of Power. Power Statistics: Current Power Generation (2015) www.power.gov.ng.

[12] Lensink, Robert Structural adjustment in Sub-Saharan Africa (1st Ed.). Longman (1996)

[13] Privatization in the Power Sector Navigating the Transition www.pwc.com.ng

RESPONSE OF TRAINEES ON INTRODUCTION OF TUBER-BASED FOOD PRODUCTS IN RELATION TO FOOD SECURITY AND DIVERSIFICATION:

a Case Study of Training for Trainees Facilitated by Food Security Agency of East Java Province, Indonesia

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Abstract

Introduction of tuber-based food processing would support the local based-food diversification program established by the Government of Indonesia (the GoI). This study aimed to evaluate the trainees' responses on the introduction of tuber-based food products facilitated by the Food Security Agency of East Java Province in ILETRI from April until June 2014 for three different groups. This study used open questionnaires distribution to collect information from 114 trainees representing from 19 regencies in East Java. The result showed that the average age of trainees was 41.26 years old; majority of gender was female (77.19%); and majority of profession was boards and members of family welfare organization (49.12%). This was the first training for majority of trainees (85.96%), while the rest of 14.04% revealed that they had ever joint similar training. Almost 100% of trainees stated that the training was very useful considering they could practice how to process the local tubers into food products with simple methods. The majority of trainees (42.11%) wished to deliver the training results to others and this was not influenced by neither gender nor profession. About 64.91% of trainees found the constraining if they want to develop the products, particularly related to the availability of raw materials in market (51.35%). This information would be useful for local government to set relevant policies to enhance local-based food diversification program.

Keywords: trainees' responses, tuber-based food products, food diversification

INTRODUCTION

Food security is characterized by the increase of food availability and the development of food diversification. The introduction of food processing based on legumes and tubers is essential in supporting local based-food diversification program to decrease the dependency on rice and wheat flour consumption.

Indonesia is a rich country with many sources of local food. Nasution (2007) recorded 77 food crops as carbohydrate sources, 75 crops as fat sources, and 26 legumes which are

potentially to support food security. However, the food consumption is yet predominantly depended on rice and wheat flour. In 2010, the rice and wheat flour consumption of Indonesian was 139.15 and 17 kg/capita/year respectively (Suryana 2012). This high consumption is associated with the high import of these two commodities which was 1.11 million tonnes for rice and 6.3 million tonnes for wheat, respectively in 2012 (Trihatmoko 2013).

Food security is one of the GoI's national development priority and the development of local based-food diversification is regarded as a strategic plan in supporting food security. Tubers as local food sources have a strategic role in supporting food diversification as carbohydrate sources as well as for wheat flour subtitution. Tuber crops can be cultivated in different agroecological conditions have high productivity with ease cultivation and relatively cheap for the price (Putra 2009; Mariyani 2011).

Arowroot (*Marantha arundinacea*), blue taro or tania (*Xanthosoma* sp.), and canna (*Canna edulis* Ker.) are potential tubers that are existing in all regions in Indonesia. However they have not been well cultivated like cassava or sweet potato. In Indonesia these three tubers involved as inferior ones. There is no actually any special reports related to their production. Central Bureau of Statistics (BPS Indonesia) has only production record for cassava and sweet potato as main tubers in Indonesia (Sukesi, 2013).

The three tubers were originally from America, however they have been locally cultivated in Indonesia for a long time. Arowroot can be found in some areas of Java, Maluku, and Sulawesi and has not been intensively cultivated by farmer, except in some areas of Central Java and Yogyakarta. There are many local names of arowroot, such as *garut* in East Java and Central Java, *selarut* or *laru* in Madura, *larut* in West Java, *huda sula* in Ternate, and *labia walanta* in Gorontalo. Blue taro is also known as Belitong taro. Blue taro has been cultivated in some regions in Indonesia, such as North Sumatera, South Sumatera, East Kalimantan, North Sulawesi, West Nusa Tenggara, West Java, and East Java (Marinih 2005). There are some local names of blue taro, such as *taleus hideung*, *kimpul bodas*, *kimpul bejo* in West Java, *bentul*, *kimpul linjik* in Java, *mbote* in East Java, and *tales campa* in Madura. Canna has been well-known in Indonesia since 1905 and has been cultivated in all regions in Indonesia with some producer areas in Central Java, East Java, and Bali. There are two varieties of canna in Indonesia, i.e. red and white canna. Red canna is usually consumed in fresh tuber or boiling, while white canna is proccessed into starch which is used in rice-noodle (or *bihon* in Chinese) and porridge preparation.

Arowroot has complete nutrition. Every hundred gram of arowroot contain 69.0-72.0% water, 19.4-21.7% starch, 1.0-2.2% crude protein, 0.1% fat, 0.6-1.3% crude fiber, and 1.3-4.0% ash. High fiber content of arowroot is good for digestive health. It has low glycemic index (GI) i.e. 14, much lower than GI of rice (96) and canna (105). Nutrition content in a hundred gram of fresh blue taro is 23.70 g carbohydrate (with 77.90% starch), 1.90 g protein, and 0.20 g fat (Mahmud *et al.* 2000). While every hundred gram of canna has 95 kcal calori, 1.0 g protein, 0.1 g fat, and 22.6 g carbohydrate (Koswara undated[a]).

Due to high content of carbohydrate with high-quality of starch, the three tubers are potential for flour processing. Flour and starch from arowroot and canna are suitable for infant and people with illness (Mahmud *et al.* 2000; Koswara undated[a]; Koswara undated[b]). The utilization of starch and flour from arowroot are for cookies, partly subtitution for bread, filler for nugget, and prebiotic for yogurt making. Flour from canna can be used for Javanese traditional snack making (*ongol-ongol*, *tiwul*, *dodol*) and noodle (*e-book pangan* 2009). However, due to the limited information on these three tubers, people still utilize them in traditional way such as boiling, frying, grilling, or making porridge from flour or starch. Therefore, introduction of various products from tubers of arowroot, blue taro and canna is important. Introduction training is performed particularly for women as housewives and local food processors.

The Indonesian Legume and Tuber Crops Research Institute (ILETRI) as an institution under Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture has a mandate to do research on legumes and tubers, including these three potential tubers and disseminate the results. Food Security Agency based on Regulation of President number 22 year 2009 related to the policy on acceleration of diversified local-based food consumption has a program to empower home-garden as a sustainable local-foods provider. Food Security Agency was collaborated with ILETRI to do training on tubers processing. Therefore, research had an aim to evaluate one of trainings on tuber-based food products processing conducted by ILETRI involving participants facilitated by Food Security Agency of East Java Province.

METHODOLOGY

Training on tuber-based food products processing was conducted in ILETRI from April until June 2014. The participants were facilitated by Food Security Agency of East Java

Province which was divided into three different groups. Total of trainees was 114 representing 19 regencies in East Java. Group of trainees including housewives, local food processors, boards and members of farmer group, boards and members of family welfare organization in village level, agricultural extension workers/staffs of agricultural office/food security agency, and others (private sectors and village chiefs). Number of people in each group is varied and could not be determined previously.

Model of training was a full-day training. Steps of training was as follows:

(1)Presentation on tubers processing technology supporting food diversification

(2)Spread-out booklet and leaflet of tuber-based food recipes have been tried in ILETRI

(3)Tuber-based food products display

(4)Direct practice for tuber-based food products processing

(5)Discussion and questionnaires distribution

The quantity of tubers flour or starch use in food product making is varied. Table 1 shows the tuber-based food products introduced in the training.

Table 1. Kind of tuber-based food products introduced in the training (ILETRI 2014)

No	Kind of tubers	Kind of food products	Raw material
1	Arowroot	Bread	20% of tuber-flour
	(Marantha arundinacea)	Cookies	100% of tuber-flour
2	Blue taro/tannia	Chips	Fresh tuber
	(Xanthosoma sp*)*	Cake	50% of tuber-flour
		Sweet bread	20% of tuber-flour
		Noodle	30% of tuber-starch
3	Canna	Traditional drink '*dawet'*	100% of tuber-starch
	(*Canna edulis* Ker.)	Cookies	100% of tuber-flour
		Cake	50% of tuber-flour

Method of research was case study. Data collected was primary and secondary data. Primary data was obtained from open questionnaires distribution. Secondary data involved literature study. Research used simply descriptive qualitative and quantitative analysis. Data collected were: (1) characteristic of trainees (age, gender, profession, and origin of trainees); (2) experience on similar training; (3) response of trainees; and (4) constraining. Furthermore, those data obtained was analyzed, prepared in table or graphic for then was described to know the response of trainees on training of tuber-based food products processing.

RESULT AND DISCUSSION

a. Characteristics of trainees

General characteristics of trainees involved age, gender, profession, and origin of trainees. The average age of trainees was 41.26 years old (Table 2). The age of trainees was involved in a group of productive age (15-64 years old) based on data of Indonesian statistic (BPS 2013). A productive age influences the ability of people both in physic and mind setting as well as his ability in making decision for technology adoption and enterpreneurship development (Muis 2012 *in* Hapsari *et al.* 2013). Lestari *et al.* (2009) revealed that the age of broiler farmer in Batanghari Regency influenced the adoption level of farmer in stock breeding innovation. They who involved in a productive age group had a better adoption if compared to the younger or elder group (Derosari *et al. in* Hermawati 2002).

Table 2. Characteristics of trainees based on age, gender, and profession

No	Characteristics of trainees	Number of trainees (persons; %)
1	Range of age (Average = 41.26 years old)	
	a. < 40 years old	46 (40.35)
	b. 40-50 years old	46 (40.35)
	c. > 50 years old	22 (19.30)
	Total	114 (100)
2	Gender	
	a. Female	88 (77.19)
	b. Male	26 (22.81)
	Total	114 (100)
3	Profession	
	a. Housewives	9 (7.89)
	b. Boards or members of family welfare organization	56 (49.12)
	c. Local food processors	3 (2.63)
	d. Boards or members of farmer group	2 (1.75)
	e. Agricultural extension workers or staffs of agricultural/food security office	35 (30.70)
	f. Others (private sectors and village chiefs)	9 (7.89)
	Total	114 (100)

More than third quarter (77.19%) of trainees was female. Almost a half of trainees was boards or members of family welfare organization at village level (49.12%). Actually, the majority members of this informal organization are housewives and they came as representatives of the organization. The second highest number of trainees was agricultural

extension workers or staffs of agricultural/food security office (30.70%). They represented 19 agricultural/food security offices in East Java Province and they came to accompany other groups of trainees from each regency (69.30%).

From 19 regencies in East Java Province which joint to the training, the highest number of trainees was from Jombang and Sidoarjo (7.89%); while the lowest was from Nganjuk (1.79%). The trainees from host regency (Malang) was 5.26% (Fig. 1).

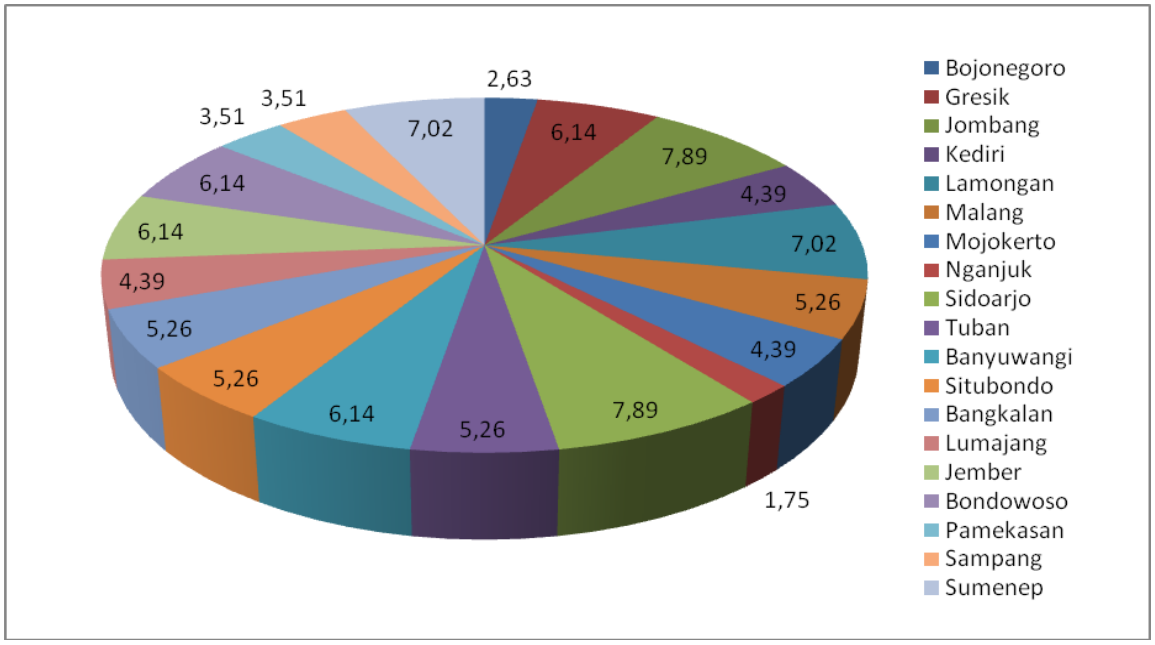


Figure 1. Percentage of trainees distribution based on the origin of regency in East Java

Administratively, East Java Province has 29 regencies and 9 cities (*http://www.jatimprov.go.id/site/kabupaten-kota/*). Each regency has potential tubers that can be developed. Production center of canna in East Java is in Malang and Pasuruan (Julianto 2014). Canna and arowroot was also found in small areas in Bangkalan, Madura. These tubers were mostly sold in form of fresh. In very small number, intermediate products for instance chip and flour, and traditional food products for instance snacks, *rog orog* and *bugul* were also produced for non-commercial purpose (Indarto and Ulya 2012).

b. Trainees' experience on similar training

Mostly trainees (85.96%) stated that they have never joint to this similar training previously. Only about 14.00% revealed that it was not their first training. Resource person of those training was majority from outside ILETRI (75.00%) for instance from local

agricultural/ food security office, university, Assessment Institute for Agricultural Technology (AIAT), family welfare organization in regency and province level, etc. Location of training were inside and outside the origin regency of trainees (Table 3).

Although for majority of trainees, it was their first training on tuber based-food product processing, some studies on training impact revealed that training was able to improve knowledge of trainees. Diffusion of technology and knowledge from trainees to non-trainees sometimes might not be occured due to training material was complicated to be transfered. Moreover, training was able to give deeper understanding for trainees. It could encourage them for better changes in attitude if compared to non-trainees as well as it was able to give economic impact for them (Kuntariningsih and Mariyono 2013; David 2007).

Table 3. The involvement of trainees on other similar trainings previously

No	Description	Number of trainees (persons; %)	
1	The involvement of trainees on other similar trainings previously:		
	• Yes	16 (14.04)	(If the answer is yes, continue to number 2)
	• No	98 (85.96)	
2	Resource person of training:		
	• From ILETRI	4 (25.00)	
	• From outside ILETRI	12 (75.00)	
3	Location of training:		
	• Inside the regency	7 (43.75)	
	• Outside the regency	8 (50.00)	
	• Both	1 (6.25)	

c. Response of trainees on training

Almost all trainees (98.25%) stated that this introduction training was useful for them (Table 4). Trainees revealed that by the training they could achieve many knowledge on local tuber-based food processing due to up to now they only know traditional way on processing tuber-based food products such as boiling, steaming, or frying. After joining this training, they majority wished to spread out the training results to others (42.11%). Besides, the trainees will re-try the food product recipes for their own family/relative as same percentage as they will develop the food products for entrepreneurship purpose, i.e. 18.42%.

Trend of trainees to spread out the training results to others is in accordance with some previous literatures. Studies on extension revealed that farmer-to-farmer diffusion in form of interpersonal communication and hands-on training has a stronger positive effect on learning

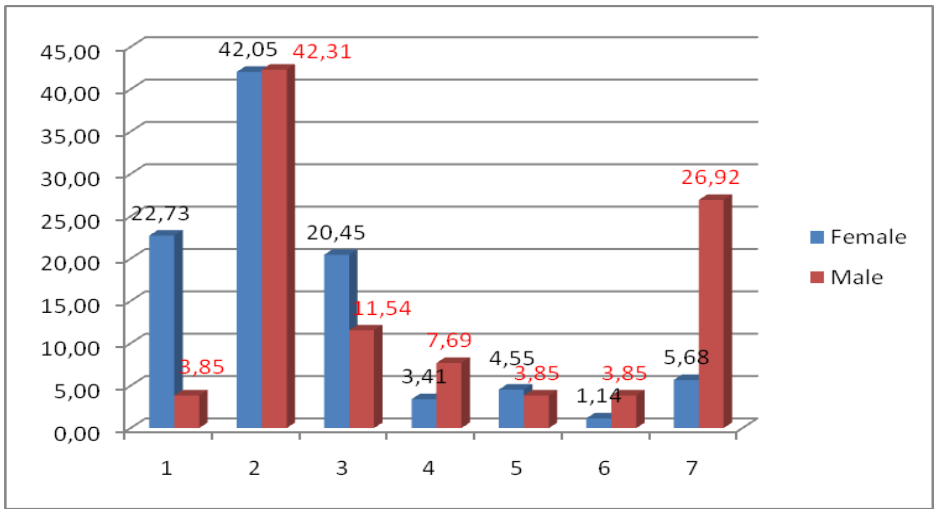
and adoption rates (Bentley *et al.* 2003; Rogers 1995). Moreover, study of David (2007) on diffusion of knowledge and practices by participants of cocoa farmer field study in Cameroon found that informally trainees will trained their relatives, friends or neighbours, and fellow members of farmer group. And significantly, the diffusion occured predominantly from they who live in the same village (84%), while the rest (16%) occured outside the participants' village.

Table 4. Response of trainees on tuber-based food products training

No	Description	Number of trainees (persons; %)
1	Is this training useful?	
	• Yes	112 (98.25)
	• No	0 (0.00)
	• [No answer]	2 (1.75)
	Total	114 (100)
2	Response after joining the training:	
	1. Try for their own family/relative	21 (18.42)
	2. Spread out the information to others	48 (42.11)
	3. Develop for entrepreneurship	21 (18.42)
	4. Both of point 1 and 2	5 (4.39)
	5. Both of point 2 and 3	5 (4.39)
	6. Both of point 1 and 3	2 (1.75)
	7. All of point 1, 2, and 3	12 (10.53)
	Total	114 (100)

The response is seemingly not influenced by gender (Fig. 2) and profession (Fig. 3). Men and women shared the equal percentage for the majority answer of spread out the training results to others after joining training (Fig. 2). This result is similar to study of Matindas *et al.* (2011) where when farmers obtained information on agriculture from their group, men and women tend to spread out the information to others. However, the information obtained by women usually would be used as comparation material and discussion material with others as well.

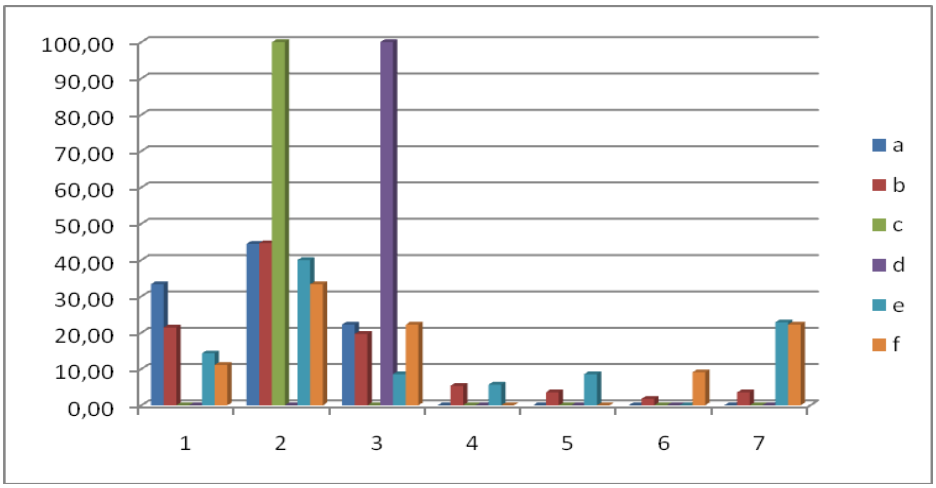
All groups based on profession gave the similar response, i.e. to spread out the training results to others after they went back to their home, except the response from the group of local food processors (Fig. 3). Background of entrepeneurship is seemingly encourage this group to accept new knowledge or information from the training as a new chance to develop their business in the future.



Description:

1. Try for their own family/relative
2. Spread out the information to others
3. Develop for entrepreneurship
4. Both of point 1 and 2
5. Both of point 2 and 3
6. Both of point 1 and 3
7. All of point 1, 2, and 3

Figure 2. Response of trainees based on gender



Description:

1. Try for their own family/relative
2. Spread out the information to others
3. Develop for entrepreneurship
4. Both of point 1 and 2
5. Both of point 2 and 3
6. Both of point 1 and 3
7. All of point 1, 2, and 3

a. Housewives
b. Boards or members of family welfare organization
c. Boards or members of farmer group
d. Local food processors
e. Agricultural extension workers/ staffs of agricultural office/ food security agency
f. Others

Figure 3. Response of trainees based on profession

d. Constraining for future products development

Almost two third of trainees (64.91%) stated they faced constraining if they want to develop the products, particularly related to the availability of raw materials in market (51.35%) (Table 5).

Trainees mentioned that it is difficult to find raw materials in form of flour and starch from tubers. It should be admited that up to now, tuber-based flours and starches (except tapioca from cassava) have not been widely distributed in the market in Indonesia. Domestic market demand for tuber-based flours is still low, even much lower if compared to other kinds of flour such as wheat flour, rice flour, tapioca, and maizena.

In Indonesia, tubers-based flour particularly sweet potato flour has been produced in commercial scale, however mostly in small home-industry scale. Bogasari Flour Mills and PT. Galih Estetika are two big producer of sweet potato flour in Indonesia. However their product is more oriented to export market than the domestic one. Community still has a little knowledge on tuber-based flours utilization therefore consumer of this product is limited. This supported by Richana and Sunarti (2004) statement that up to now staple foods in Indonesia is yet predominantly by rice, corn, cassava, and sweet potato. The use of others including potential tubers is still low. Indonesia has many kinds of potential tuber, however their utilization has not been optimal yet. It is still limited in form of fresh product or traditional processing such as frying, boiling, steaming, or grilling.

In 2006, Bogasari Flour Mills had launched sweet potato flour for domestic market purpose with brand name of 'Sariumbi'. At that time, the selling price of this flour was IDR 7000-8000 per kg (almost similar to the price of wheat flour) (Winneke, 2006). It is meant that economically, the selling price of sweet potato flour could compete wheat flour. However, since some years ago we could not find 'Sariumbi' in market, and even in Bogasari website (*www.bogasari.com*), they do not mentioned 'Sariumbi' as their product anymore. PT. Galih Estetika which is up to know still focus to produce intermediate products from sweet potato and to be an exportir for Japan market should be competed with some other producers. It results the decrease on their selling volume and market demand year by year (Bestari 2010).

This condition was on the contrary with other countries for instance Japan, China, Korea, and Vietnam where tuber-based flours has been applied for many food products and selling price of sweet potato flour was higher than wheat flour, i.e. four times in Japan and 25% higher in Singapore (Ambarsari *et al.* 2009). Some small home-industry scale in

Indonesia has actually determined the price of sweet potato flour in IDR 25,000-40,000 per kg (now it is two up to four times higher than selling price of wheat flour). Besides the problem on limited knowledge on tuber-based flours utilization, this very high price of the flour apparently should not encourage consumer to use this flour in their daily menu.

Table 5. Constraining for future products development

No	Description	Number of trainees (persons; %)	
1	Is there any constraining for products development?		
	• Yes	74 (64.91)	(If the answer is yes, continue to number 2)
	• No	38 (33.33)	
	• [No answer]	2 (1.75)	
2	Kinds of constraining		
	1. Raw materials		38 (51.35)
	2. Processing equipments		23 (31.08)
	3. Processing manners		2 (2.70)
	4. Marketing		6 (8.11)
	5. Capital		0 (0.00)
	6. [Answer more than one choice]		4 (5.41)
	7. [No answer]		1 (1.35)

Constraining for this tubers-based food products development could be a supporting input particularly for East Java Provincial government in doing dissemination and promotion on availability of various local foods. The policy on acceleration of diversified local-based food consumption based on Regulation of President number 22 year 2009 have to be a reference for both central and local government in doing planning, conducting, evaluating, and controlling acceleration of diversified local-based food consumption.

Support from local government for empowering diversified and safety local-based food products could be realized by providing raw material, both in form fresh tubers and intermediate products. Raw material which is easy to be accessed and has affordable price is hopefully can enhance community to utilize them continuously for food product processing.

Moreveor, the other constraining was availability of processing equipments (31.08%) and marketing (8,11%). Other support from local government could be in form of providing processing equipments and facilities, assisting in processing activity, as well as doing promotion and opening market access to spread out intermediate products and tubers-based food products. Availability of insentif and facilities for economical empowering are important for commercial-big scale industry and home industry which are able to develop intermediate

products and diversified local-based food products. It could be an attracting point for community to be actively participated in establishing sustainable food security. As in Regulation of President number 22 year 2009, it has been stated as well that the development of local-based food consumption could be a momentum for local government to stimulate the new economy growth in rurals.

CONCLUSION

Trainees stated that tubers-based food product processing training conducted by ILETRI was useful for them. Eventhough, it was their first tubers-based food training, trainees admited that they achieve many knowledge on food processing. Trainees wished to spread out the training results to others. Informally they will train their relatives, friends or neighbours, and fellow members of their group. Their constraining for future products development was mostly related to the availability of raw materials. It is expected could be a supporting input for local government in implementing policies of local-based food diversification.

REFERENCES

Ambarsari, I, Sarjana, and A. Choliq. 2009. *Rekomendasi penetapan standar mutu tepung ubijalar* (in Bahasa Indonesia). *Jurnal Standardisasi* 11(3): 212-219.

Bentley, J., E. Boa, P. Van Mele, J. Almanza, D. Vasquez, and S. Eguino. 2003. Going public: A new extension method. International Journal of Agricultural Sustainability 1(2): 108-123.

Bestari, L. R. 2010. *Analisis Strategi Pemasaran Pasta Ubijalar PT. Galih Estetika Kuningan Jawa Barat* (in Bahasa Indonesia). Undergraduate theses. Faculty of Economics and Management, Bogor Agricultural University. In *http://repository.ipb.ac.id/handle/123456789/60536,* Accessed in June 3rd, 2015.

BPS. 2013. *Proyeksi Penduduk Indonesia* (Indonesian Population Project) 2010-2035. Bappenas, BPS, UN Population Fund. ISBN 978-979-054-505-3. Central Bureau of Statistics, Jakarta. 468 pages.

David, S. 2007. Learning to think for ourselves: Knowledge improvement and social benefits among farmer field school participants in Cameroon. Journal of International Agricultural and Extension Education 14(2): 35-49. DOI:10.5191/jiaee.2007.14203.

Hapsari, R.T., A. Sulistyo, and M.M. Adie. 2013. *Preferensi petani terhadap karakter kedelai di Desa Mekarjaya, Kec. Baito, Kab. Konawe Selatan, Sulawesi Tenggara* (in Bahasa Indonesia). *In* Nurismanto, R., D.F. Rosida, and N. Hapsari (eds). Proceeding. National

Seminar of *Pengembangan Sumber Daya Lokal untuk Mendorong Ketahanan Pangan dan Ekonomi*. UPN Veteran, Surabaya, East Java.

Hermawati, B. 2002. *Peranan Wanita Tani pada Usaha Tani Sayuran dalam Kaitannya dengan Sasaran Penyuluhan Pertanian di Kecamatan Jambi Selatan Kota Jambi* (in Bahasa Indonesia). Undergraduate theses. Faculty of Agriculture, Jambi University, Jambi.

Indarto, C. and M. Ulya. 2012. *Inventarisasi Potensi Ubi-ubian di Wilayah Madura* (in Bahasa Indonesia). Paper in National Seminar of *Kedaulatan Pangan dan Energi*, Faculty of Agriculture, Trunojoyo University In *http://pertanian.trunojoyo.ac.id/semnas/wp-content/uploads/INVENTARISASI-POTENSI-UBI-UBIAN-DI-WILAYAH-MADURA.pdf*, Accessed in May 26th, 2015.

Julianto (*ed*). 2014. *Mengangkat Nasib Ganyong* (in Bahasa Indonesia). In *http://mail.tabloidsinartani.com/content/read/mengangkat-nasib-ganyong/,* Accessed in May 21st, 2015.

Koswara, S. Undated[a]. *Teknologi Pengolahan Umbi-umbian Bagian 4: Pengolahan Umbi Ganyong* (in Bahasa Indonesia). Modul. Tropical Plant Curiculum (TPC) Project. SEAFAST Center, Research and Community Service Institution, Bogor Agricultural University.

Koswara, S. Undated[b]. *Teknologi Pengolahan Umbi-umbian Bagian 1: Pengolahan Umbi Talas* (in Bahasa Indonesia). Modul. Tropical Plant Curiculum (TPC) Project. SEAFAST Center, Research and Community Service Institution, Bogor Agricultural University.

Kuntariningsih, A. and J. Mariyono. 2013. *Dampak pelatihan terhadap kinerja usahatani kedelai di Jawa Timur* (in Bahasa Indonesia). *Sosiohumaniora* 15(2): 139-150.

Lestari, W., S. Hadi, and Nahri I. 2009. *Tingkat adopsi inovasi peternak dalam beternak ayam broiler di Kecamatan Bajubang Kabupaten Batanghari* (in Bahasa Indonesia). *Jurnal Ilmiah Ilmu-Ilmu Peternakan* XII(1): 14-22.

Nasution, M. A. 2007. *Membangun Ketahanan Pangan, Menciptakan Lapangan Kerja dan Kemandirian Nasional* (in Bahasa Indonesia). In *www.mma.ipb.ac.id*, Accessed in April 13th, 2014.

Mahmud, Mien, K., Hermana, Nila, A.Z., Aprianto, R.R., Ngaditao, I., Hartanti, B., Bernadus, dan Tinexcelly. 2000. *Tabel Komposisi Pangan Indonesia* (In Bahasa Indonesia). PT. Media Elex Komputindo, Jakarta.

Marinih. 2005. *Pembuatan Keripik Kimpul Bumbu Balado dengan Tingkat Pedas yang Berbeda* (in Bahasa Indonesia). Undergraduate theses (Online). State University of Semarang, Major of Service and Production Technology. Accessed in June 10th, 2012.

Matindas, K., Aida V.S. Hubeis, A. Saleh, and H. Suwardi. 2011. Communication activities of organic vegetable farmers in seeking and using gender-based agricultural information (in Bahasa Indonesia). *Forum Pascasarjana* 34(1): 13-22.

Rogers, E. 1995. Diffusion of Innovation. The Free Press, New York.

Winneke, O. 2006. *Sariumbi, Tepung Ubijalar Berkhasiat* (in Bahasa Indonesia). In *http://food.detik.com/read/2006/01/02/160135/510398/296/sariumbi-tepung-ubi-jalar-berkhasiat*, Accessed in June 3rd, 2015.

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Role of University Education in Community: A case study of Community Education Project of Kathmandu University

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Abstract

Community Education Project (CEP) is a program run by Kathmandu University (KU), which intends to work in collaboration with national and international organizations and agencies, for improving the quality of life of the rural people, through Community Education Programs. The program has three major components: community service, community education and business incubation. The main activity of the program is to mobilize interdisciplinary groups of university students for different purposes like: To serve the community with the knowledge that students have acquired, To know the real situation of education in the rural areas of Nepal, To explore the culture, location, lifestyle and needs of the rural community, To support education in government schools. CEP has been able to create a platform, where students and faculties can actively participate in different community activities and gain hands on experience of working on community and directly deal with community people. Students are motivated to work in community for the enhancement of lifestyle of community people: by providing different skill oriented trainings and implementing different community based projects. The involvement of students in community is encouraging them to work on community based projects during their study.

Keywords: Education, community, community development

Introduction

Education is generally defined as the wealth of knowledge acquired by an individual after studying particular subject matters or experiencing life lessons that provide an understanding of something [2]. Kathmandu University has high emphasis on faculties and students to do research and community activities in different communities by applying their knowledge gained during their study. So both faculties and students are encouraged to apply their education for community service. In this regard, CEP has been playing a key role by creating a platform for the faculties as well as students to disseminate their knowledge in the community.

Community means the people living in one particular area or people who are considered as a unit because of their common interests, social group or nationality [1]. Keeping this in mind, CEP was started in 2010 as a pilot project. Pilot phase expanded till an ongoing program. Its target areas are: Tamakoshi valley, Langtang valley and outreach centers of Dhulikhel Hospital. It is a 3-legged program i.e. education, community development and

business incubation. The project is funded through Himal Partner project under the theme "Engineers for Development". More than 1000 students have been already mobilized through this project. The major mission of the project is: "To improve the quality of life in rural communities, through community services, community education and business incubation" and its vision is: "To establish outreach centers to expose its students and faculty members to rural environments, partly to enhance the students understanding of the rural living conditions, partly to enhance motivation for service in rural communities in the country". The objectives of the project are: To expose KU students and faculties to rural environment, practically implement the academic knowledge of the faculty staffs and students in rural communities, educate and benefit the underserved areas specially hills, mountains and unreached indigenous groups and other backward communities, provide technical and other resources available in KU to uplift their local business to cover all the potential rural communities, bridge the gaps between the rural community and KU through workshops, interactions or through outreach centers and identify the areas of scope and possibilities where KU could work on for various research or surveys.

Community development is a way of strengthening civil society by prioritizing the actions of communities and their perspectives in the development of social, economic and environmental policy [4]. Students are mobilized to different identified areas to do community service. They work voluntarily for some weeks according to the nature of their task. Generally volunteering is done for self satisfaction. Some of the factors why students are very much motivated to work as a volunteer are: it reduces stress, makes you healthier, saves resources, gain professional experience, brings people together, promotes personal growth and self esteem, strengthens your community, learn a lot from the community, get a chance to give back, encourages civic responsibility and it's a good opportunity to make a difference [5].

Methods

Pilot phase: During 2010-2012, a pilot-project with students from electrical, computer science and engineering and mechanical engineering was implemented. The student groups were placed in the identified region for a week for student projects. For example, one of the projects was repairing a telemedicine device through which basic district hospital could undertake more complicated operations through internet guidance from a specialized hospital in Kathmandu. The pilot project clearly showed the interest from the community and from the students to take this further. The students achieved the goal of community service by performing the action to benefit the community [3].



Figure 1: Students field visit to Langtang


Figure 2: ICS project in Manekharka



Figure 3: Students repairing computer



Figure 4: Students delivering lectures

Collaboration with different schools: Collaboration with different schools is done to create an environment for interdisciplinary projects. Students generally form a small group consisting of students from different departments. Then they apply for a financial support to CEP for the implementation of their proposed activities in the identified areas. The fund is provided only to support their basic needs like food, accommodation, travel and buying of necessary project equipments.

Establishment of Kathmandu University Business Incubation Center (KUBIC): Kathmandu University Business Incubation Centre (KUBIC) is established in the university to support students with great potential ideas turn into a market feasible business. KUBIC is financially supported by Community Education Project (CEP).

Interdisciplinary projects: Different community based projects are implemented in different identified areas. The projects are of different types and conducted by different interdisciplinary students. Students mobilized are from different disciplines (science, engineering and arts). Basically pharmacy, environment and biotech students are from school of science and mechanical, civil, electrical, geomatics and computer students are from school of engineering. Similarly community development students are from school of arts. The projects are conducted in different regions of Langtang (Syaphrubesi, Dhunche and Ghatlang). Tamakoshi (Singati, Charikot, Manthali) and different outreach centers of Dhulikhel hospital (Melamchi, Salambu, Dapcha and Manekharka).

Conduction of Workshop and Seminar: Seminars are being conducted frequently for the interaction of faculties and students of different schools. The interaction focuses on the impact of the proposed activities in different communities and how it is going to enhance the lifestyle of community people.

Expansion of Community Outreach Centers (identified areas): In the year 2014, CEP expanded its targeted region to some of the outreach centers of Dhulikhel hospital. The expansion was done basically to increase the community activities to some other parts of the country and this step was very successful as the project was able to conduct several community activities in those regions too.

CEP in continuous change: Developed from being just a course for second year engineering students, now CEP is expanding to comprise all the students. Since the start of CEP, more than 1000 students have been sent to different regions. Students has contributed by activities

like: solar panel installations, repaired computers and mobiles, developed apps for touristic purpose, organic farming training, improved cooking stove (ICS) installation, awareness on health and sanitation, etc. Students themselves are starting to propose interesting student projects for the fieldtrip. Their ideas are scrutinized and have to be approved before going to the field. A result of this is a lot of creativity and base for the newly established business incubation centre at KU. Community Service adds measurable value to communities [6] but it is not an easy task. So, before going to the rural communities, students are briefed on: how to meet people, how to conduct and how to communicate since respect regardless of reactions, is important. This is not necessarily always the case in the society, but very important for KU's reputation.

Result and Analysis

Relation between education and community: Students and supervisors (faculties) are mobilized to different outreach centers to disseminate knowledge for the community service. Through the project, the faculties and students have been exposed to the rural community for some weeks or shorter periods according to the nature of their tasks, which is helping them to gain practical useful experience. This is part of the project goals.

Incubation of business: Kathmandu University has established a Business Incubation Centre (BIC) to support students with great potential ideas turn into a market feasible business. KUBIC is financially supported by CEP.

Community development: Community development is strengthening the capacity of people as active citizens through their community groups, organizations and networks; and the capacity of institutions and agencies (public, private and non-governmental) to work in dialogue with citizens to shape and determine change in their communities [4]. So this part is achieved by the mutual cooperation with the local communities obtained from the implementation of different community activities throughout the year, in the form of training, seminars, community based projects and field visits to outreach centers.

Students are exposed to rural environment and able to handle real life problems: Students and supervisors (faculties) are mobilized in targeted regions to conduct different community activities like trainings, awareness campaign and implementation of community based projects. The main objective is to make the communities self-sustained in terms of gaining basic skills to upgrade the lifestyle of rural people.

KU will become a leader in those outreach centres and have a large network: Continuous activities in the regions and variety of activities time and again in the targeted region are conducted by the students of KU. It is difficult to document to which degree this is true so the indication is the feedback given by the communities visited. Several Non Governmental Organizations (NGOs) and International Non Governmental Organizations (INGOs) are operating in the communities, but the community members expressed more satisfaction on our activities due to various reasons like: available of human resources in large numbers and expertise in different areas.

The needs from the community will be implemented in the project. Students will visualize the needs of the community and will develop or model a concept of the project which will help them in their academics: Several community based projects are

implemented throughout the year in different communities. The projects are conducted after the feasibility study of the particular area, which helps to identify the needs of those communities before implementation. The projects are implemented to enhance the lifestyle of rural people and the need of the communities. For example, Information Technology (IT) related projects like web designing, e-library projects were conducted in Charikot area due to densely populated region and where most of the people are comfortable with IT and handling of computers. Similarly Improved Cooking Stoves (ICS) were installed in two households of Manekharka (one of the outreach centres of Dhulikhel hospital). Room heating system was designed and implemented by mechanical students in Mude area (one of the coldest area in the Tamakoshi region).

Discussion and Conclusion

CEP has been able to get higher degree of motivation to work in communities especially from the good positive feedback from students and faculties for providing them opportunity to work in community. Real community activities/projects which directly make the difference in communities are conducted like: ICS installation in different household in Manekharka, Electric bell implementation in government school in Salambu, e-library implementation in government school of Charikot, through this project. The project has been receiving appreciation and feedback for its good work in the community. So this is helping in build-up of relations with communities which is in the process of improving. CEP has been able to create a platform, where students and faculties can actively participate in different community activities and gain hands on experience of working in/for/with community. The project is acting as a good medium to identify the possible business areas and scopes in different parts of Nepal for students in future. The involvement of student in community is encouraging them to work on community based projects during their study. They are motivated to work in the community for the enhancement of community people. Overall, the project has made significant contribution in the sustainable development of communities.

References

[1] Community, [Online], Available: http://dictionary.cambridge.org/dictionary/british/community [accessed 2015, June 3].

[2] Education, [Online], Available: http://www.businessdictionary.com/definition/education.html [accessed 2015, June 7].

[3] What is Community Service? [Online], Available: http://www.wisegeek.org/what-is-community-service.htm [accessed 2015, June 8].

[4] What is Community Development, [Online], Available: http://www.scdc.org.uk/who/what-is-community-development/ [accessed 2015, June 3].

[5] Community Service: Top 10 Reasons to Volunteer, [Online], Available https://students.ucsd.edu/student-life/involvement/community/reasons.html [accessed 2015, June 3].

[6] What is Community Service? [Online], Available http://www.probation.ie/pws/websitepublishingdec09.nsf/Content/What+is+Community+Service [accessed 2015, June 4].

Author profile

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Small farms as one of the factors sustaining biodiversity in mid - field habitats in southern Poland

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Abstract. Mid - field habitats are very specific contact zones where different plant communities may be found together. The research was carried out in southern Poland north of Krakow. In that area small farms are still predominant, and size of particular fields is also rather small. Between those fields there are floristically diversified stripes of unploughed ground, that are called ecotones. In such stripes, that spread from 2 to 6 meters in width each, there have been done 50 phytosociological records. In total there have been found 219 species of vascular plants, that belonged to different plant communities. Maintaining small farms in the future is crucial for sustaining the biodiversity of that area, which is one of the goals of the European Strategy 2020 and Rural Development Plan 2014 - 2020.

Key words: biodiversity, mid - field habitats, small farms, southern Poland

INTRODUCTION

Macroregion of Nida Basin, which is located in southern Poland, is largely fertile agricultural land, where limestone soils can be found. In this area, especially floristically diversified are stripes of ground between xerothermic vegetation and small fields on limestone. That abundance in plant species is determined by specific soil conditions and maintaining the extensive type of plant production. Therefore many plant species, some of whom are rare or even endangered, occur in that area of Poland [Musiał 2011].

The mid - field habitats may be a kind of boundary in the physical environment where species from different communities will be found together, but there are also some unique local species [Marciniuk 2009, Piórek and Krechowski 2010]. The place where such two communities meet each other is called ecotone. Plants in a competition extend themselves on one side of such contact zones, as far as their ability to maintain themselves allows. Beyond the zone competitors of the adjacent community take over, so the term ecotone means that ecologies are "under pressure". Not only species common to the communities on both sides can be find there, but such transitional areas may include a number of highly adaptable species also from different types of communities.

Farms defined as small ones are those with 1 - 5 ha, and there are about 1 million of such farms in Poland. In southern Poland small farms dominate in agricultural land in terms of both number and area. Small area of such farms and their expanse contribute to the mosaic landscape. That is why if small holders decide to withdraw from land ownership it may lead to serious changes in the landscape, which will also affect the biodiversity of plants and animals [Perepeczko 2012, Musiał 2013, Kania 2014].

The aim of the study was the analysis of floristic composition of the vegetation occurring in such contact zones between small fields, where common are species both from segetal and xerothermic communities.

MATERIALS AND METHODS

The study area was located within the macroregion of Nida Basin [Kondracki 2009], that is situated north of Krakow. Nida Basin is built of mesozoic sediments, on which specific soils that are called rendzinas have developed. Rendzina is an intrazonal soil which means that its development does not depend on the climatic conditions. It is one of the soils that are most closely associated with the bedrock type and an example of initial stages of soil development. It is usually formed by weathering of soft rock types: usually carbonate rocks, such as limestone [Dobrzanski and Zawadzki 1995].

The research was carried out in 2013 - 2014, at the elevations from 313 to 332 m above sea level. In total, 50 phytosociological records have been done in that mid - field habitats, that spread from 2 to 6 meters in width each. Those stripes occurred between xerothermic vegetation and segetal weeds communities, on rendzinas. The total number of species and botanical families was assessed. Protected species and those that appear in the red lists data in Poland have been pointed out [Mirek et al. 2006].

Particular species were assigned into historical - geographical groups, according to Thellung classification [Zając 1979, Tokarska – Guzik 2005, Zając and Zając 1992]. They were anthropophytes which are alien synanthropic species for the flora of Poland: archaeophytes and kenophytes. On the other hand, there are also native synanthropic species, called apophytes. They were divided into several groups, according to the type of habitat in which they usually occur. On that basis they were assigned into different phytosociological classes.

RESULTS

As the result of the studies, there have been noticed 219 species of vascular plants, that belong to 37 botanical families. The most numerous were representatives of *Fabaceae* family - 34 species (15,5% of the whole flora), *Asteraceae* - 27 (12,3%), *Poaceae* - 24 (10,9%) and *Rosaceae*

15 (6,8%). On the other hand, some botanical families were represented just by 1 species, such as: *Alliaceae - Allium vineale, Cuscutaceae - Cuscuta epithymum, Fumariaceae - Fumaria officinalis, Resedaceae - Reseda lutea* and *Verbenaceae - Verbena officinalis*. Furthermore, in that ecotone habitats there were noticed 3 protected species: *Anemone silvestris*, *Carlina acaulis* and *Cerasus fruticosa*. Moreover, 5 species had a degree of threat: one of them, *Bupleurum rotundifolium* was critically endangered (E) and 4 other species were vulnerable (V). There were: *Adonis aestivalis, Asperula tinctoria, Bromus secalinus* and *Rosa gallica.*

The type of soil determined occurrence of many plants that thrives in lime rich soil. Such species as: *Adonis aestivalis, Aethusa cynapium, Anagalis arvensis, Lathyrus tuberosus, Consolida regalis* and *Neslia paniculata* are called calciphytes. Plant communities on rendzinas are distinctive, with much scrub and calcareous grassland, often with some rare species. Communities such as: *Caucalidion lappulae* from the *Stellarietea mediae* class and *Cirsio - Brachypodion pinnati* from the *Festuco - Brometea* class are typical of such soils.

In the mid - field communities occurred species from different historical - geographical groups, like: archaeophytes, kenophytes and apophytes (fig. 1). In this flora prevailed apophytes - 148 species (67,6% of the whole flora). Among them most frequent were such species as: *Achillea millefolium, Echium vulgare, Lathyrus pratensis, Melampyrum pratense, Euphorbia cyparissias* and *Linaria vulgaris*. There were noted 67 species of archaeophytes (30,6%), which are old synanthropic species, such as: *Agrostemma githago, Anagalis arvensis, Bromus secalinus, Camelina microcarpa, Centaurea cyanus, Melandrium noctiflorum* and *Papaver rhoeas.* There were also noted just 4 species of kenophytes (1,8%) which are alien species that arrived in Poland after 15th century. They were not so common in the ecotone communities, as they do not occur very often in segetal or in xerothermic habitats. *Bromus carinatus, Conyza canadensis, Galinsoga parviflora* and *Veronica persica,* have been noted within this group and they occurred in less than 20% of all the records.

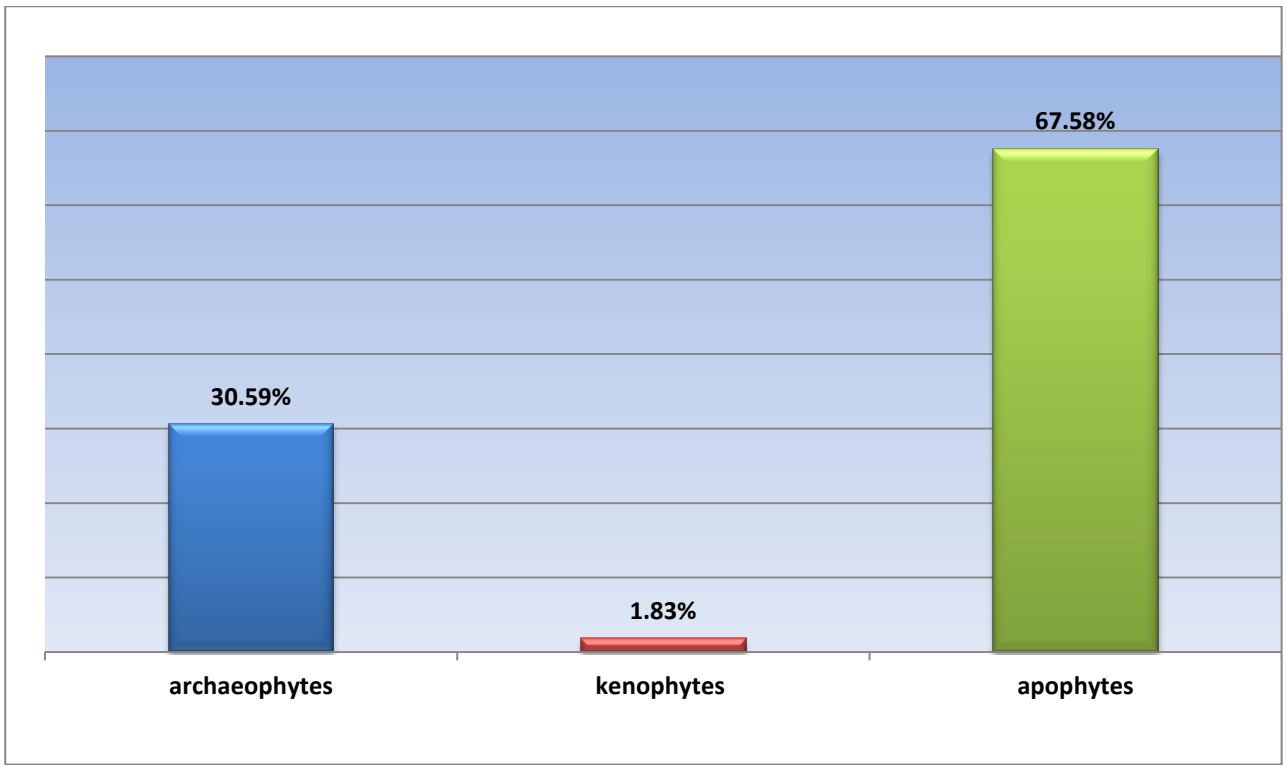


Figure 1. Affiliation to historical - geographical groups.

Apophytes that dominated in the mid - field stripes of ground, belonged to different phytosociological classes, according to the type of habitat in which they usually occur (fig. 2). In the area of study they were represented by several classes, among which the most numerous were: *Festuco - Brometea* - 65 species (29,7% of the whole flora) that is the class of xerothermic species and *Stellatietea mediae* - 62 (28,3%) that includes species from segetal weeds communities. Also quite numerous were species from *Molinio - Arrhenatheretea*, that represents meadow communities - 35 (15,9%) and *Artemisietea*, which contains some ruderal species - 21 (9,6%).

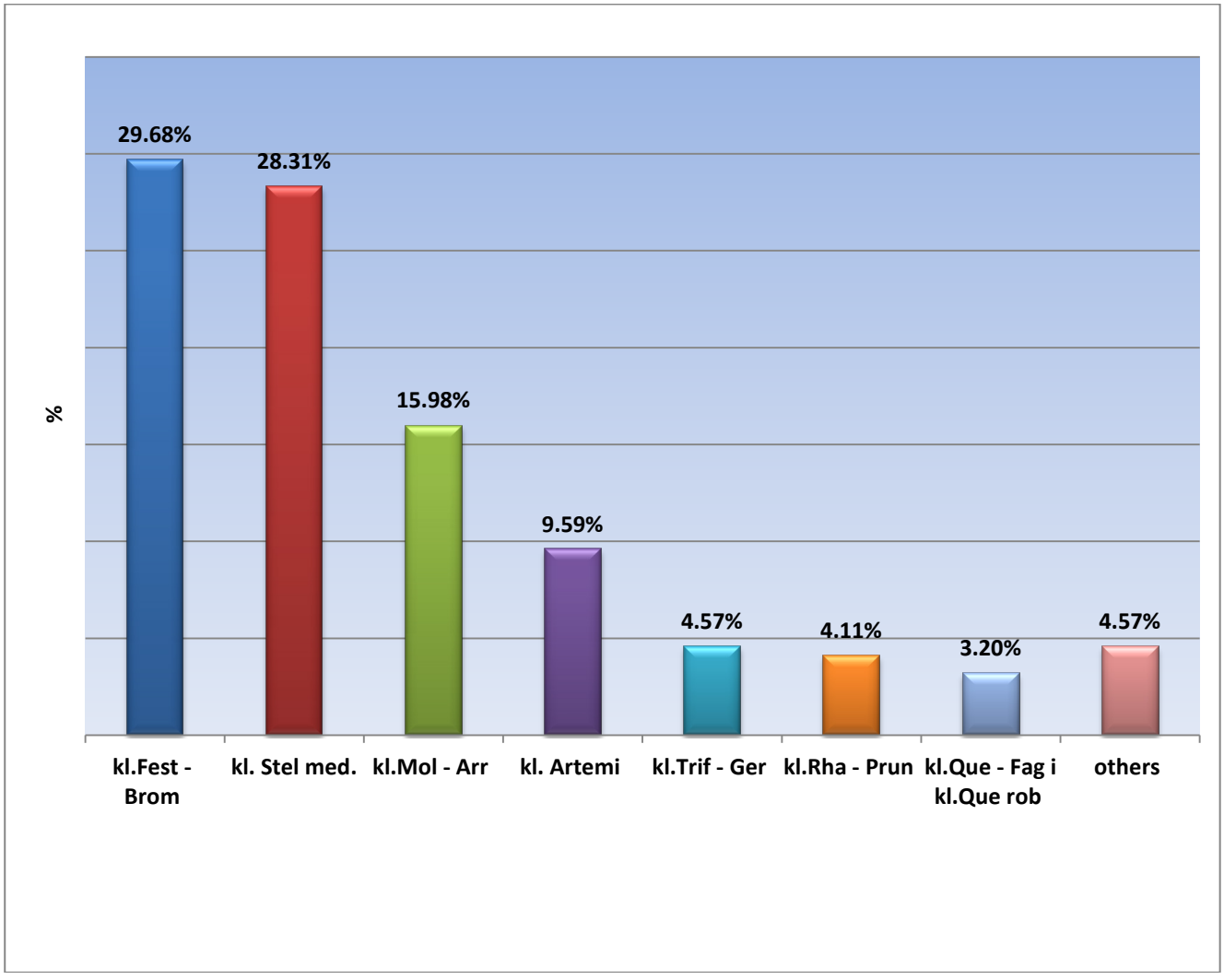


Figure 2. Apophytes - affiliation to different phytosociological classes:
Fest - Brom - *Festuco - Brometea,* **Stel med** - *Stellatietea mediae,* **Mol - Arr** - *Molinio - Arrhenatheretea,* **Artemi** - *Artemisietea,* **Trif - Ger** - *Trifolio - Geranietea sanguinei,* **Rha - Prun** - *Rhamno - Prunetea,* **Que - Fag** - *Querco - Fagetea,* **Que rob** - *Querco robori - petraeae.*

Among others there should also be mentioned *Trifolio - Geranietea sanguinei* - 10 species (4,6%). That class comprises quite specific plants which occur in narrow belts between forest and shrub communities and xerothermic vegetation, such as: *Anemone silvestris, Astragalus glycyphyllos, Clinopodium vulgare* and *Coronilla varia*. An interesting group of species was also represented by the class *Rhamno - Prunetea* - 9 (4,1) which build communities of shrubs, such as: *Cerasus fruticosa, Cornus sangiunea, Crataegus monogyna* and *Prunus spinosa*.

DISCUSSION

Transformation of the environment in Poland has been occurring rapidly since the second half of 20th century. As a result many species and their populations that belong to various habitats have become rare and vulnerable. Both increasing mechanization and specialization in agricultural production contributed to adverse changes in rural landscape. That led to rising of its monotony and decreasing number of different habitats and plant species [Loster 1991]. As vegetation cover has been transformed significantly, synanthropic species have become common components of damaged and disturbed natural communities. The biggest group of species in such areas are often apophytes that are characterized by a limited geographic range. Apophytes dominate in the studied area which shows that these native species may be especially expansive in different habitat conditions [Zając and Zając 2009].

In the area of Central Europe, where Poland is situated, a significant number of people live in the country and that also affects living conditions of different species of plants and animals [Tryjanowski et al. 2011]. Alterations in the farm space management, have largely influenced the changes in the number of species and their populations. Most of them are decreasing due to disappearing of small farms and the intensification of agriculture which also have caused losing and fragmenting a number of habitats in rural land.

Some species of field weeds that occur on rendzinas, are rare in Poland and their frequency and abundance have been decreasing since the 2nd part of 20th century. The group includes especially archaeophytes, which according to Trzcinska - Tacik [1975], started to become rare and endangered as far back as in the 70 - ies of the last century. Nowadays some of them, like *Bupleurospermum rotundifolium,* are critically endangered, while others for example: *Euphorbia exigua, Melandrium noctiflorum* and *Stachys annua* are rare. It has been noticed in the area of research, but it has also been noted that in a similar situation there were some less common apophytes, as *Rosa gallica* and *Verbascum phoeniceum.*

The mid - field habitats are particularly rich in plant species and are also quite differentiated. They represent many different types of habitats, where they naturally occur, like xerothermic or segetal communities and shrubs [Piórek and Krechowski 2010]. They also belong to different phytosociological classes. Some ecologists emphasize the importance of extensive agricultural land usage, that is often representative for small farms. It allows sustaining the biodiversity and protection of some rare and precious species. It is also essential that the management of agricultural economy should be focused on either elimination or minimization of an abandonment of small cultivated fields [Musiał 2010].

CONCLUSIONS

1. The stripes of mid - field habitats were characterized by a big biodiversity of species, some of them were: rare, protected or threatened.
2. In the ecotones there occurred species from different historical - geographical groups, among which apophytes were predominant.
3. It is crucial to maintain small farms as they may help to sustain the biodiversity.

REFERENCES

1. Dobrzański B., Zawadzki S. 1995. Gleboznastwo. Charakterystyka gleb Polski: 341 - 362.
2. Kania J. 2014. Young farmers in family farms of the European Union. Problems of Small Agricultural Holdings. 3: 35 - 50.
3. Kondracki J. 2009. Geografia regionalna Polski. Warszawa PWN, wyd. III uzupeł.: 263-270.
4. Loster S. 1991. Różnorodność florystyczna w krajobrazie rolniczym i znaczenie dla niej naturalnych i półnaturalnych zbiorowisk wyspowych. Fragm. Flor. Geobot. 36 (2): 427 - 457.
5. Marciniuk P. 2009. Floral vegetation of mid - field habitats in the region of Podlaski Przełom Bugu. Instytut Botaniki im. W. Szafera, PAN, Kraków: 7- 10.
6. Mirek Z., Zarzycki K., Wojewoda W., Szeląg Z. 2006. Red list of plants and fungi in Poland. Krakow: 13-20.
7. Musiał K. 2011. Archeophytes accompanying cereals in field habitats in country boroughs of Sedziszow and Slupia in the Swietokrzyskie Region. Episteme. 12, t.1: 201 - 207.
8. Musiał W. 2010. Determinants of Agriculture Development in Regions with Structural Fragmentation. Roczniki Naukowe SERiA, Warszawa – Poznań – Szczecin, t. XII, z. 2: 231 – 235.
9. Musiał W. 2013. Some structural, economic and production - related problems of small farms in the Małopolskie Voivodeship. Problems of Small Agricultural Holdings. 1: 41 - 63.
10. Perepeczko B. 2012. Small farms in the Nature 2000 rural areas. Problems of Small Agricultural Holdings. 1: 115 - 128.
11. Piórek K., Krechowski J. 2010. Penetration of species in the contact zone of roadsides and segetal communities. Fragm. Agron. 27 (3): 112–121.
12. Tokarska - Guzik B. 2005. The establishment and spread of alien plant species (kenophytes) in the flora of Poland. Wydawnictwo Uniwersytetu Śląskiego, Katowice: 29-108.
13. Tryjanowski P., Dajdok Z., Kujawa K., Kałuski T., Mrówczyński M. 2011. Threats to biodiversity in farmland: are results from western Europe good solutions for Poland. Polish Journal of Agronomy 7: 113 - 199.
14. Trzcińska - Tacik H. 1975. Notatki florystyczne o niektórych chwastach polnych z terenu województwa krakowskiego. Zeszyty Naukowe Uniwersytetu Jagiellońskiego. Prace Botaniczne, zeszyt 3: 17 - 22.
15. Zając A. 1979. The origin of the archaeophytes occurring in Poland. Nakładem Uniwersytetu Jagiellońskiego, Kraków: 17- 156.
16. Zając M., Zając A. 1992. A tentative list of segetal and ruderal apophytes in Poland. Zeszyty Naukowe Uniwersytetu Jagiellońskiego. Prace Botaniczne - zeszyt 24: 7-23.
17. Zając M., Zając A. 2009. Apophytes as invasive plants in the vegetation of Poland. Biodiv. Res. Conserv. 15: 35-40.

Solar Energy as a key resource for technological change and rural development: An alternative pasteurization process for rural dairy plants

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Abstract

Mitigate the devastating effects of climate change implies the need to de-carbonize the global economy in a few decades, and thus lead to industrial scale to non-conventional renewable energy (NCRE) technologies. One of the most promising applications is the use of solar thermal energy for industrial processes, which require temperatures between 60 ° C and 260 ° C. These applications can be of great impact on rural production areas with limited access to conventional energy. Between April 2013 and August 2014, a project was developed in Arequipa - Peru, which sought to develop locally a pasteurization milk process, designed for small rural dairy plants. It was aimed to obtain a robust and comparatively inexpensive technology, with high process standards (comparable to commercial HTST pasteurization process), and able to integrate solar energy in more than 50%. Finally, it was obtained a pasteurization system, capable of pasteurizing 300 liters / day of milk at 72 ° C (under HTST system), using a solar thermal contribution of 70%, with less than 40% investment cost compared to traditional pasteurizers. Using this technology, a rural dairy plant can mitigate a 47% of total emissions compared to traditional systems, which corresponds to 1.75 tons of CO2 annually.

1. Introduction

Mitigate the devastating effects of climate change implies the need to de-carbonize the global economy in a few decades, and thus lead to industrial scale non-conventional renewable energy (NCRE) technologies.

Solar energy is a renewable energy source per excellence. Thermal solar technologies have been used to generate steam generation system for electricity production (Byrne et al, 2010). However, one of the most promising applications is related to the generation of process heat for industrial processes (IEA, 2010). In fact, several industrial sectors, whose processes require temperatures between 60 ° C and 260 ° C, have been identified as very promising according to the Program Solar Heating and Cooling, promoted by the European Union (Brunner et al., 2008). These sectors are food, chemical, plastics, textiles and materials. According to Kalogirou (2001), the most important industrial processes that use heat at these temperature levels are sterilization, pasteurization, drying, hydrolysis, distillation, evaporation, washing, cleaning, and polymerization.

In order to develop applications of solar energy for industrial processes, it is known that these are feasible only when there is a suitable index of direct sunlight, especially when it comes to concentrated solar power. According to Aringhoff et al. (2005), for the installation of solar thermal applications, it is needed to receive at least 2,000 kWh of solar radiation per square meter-year, while the best areas may receive more than 2,800 KWh / m2.year. (Byrne et al 2010).

Around the world, there are rural areas with little access to power, but with significant solar resource. Solar energy becomes an interesting resource for rural development. In Peru, there are about 2,000 rural dairy processing plants, which perform productive processes without considering the minimum health standards required by the national public health regulations, including mainly the absence of pasteurization or thermal treatment processes for cheese production. Because of that, many plants are not able to obtain sanitary certificates, neither to get access to formal commercial channels. (Aubron & Cochet, 2009)

There are different barriers associated with the absence of pasteurization in rural production dairy processes, including the technological complexity and cost, and limited access to energy (ITDG, 2006). In fact, conventional pasteurization technologies use steam, compressed air, and electronic control in order to perform a normal process. Furthermore, this kind of processes require usage of high power energy.

Between April 2013 and August 2014, the NGO “El Taller” located in Arequipa-Peru, developed a project called: "Development of a Cost Effective and High Standard Production System for Rural Dairy Plants in Arequipa, Using Solar Thermal Energy as Key Resource". The project aimed to develop locally a robust comparatively inexpensive technology, with high process standards, that could integrate solar energy in more than 50%. The technology was implemented in two rural dairy plants located in Castilla province, at 3600 m.a.s.l., in the high land area of Arequipa. The results are shown in this paper.

The project had the support of the Ministry of Foreign Affairs of Finland, The Andean Regional Energy and Environment Partnership Programme (EEP) and the Inter-American Institute for Cooperation on Agriculture.

The purpose of the pasteurization is to eliminate any diseases generator that feedstock may contain. In this case, microorganisms contained in milk. The process also seeks a significant reduction of total bacterial count in order to improve food conservation capacity.

Pasteurization destroys the lipase and other enzymes in natural milk. For many years, temperatures and pasteurization times employed aimed to ensure destruction of M. tuberculosis. Two are the pasteurization methods accepted today. The first, the batch method LTLT (Low temperature long time), where milk is heated until it reaches a minimum temperature of 62.7 °C and is held for a minimum of 30 minutes. The second, the HTST method of high temperature-short time in which milk is heated until it reaches a minimum temperature of 72 ° C and held for a minimum of 15 seconds. (Potter, 1978)

In HTST pasteurization, raw milk stored in a storage tank is pumped through a heat exchanger and is heated until it reaches the required temperature. The key to the process is to ensure that each particle of milk is at 72 ° C for a minimum of 15 seconds. This is achieved by pumping the hot milk through a holding tube with such length and diameter that allows each particle to stay at least 15 seconds in the path. At the end of the tube is a sensory apparatus, that measure temperature accurately, and a valve. If at this point, it is obtained some milk with a lower temperature than required, a flow diversion valve

would stop the flux and send back through the heat exchanger so that it is re-heated. (Potter, 1978)

This system therefore requires electronic control elements that work with control valves, which require use of compressed air. In addition, for control of the pasteurization temperature, high power heating systems based on steam production are needed. Steam is injected into the system by modulating valves. (Saravacos, G., and Kostaropoulos 2002)

Various types of heat exchangers are used in the food processing industry, designed according to the different requirements of heating, cooling, sterilization, baking, etc. In milk pasteurizers, the plate heat exchangers have being widely used. The tubes heat exchanger also has been used for many food processing applications.

2. Methodology

The aim of this work was to develop locally, a robust and comparatively inexpensive technology, with high process standards, and able to integrate solar energy in more than 50%. The following assumptions were considered:

- Solar energy can be integrated successfully in a pasteurization process of milk high standard as HTST pasteurization.
- It is possible to integrate solar energy in more than 50% compared to the overall energy requirement
- The initial investment of a pasteurization system designed and built locally, decrease equipment costs by over 30% compared to plants using imported pasteurization systems.
- The integration of solar energy in the process gets energy savings would cover the cost of the system in less than 10 years.
- Solar integration process allows cost-effectively replace more than 30% of annual CO2 emissions.

For the design process, it has been taken into account engineering design practices and the state of the art of artisan dairies located in the project area. As for the calculation of energy demand, material and energy balances as well as evaluation of alternative technologies were made. For the conceptual design and detailed engineering, good engineering practices for the development of power supply systems for medium and high temperature were used as methodological framework. At the same time, professional specialists in the field were consulted to validate the calculation procedures.

Technical, economical and environmental analysis has been conducted to evaluate the technology. For technical analysis, it has been evaluated the accomplishment of process parameters; also, the overall thermal efficiency achieved by the system was calculated. For the economic analysis, a comparison of investment costs of equipment and energy costs was made, taking into account documented information from reputable sources. Finally, for the environmental assessment, the results of technical analysis were taken to calculate the energy savings and tons of CO2 avoided by the inclusion of solar power over the use of electricity and propane.

3. Conceptual design

For the process design it was considered as a reference, a small traditional cheese pasteurization plant. A maximum production capacity of 300 liters per day was fixed considering a pilot plant scale.

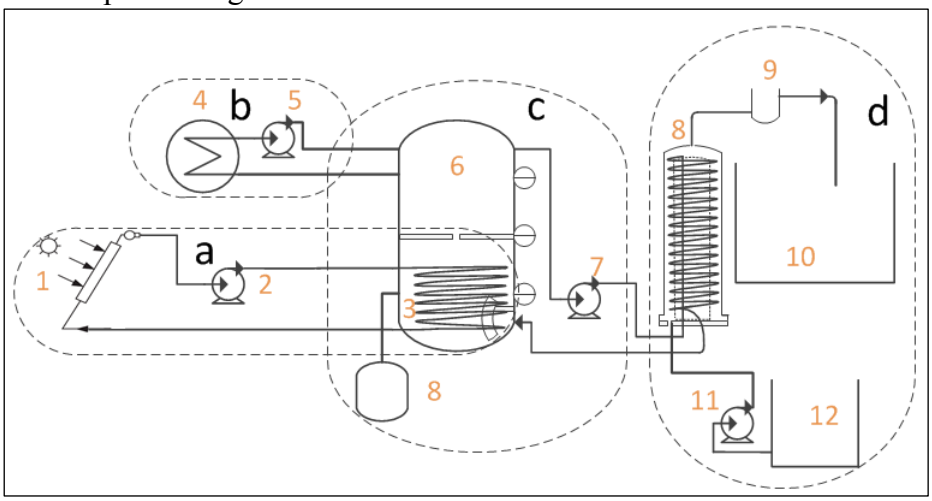
Table 1: Characteristics of selected process

Feature	**Parameter**
Industry	Food
Product	Pasteurized Cheese
Raw material	Milk
Process type	Batch
Capacity	300 liters /day
Pasteurization type	HTST (High Temperature short time)
Pasteurization temperature	72°C
Retention time	> 20 seconds
Location	Arequipa

The following design criteria were:

- Ensuring critical control points for food safety quality assurance.
- Ability to leverage non-permanent thermal energy supply (ie, variable or intermittent supply) from renewable sources such as solar, geothermal, biogas, or other sources.
- Versatility for exploiting low power energy stored as heat pressurized water or other fluid; without relying exclusively on high power auxiliary systems based on steam generation.
- Low cost compared to traditional pasteurization or heat treatment systems due to the absence of auxiliary steam generation systems, lack of temperature control systems highly sophisticated, simplification in the manufacture of the heat exchanger.

Figure 1: Conceptual design



The conceptual design is composed of four subsystems: (a) a subsystem of solar energy, (b) a high power heating subsystem (electric resistance), (c) a system of energy storage, and (d) energy delivery subsystem into de process.

The subsystem of solar energy (a) consists of a traditional system of flat plate solar collector (1). This system provides low power energy storage tank of hot water or thermal fluid, through a spiral heat exchanger (3). In this case, the fluid is a solution of propylene glycol to prevent freezing during cold weather. The pump (2) drives this solution.

The heating subsystem high power (b) is composed of a heating system based on this case by resistors (4). This system provides high power energy to the storage tank of hot water or thermal fluid, and serves as a "corrector" temperature at top level of the tank, which contains the heat transfer fluid that is ready to be delivered to the pasteurization or heat treatment process.

The energy storage subsystem (c) comprises a storage tank (6) containing in this case water. The tank can be optionally pressurized. If the tank is pressurized requires protection devices volume changes due to changes in temperature or fluid phase (8). If the tank is not pressurized, requires using a fluid having a boiling point not higher than the temperature of the system plus a safety margin.

Subsystem energy supply to the productive process of pasteurization or heat treatment (d) consists of a heat exchanger tube and shell type, whose design is based on heat exchange water - milk counter. The details are included in the utility model application, Indecopi 1230/2014 Peru.

The hot water stored in the tank (6) is passed through the heat exchanger, together with milk. Therefore, the water temperature will be the maximum of the tank in the upper part thereof. This temperature becomes the critical process control. If the tank does not reach the minimum temperature necessary to ensure pasteurization at 72 ° C, the process can´t be started.

Operation description of the conceptual design

Before pasteurization or heat treatment is ready to start, it is needed to test the temperature of the tank at the top level. When this temperature is equal to or greater than the set control temperature for the start of the process, then this can be accomplished. If the temperature does not reach the control temperature, the heater high power system (electrical resistances) lights until the control temperature reaches the desired level.

The process starts by turning on the pump drive tank heat transfer fluid (water) (7). The hot water enters the heat exchanger. Once heated the system, the process fluid contained in the lung tank (12) is driven through the heat exchanger (18).

The process fluid heated to the desired temperature, is passed from the bottom up by a holding tank temperature (9), which applies the retention time established by health standards. Finally the thermal fluid exits the holding tank and is stored in a tank (10). As the fluid is stored can be cooled to a temperature suitable for the process, circulating cold water through a jacket.

4. Engineering Calculations

System Global Energy Demand

The energy demand for pasteurization is given by the amount of milk to be processed, and the pasteurization temperature. For design purposes, we took into account the following assumptions:

1. Cold milk is at a temperature of 15 °C
2. The minimum pasteurization temperature is 72 °C. For calculation purposes, it is considered that the milk must be heated to a temperature of 75 °C (according to the rules HTST pasteurization, the temperature should be between 72 and 75 °C)
3. The thermal capacity of milk is: c20 = 3,850 J / kg K (20 ° C)
4. The density of milk is: ρ^{-}= 1,032 kg / m3
5. The amount of milk to be pasteurized is 300 liters
6. Maximum time for pasteurization: 1 hour.

With this data, the energy for heating 300 liters of milk from 15 °C to 75 °C is calculated:

$$Q = \rho \cdot V \cdot c \cdot \Delta T$$

$$Q = 1{,}032\,\frac{kg}{m^3} \cdot 0{,}3 m^3 \cdot \frac{3{,}850 KJ}{kgK} \cdot (75°C - 15°C)$$

$$Q = 71\,517\ kJ$$

$$E = 19.9\ kWh$$

For this pasteurization process, 19.9 kWh of net thermal energy is required. Accordingly, 382 liters of water, at a temperature of 85 ºC, are needed to provide heat to the entire system. For purposes of having greater stability in the system and increased autonomy, the amount of water required by the system is doubled. Then the final volume of the storage tank hot water is 750 liters.

The design of the hot water storage tank, considered a liner of 100 mm of mineral wool. Therefore, an energy loss through the walls was calculated for 24 hours: Q = 6.5kwh / day. The losses from pipes were estimated in 10% of this value, equivalent to 0.65 kWh / day. Finally, the total energy demand of the system is:

$$Q_T = 19.9 + 6.5 + 0.65 \frac{kWh}{day}$$

$$\boldsymbol{Q_T = \approx 26 \frac{kWh}{day}}$$

Flat plate collectors Sizing

According to previous calculations, the solar system must be prepared to provide more than 50% of energy required for pasteurization of 300 liters of milk. The reference used was the average radiation of Arequipa, which averages to 2130 kWh / m2 year. (5.84 kWh / m2 day)
In typical working conditions, when there is a difference of 60 ° K between collector (80 °C) and ambient temperature (20 °C), the solar collector shows an efficiency rate of approximately 30% (I = 700 W/m2).

Considering these data, and seeking a solar contribution of 75%, a static calculation of the amount of solar panels to be used, is made.

Panels area used = Energy demand / global annual average radiation efficiency of panels x.

Panels area = (26 kwh /día) x 0.75 / 5.84 kwh / m2 día

$$\text{Panels area} = \frac{19.5 \text{ kwh /day}}{5.84 \text{ kwh / m2 day x } 0.3}$$

Panels area = 11.13 m2

According to the National Service of Meteorology and Hydrology of Peru (2010), the average monthly values of solar radiation in Arequipa are shown as follows:

Table 2: Average monthly values solar radiation in Arequipa

Month	YAN	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DEC
W/m2 day - average	6681	5796	6299	5579	4973	4540	5041	5501	5817	6594	7310	6105

Considering an efficiency of 30% and an effective area of absorption of radiation of 10.86 m2, the heat supplied by the solar system per month, will be as follows:

Table 3: Solar energy given to the system

MES	YAN	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DEC
W/m2 day - average	6681	5796	6299	5579	4973	4540	5041	5501	5817	6594	7310	6105
Kwh h / m2 day	6.7	5.8	6.3	5.6	5.0	4.5	5.0	5.5	5.8	6.6	7.3	6.1
day / month	31	28	31	30	31	30	31	31	30	31	30	31
Kwh h / m2 month	207.1	162.3	195.3	167.4	154.2	136.2	156.3	170.5	174.5	204.4	219.3	189.3
Collector efficiency	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Total Area collector	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Energy given to the system	674.8	528.7	636.2	545.3	502.3	443.7	509.1	555.6	568.6	666.0	714.5	616.6

Finally, the monthly thermal energy demand of 793 kWh / month (26 kwh / day). If the solar system is able to provide 580.1 kwh / month, then the calculated solar contribution is close to 75%.

Heat exchanger

For this case, it was decided to use a countercurrent flow exchanger, since this arrangement allows the use of lower temperature gradients between the heating flow and the product, comparing with the case of the parallel flow.

The heat exchanger also considered the following specifications:

- Operating temperature between 15 ° C and 85 ° C
- Work pressure: 1 Atmosphere
- Construction Material: Stainless Steel 304 - 2B sanitary finish.
- Easy to remove outer cylinder for the thorough cleaning of equipment.
- Connection of outer cylinder with the inner cylinder through flange and tight seal
- Inner cylinder 6 inches in diameter (standard pipe 6 "diameter).
- External cylinder 8 inches in diameter (standard 8 Pipe "diameter).
- OD tube coil ½ ", 60 turns, 05mm separation between turns; welded to the inner tube.
- Flange type couplings for both the coil and ducts and out of milk.
- Total length of coil: 1200 mm.
- Overall heat transfer coefficient: 1564.64 w / m2 ° C
- Swap area: 0.82 m2

5. Construction and Installation

Construction of dairy equipment, installation and commissioning of developed between December 2013 and March 2014.

Figure 2: Construction and operation tests workshop (Arequipa)



Figure 3: Installation in the project area



Figure 4: System details







6. Technology analysis

Pasteurization parameters

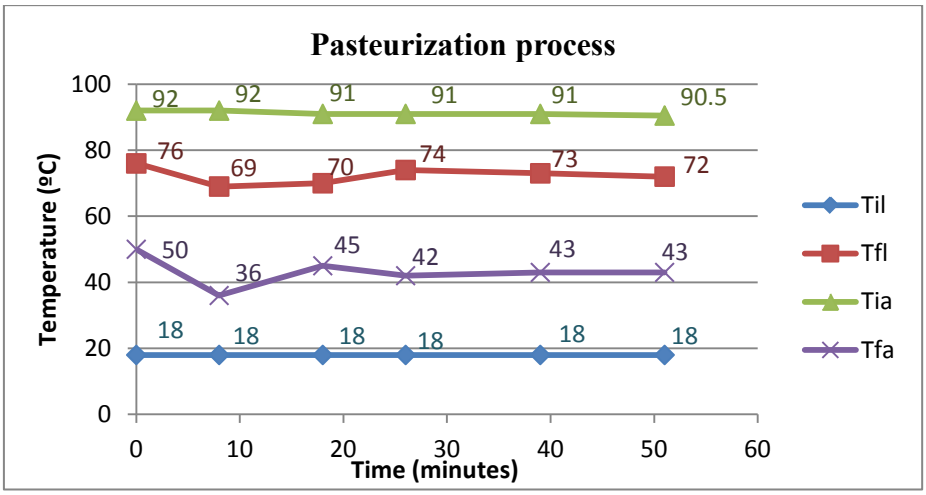
For technical validation, several functioning tests were performed considering a milk flow Qmilk=5 liters/minute. In order to pasteurize 300 liters, the expected time for the whole process was between 50 and 60 minutes.

Til	temperature cold milk
Tfl	temperature hot milk
Tia	hot water temperature
Tfa	cold water temperature

Table 4: Flow average temperature

Time (seconds)	Temperature (°C)			
	Til	Tfl	Tia	Tfa
0	18	76	92	50
8	18	69	92	36
18	18	70	91	45
26	18	74	91	42
39	18	73	91	43
51	18	72	90.5	43
Promedio	**18**	**72**	**91**	**42**

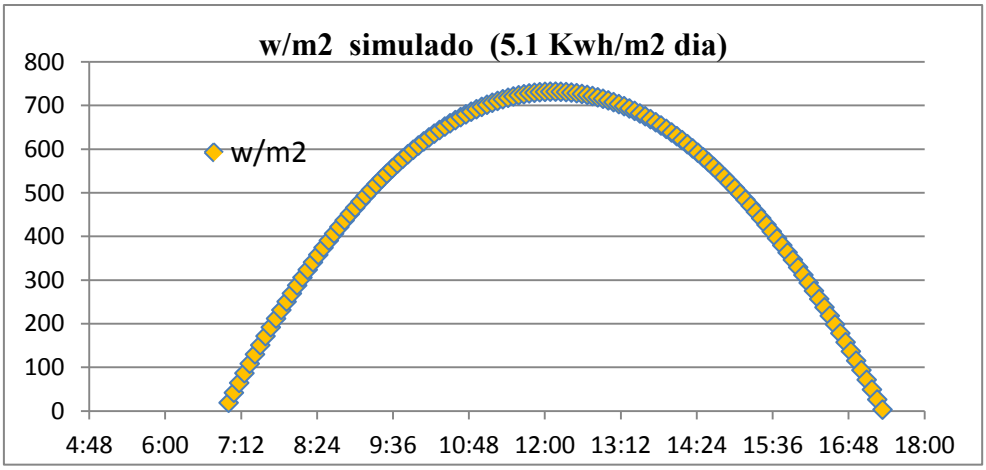
Figure 5: Temperatura de flujos en validación de proceso de pasteurización



Global thermal efficiency of the system

It was needed to identify the thermal behavior of the system, the contribution of solar energy to the process, and the global thermal efficiency of the system. In order to accomplish this, a testing procedure was conducted for analyzing performance operation of the overall system once it was installed. The test was conducted for 6 days, between 10 and 15 August 2014.

Figure 6: Solar resource simulated curve based on data obtained in testing days



For the project area, the average global solar irradiation rate is 5.1 Kwh/m2.day.

Analysis of factors that influence the energy balance of the system

It was necessary to identify energy gains and energy losses of the system. Within the system energy gains, we consider the contribution of the solar energy system (According to availability of solar resource) and energy backup system (adjusted to cover the energy deficit). Within the system losses we consider the energy delivered to the process (19.9 Kwh/day), the heat loss through the tank and pipes (7.15 Kwh/day), and "other losses" caused by operation procedures, like pre heating, tuning, etc. (8.8 Kwh/day).

The solar gains, are given by the solar resource (global solar irradiation of 5.1 Kwh/m2 day average year), the total collector area (10.86 m2) and the thermal efficiency of the collectors. This last factors, depends of the temperature difference between the collector and environment. According to the testing results, we obtained an efficiency between 40 and 50%. Finally, the energy gain by solar radiation was 24.92 Kwh/day. The final thermal gain, from the back up system, was the amount of energy needed to cover the energy losses. In this case, the back up system, contributed with 10.93 Kwh. (At this conditions, the water storage tank remains at the same temperature, that is to say, that the energy balance in the storage system was cero after a cycle of 24 hours of operation)

Regarding the previous results, the solar thermal contribution to the system was 69.5 %, and the back up contribution was 30.5 %.

Finally, the global thermal efficiency is given by the ratio of the energy used effectively in the process, divided by the amount of total energy provided to the system, taking into account cero energy loses of gains in the water storage tank. In this case, the total energy provided came from solar and the backup system. In the first case, the thermal efficiency of collectors was 45%, and in the second, the efficiency of heater resistors was 95%. For each source of heat, the total energy provided was 55.38Kwh/day and 11.50 Kwh/day.

If the energy used effectively in the process is given by the thermal requirements for pasteurizing 300 liters of milk (19.9 Kwh/day), the global thermal efficiency of the system is given by:

$$GTE(\%) = \frac{Energy\ used\ for\ the\ process}{Total\ energy\ provided} = \frac{19.9\ Kwh/day}{55.38 + 11.50\ Kwh/day} = 29.7\ \%$$

7. Economic analysis of technology

For validation of the economic system, it is needed to compare both capital costs and operating costs of the energy system over other milk pasteurization systems available in the market.

In order to have a certain degree of credibility, it was decided to take as a benchmark case the study: "Start-up and operating costs for artisan cheese companies" by Andrea Bouma, Catherine A. Durham, and Lisbeth Meunier-Goddik, Oregon State University, USA. The research was published in the Journal of Dairy Science, 97: 3964-3972, 2014.

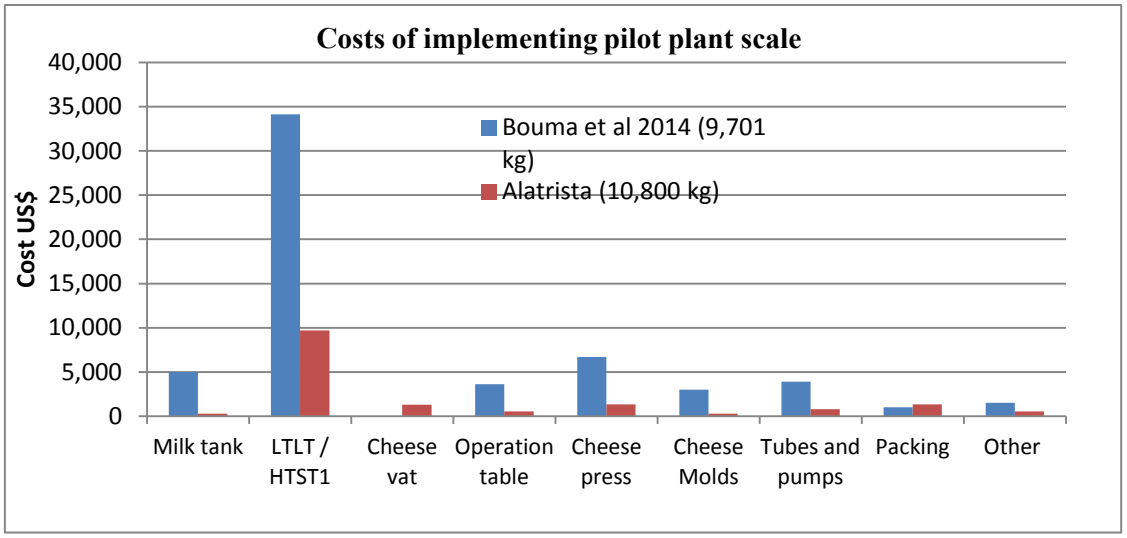
According to Bouma et al (2014) for three scenarios considered in the study, processed cheese manufacturers around 3402 kg and 13,608 kg of cheese, still use a batch type pasteurizer at a production rate of 3 days per week .

According to Bouma et al (2014), where annual production is about 19,400 kg, the batch type production is no longer feasible. Instead, the process uses a HTST unit and a separate cheese vat. However, is is commented that artisan cheese producers tend to avoid HTST process for several reasons: the cost of equipment, operation complexity, the need for a license to use pasteurizer HTST, requirements of work experience, and the need to install cleaning in place (CIP) systems. It also shows that the use of pasteurization and HTST CIP significantly increase the total cost of the equipment.

Interestingly, Bouma et al (2014) mentioned that the cost of small equipment is often close to that of larger scale equipment; also indicates that a large volume of production is needed to justify equipment sufficient scale HTST processes.

Several factors affect the price of new equipment, including import costs, currency exchange rates, types of cheese (eg cheddar cheeses requiring brine tank), among others.

Figure 7: Comparative Costs of equipment Bouma et al (2014) and the present study



As shown in the graph, the pasteurizer is the equipment that largely represents the higher costs.

Costs associated to the pasteurization process proposed in this study, resulted to be 40% lower than the pasteurization system shown by Bouma et al 2014; even considering that the system presented in this study enables HTST batch type, while the second only allows a LTLT pasteurization process. It can be assumed that the differences between the costs of equipment is strongly influenced by the cost of labor, obviously being more expensive in the United States. However, the difference mostly lays in the fact that the pasteurization system proposed, doesn't use advanced electronic control, neither high power energy in the way of steam, so this makes a more simple system.

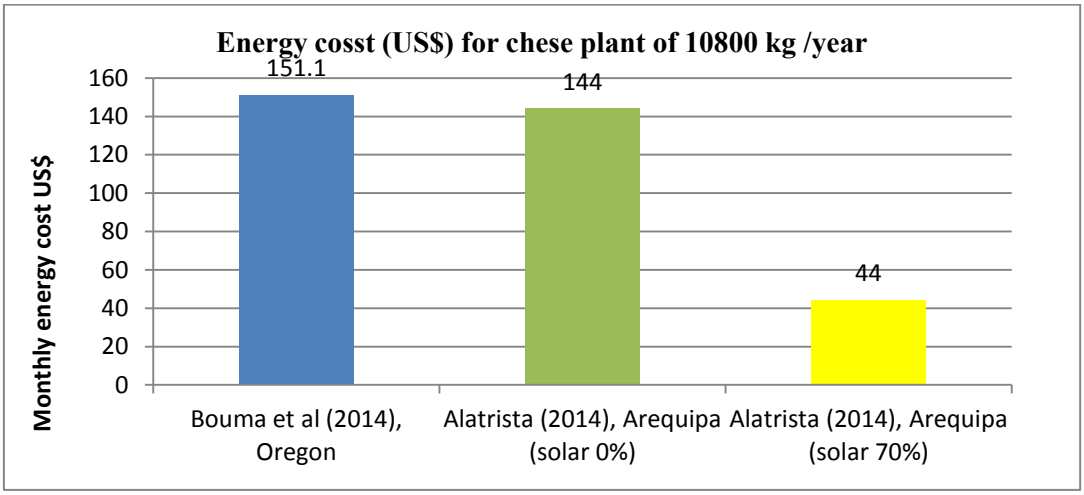
Comparison of operating costs

For a comparative analysis of the operating costs of the technologies, is was taking as a reference, the study of Bouma et al (2014) (Oregon, USA). In this paper, the energy cost is stated in terms of monetary value of energy costs associated to propane and electricity, rather than consumption. For comparison, a monetary comparison is performed.

Table 5: Comparison of energy cost

	Bouma et al (2014), Oregon (termal energy)	**Alatrista (2014), Arequipa (solar 0%)**	**Alatrista (2014), Arequipa (solar 70%)**
Energy costs (US$) for cheese milk of 10800 kg /year	151.1	144	44

Figure 8: Comparison of energy cost



The above data shows that the cost displayed by Bouma et al (2014) and the present study system are similar in the case there is not solar energy contribution to the system.

The data also shows that the use of solar energy, would save about $ 100 / month, or $ 1,200 / year, for a production of pasteurized cheese of 30 units per day. If we assume the total system cost of US $ 9.700 US dollars pasteurization, it can be inferred that only the annual energy savings would be able to cover the cost of the pasteurization equipment system from scratch in eight years.

8. Environmental analysis

For environmental analysis, a calculation of CO2 emissions resulting from the use of thermal energy for the pasteurization process was performed. Total use of 300 liters of pasteurized milk shall be taken into account to produce 30 kg of pasteurized cheese daily, or 10,800 kg of cheese annually.

As mentioned in the calculation of technical validation, the energy required for milk pasteurization is 35.85 Kwh/day. This energy is supplied in a proportion composed by 70% solar energy and 30 % electric heater resistors.

Having the energy required, four different options, capable of meeting the requirements of the energy demand, have been calculated. These options are:

- Solar energy + backup electric resistance
- Solar + Backup propane combustion
- 100% electrical resistance
- 100% propane

In case of electricity use, according to the model for CO2 calculations of the Peruvian electricity grid, developed by FONAM (Fonam, 2007), the emission factor is 0.547 tons CO2 / MWh. In case of propane gas, the CO2 emission factor was obtained from IPCC Guidelines for National Greenhouse Gas Inventories: Default Emissions factors for stationary combustion in Manufacturing Industries and Construction (2006). According to this, for stationary propane combustion, the emission factor is 63.1 gCO2 / MJ. The

calorific value of propane is 50.3 MJ / Kg or 13.97 kWh / kg. This yields a total emission factor of 3.17 kg CO2 / kg of propane. (2006)

Table 6: Calculation of daily emissions scenario

Energy source	**Emission per day Kg CO2**	**Annual emission Kg CO2**
solar 70%+ electric resistor 30%	5.4	1971
solar 70% + propane gas 30%	3.0	1095
100% propane gas	10.2	3723
100 % electric resistor	18.2	6643

9. Conclusions

For obtaining a pasteurization system of 300 liters of milk, of low cost and capable of been powered by solar energy some design considerations were taken. The design considered the use of a flat plate collectors system of 10.86 m2; an energy storage system composed by a pressurized water tank of 750 liters; and a process system, composed mainly by a countercurrent flow tube heat exchanger (capable of been manufactured in the local market) of 0.82 m2 of area and 1564.64 w/m2ºK heat capacity. The heat exchanger had special design for being easily cleaned and sanitized. A solution of propylene glycol was used as a heat transfer fluid from the collectors, to prevent collapse of copper tubes by internal freezing.

Daily energy demand for the pasteurization system was calculated in 26 kWh/day. 19.9 kwh/day corresponds to the thermal requirement of pasteurization, 6.5 kwh/day to heat loss through the tank and 0.65 kwh/day to the loss of heat through pipe walls.

For the technical evaluation of the system, an analysis of the process parameters was performed. At this early stage it was found that it was possible to achieve a pasteurization temperature of 72 ° C, when the water in the storage tank reached at least 85 ° C. Heat exchange had place with a milk flow of 5 liters/minute and a water hot water flow of 5.5 liters/min.

For purposes of evaluation global heat balance of the system, a calculation of the heat balance was done considering variations in temperature experimented by the storage tank during 6 days of testing. These estimates were compared with all energy gains and losses in the system. Among the energy gains, we counted a solar contribution of 24.92 Kwh/day and a backup contribution of 10.93 Kwh/day, based on a heating system of resistors. Energy losses were considered in the form of energy required by the process (19.9 Kwh/day), heat losses from the tank and pipelines (7.15 Kwh/day) and "other losses" associated with production practices (8.8 Kwh/day).

The solar contribution to the system was calculated in 70%. The global energy efficiency of the system was calculated in 29%.

For economic evaluation we decided to undertake a benchmark analysis considering the paper: "Start-up and operating costs for artisan cheese companies" (Bouma et tal, 2014). It was concluded that the cost of equipment for the implementation of small-scale dairy is very different if the realities shown in Bouma et al 2014 and the present study. The pasteurization system cost of this study proves to be 40% lower.

Furthermore, the results show that the operating costs related to energy consumption in both systems are very similar, if the availability of solar energy is eliminated. This adds about an energy expenditure valued at US $ 150 / month. The results also show that the use of solar energy would save about $ 100 / month, or $ 1,200 / year. If we assume a total system cost of US $ 9.700 US for the proposed system, it can be inferred that only the annual energy savings would be able to cover the cost of the thermal system from scratch in eight years.

Finally, an environmental evaluation was performed considering four scenarios of energy supply. It was concluded that the used technology (solar + resistors) offers a promising alternative to reduce CO2 emissions comparing pasteurization systems available in the market. The use of the proposed technology could contribute to mitigate a 47% of emissions generated by traditional pasteurization systems.

Acknowledgments

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References

1. Aubron, C., & Cochet, H., 2009. Producción lechera en los Andes peruanos : ¿Integración al mercado interno o marginación económica?, Anuario americanista europeo, N° 6-7, 2008-2009 p. 217-238
2. Baer, D., Gordon, M., Zarmi, Y. 1985. Design and Optimization of Solar Steam Systems for Constant Load Applications. Applied Solar Calculations Unit, Blaustein Institute for Desert Research. Ben-Gurion University of the Negev, Sede Boqer Campus. Israel 84990 Solar Energy Vol. 35, No. 2, p. 137-151, 1985
3. Baghernejad, A., Yaghoubi, M. 2010. Exergy Analysis of an Integrated Solar Combined Cycle System. Renewable Energy, Vol. 35, No. 10, p. 2157-2164.
4. Bouma, A., Durham, C., Meunier-Goddik, L. 2014. Stat-up and Operating Costos for Artisan Cheese Companies. Journal of Dairy Science. 97, p. 3964-3972.
5. Byrne, J., Kurdgelashvili, L., Mathai, M., Kumar, A., Yu, J., Zhang, X., Tian, J., Rickerson, W. 2010. World Solar Energy Review: Technology, Markets and Policies. Center for Energy and Environmental Policy. The World Bank.
6. Dirección General de Competitividad Agraria, 2009. Tecnología de leche: El Conglomerado Quesero de Bambamarca. Ministerio de Agricultura – Perú.
7. IEA, 2010. Technology Roadmap: Concentrating Solar Energy. International Energy Agency. Disponible en: http://www.iea.org/papers/2010/csp_roadmap.pdf
8. IEA, 2010. Technology Roadmap: Concentrating Solar Energy. International Energy Agency. Disponible en: http://www.iea.org/papers/2010/csp_roadmap.pdf
9. IEA, 2010. Technology Roadmap: Solar Photovoltaic Energy. International Energy Agency. Disponible en: http://www.iea.org/papers/2010/pv_roadmap.pdf
10. ITDG – Agromarketing, 2006. Análisis Subsectorial, Quesos Madurados Tipo Suizo Distrito de Tongod y Catilluc Cajamarca.
11. Kalogirou, S., 2002. The Potential of Solar Industrial Process Heat Applications. Applied Energy, 76, p. 337 – 361.
12. Kulkarni, G., Kedare, S., Bandyopadhyay, S., 2008. Design of Solar Thermal Systems Utilizing Pressurized Hot Water Storage for Industrial Applications. Solar Energy 82, p. 686 – 699.
13. NREL, 2011. National Renewable Energy Laboratories, USA. See: Solar Advisor Model: https://www.nrel.gov/analysis/sam/
14. Murphy, P., 2013. Anual Report IEA Solar Heating & Cooling Programme. Extracted from: www.iea-shc.org
15. Pietzcker, R., Manger, S., Bauer, N., Luderer, G., Bruckner, T., 2011. The Role of Concentrating Solar Power and Photovoltaics for Climate Protection. Potsdam Institute of Climate Impact Research (PIK)
16. Potter, N., 1978. La Ciencia de los Alimentos. EDUTEX SA, Mexico.
17. Price, S., and Margolis, R., 2010. 2008 Solar technologies market report. U.S. Department of Energy.
18. REN21. 2009. Renewables Global Status Report: 2009 Update (Paris: REN21 Secretariat). Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH.
19. Richter, C., Teske, S., & Short, R. 2009. Concentrating Solar Power: Outlook 2009 – Why Renewable Energy is Hot. Amsterdam: Greenpeace International, Tabemas, Spain: 146 SolarPACES and Brussels: ESTELLA. Retrieved April 19, 2010 from http://www.estelasolar.eu/fileadmin/ESTELAdocs/documents/Greenpeace_Concentrating_Solar_Power_2009.pdf
20. Romero, H. 2008. Irradiancia Solar en Territorios de la República de Chile. Proyecto CHI/00/G32 “Chile: Remoción de Barreras para la Electrificación Rural

con Energías Renovables". Disponible en: http://www.freewebs.com/infoenergia/RegistroSolarimetrico.pdf
21. Saravacos, G., y Kostaropoulos, A., 2002. Handbook of Food Processing Equipment. Kluwer Academic/ Plenum Publishers.
22. Schilling,. M, Esmundo, M. 2009. Technology S-curves in renewable energy alternatives: Analysis and implications for industry and government. Energy Policy, January 2009.
23. Senamhi, 2003. Atlas de Energía Solar del Perú. Disponible en: http://www.cedecap.org.pe/uploads/biblioteca/80bib_arch.pdf
24. Shane, S., 2008. Handbook of Technology and Innovation Management. John Wiley and Sons Editors.
25. Schmitt, B., Lauterbach, C., Vajen, K. 2010. Investigation of Selected Solar Process Heat Applications Regarding Their Technical Requirements for System Integration. Kassel University, Institute of Thermal Engineering, Kassel (Germany) www.solar.uni-kassel.de, solar@uni-kassel.de
26. Sloan, T., Alatrista, A., 2010. Dilemas Estratégicos Para el Surgimiento de Una Industria Solar en Latinoamérica: Un Enfoque Desde Chile. Congreso Latinoamericano de Energía Solar, Cusco 2010.
27. Suurs, R., 2009. Motors of sustainable innovation: towards a theory on the dynamics of technological innovation systems. PhD thesis, Utrecht University.
28. Tora, E. 2008. Optimal Design and Integration of Solar Systems and Fossil Fuels for Process Cogeneration. Master of Science Thesis, Texas A&M University.
29. Tripsas, M. 1997. Unraveling the process of creative destruction: complementary assets and incumbent survival in the typesetter industry. Strategic Management Journal, 18, 119–42.
30. USA EPA [Environmental Protection Agency]210, 2010. Clean Energy. Available at: http://www.epa.gov/cleanenergy/energy-and-you/affect/coal.html [Accessed 31 July, 2010].
31. Vajen, K., Lauterbach, C., Schmitt, B. 2012. Solar heat for industrial processes – Potential, technologies and applications. Kassel University, Institute of Thermal Engineering, Kassel (Germany). Proceedings of the "International Conference on Solar energy for MENA region (INCOSOL)". Amman, Jordan, 22-23October 2012. Paper Number: 28
32. Wolff, G., Gallego, B., Tisdale, R., & Hopwood, D. (2008). CSP Concentrates the Mind. Renewable Energy Focus, January/February, 42-47.

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Strategic Intervention Materials (SIM) in Grade 7 Science (Biology)

Ronald B. Dedace

Abstract

This study designed, developed, validated and tested the effectiveness of five Strategic Intervention Materials (SIM) in Grade 7 Science (Biology). This was conducted in Digos City National High School during the school year 2013-2014. Three stages were followed in the preparation of the SIM. These stages include: pre-development stage, developmental stage and post developmental stage. The criteria set by the Department of Education (DepEd) were used by the five panel of experts and ten potential teacher-users in evaluating the strategic intervention materials. These SIMs were also tried out to the potential student users. Results of the validation were the bases for the revision of the materials in preparation for the test of effectiveness.

The findings showed that the developed strategic intervention materials met the set criteria for validity, specifically on functionality and usability in the guide card, activity card, assessment card, enrichment card, and reference card. These developed SIMs were appropriate, appealing and interesting, challenging, easy to understand and enjoyable for the identified users.

Furthermore, from the quasi-experimental study comparing the academic achievement of the experimental group and of the control group, the experimental group taught in Grade 7 Science (Biology) with the integration of SIM, achieved better compared with the control group taught in Grade 7 Science (Biology) without the integration of SIMs. Therefore, the developed Strategic Intervention Materials (SIMs) in Grade 7 Science (Biology) could enhance the proficiency level of the students in the subject, Science 7 (Biology).

Chapter 1

The Problem

Introduction

Instructional materials are widely used in schools to deliver effective teaching and better learning among the students. These instructional materials are mainly prepared for the effective and well-organized transfer of learning. Instructional materials are facilitated in the teaching-learning situation and help teachers in conveying the lessons more simple and easy to understand. It is being practiced that teaching and learning could not be effective without adequate and relevant instructional materials.

The instructional materials are available to the teacher and learners which serve as stimuli in the teaching-learning situation. These may be either a "human person" or a "physical object." The whole purpose of materials is to initiate the students to the "real world" they live in. Instructional materials represent elements found in that world are meant to help students understand and explain reality. Portraying reality can be by direct experience, reproduction, representation or abstraction.

The Department of Education implemented the K to 12 program which involves the institutionalization of kindergarten and the addition of two more years of high school in the basic education cycle. The Philippine government believes that this program could lead to

improvements of the present state of education in the country (K to 12 Curriculum Guide SCIENCE, 2012).

In the K to 12 program, science curriculum is learner-centered and inquiry-based, emphasizing the use of evidence in constructing explanations. Concepts and skills in Life Sciences, Physics, Chemistry, and Earth Sciences are presented with increasing levels of complexity from one grade level (Grade 7 to Grade 10 (spiral progression), thus paving the way to deeper understanding of a few concepts. The science concepts and skills are integrated rather than discipline-based, stressing the connections across science topics and other disciplines as well as applications of concepts and thinking skills to real life. To be globally competitive, the science curriculum has incorporated the 21st century skills namely: learning and innovation, information, media, technology, life and career skills (K to 12 Curriculum Guide SCIENCE, 2012).

Many teachers and other educators have expressed a concern regarding the lack of student interest in many of the traditional science subjects. To help rectify this problem a collaborative effort among educators and other concerned individuals has led to the development of instructional materials that are more relevant to the lives of students (Ellis, 1993).

As stated in DepED Memorandum 225 series of 2009, Strategic Intervention Material, popularly known as SIM in Philippine Education, is an instructional material meant to reteach concepts and topics which are considered least learned by the students. The basic parts of which are: Guide Card, Activity Card, Assessment Card, Enrichment Card and Reference Card. It is exclusively designed for those students who are really in need of an intensive learning care of the teachers.

Strategic Intervention Materials (SIM) should be introduced in Philippine Education because of its necessity as learning package intended to supplement classroom learning; while the students are working independently. The SIM could potentially bridge the gap between the least learned and the mastered learning competencies especially in Science. This could also help the students to develop positive and good study habits.

Teaching science and all other subjects specially, the least learned competencies are given emphasis by the Department of Education. The science teachers are to develop various intervention schemes for remediation and enrichment of learning especially for the least learned competencies. Differentiated Instruction (DI) and Experiential Learning (EL) could also be adopted to make learning more meaningful among secondary school students.

Learning science is more fun because of the activities provided. Learners are eager to be involved with creative and problem-solving skills. On the other hand, teachers should provide a more exciting and relevant context for developing students' investigative skills.

The researcher observed that the current teaching-learning process requires more interactive learning experiences where in the learners are not just mere passive recipients of information. Hence, the Strategic Intervention Materials (SIM) is introduced as an instructional materials to stimulate the activities of the students and thereby increase their level of understanding and mastery of the subject-matter.

Designing instructional materials is not an easy task; it requires careful planning and much effort. To perform its purpose, the instructional materials should be designed and developed to anchor on learning theories in order to have educational worth and importance. The development of intervention materials will undergo three stages adopted from Simbulan's Model (2006) namely: Pre-Development Stage, Development Stage and Post Development Stage.

In needs assessment survey to the grade 7 science teachers of Digos City National High School to determine the least learned concepts in Grade 7 Science (Biology). There were top five topics considered as least learned competencies based from the results of the assessment and evaluation conducted in line with the K to 12 learning competencies namely: plant and animal cells (31.47%) low mastery, microorganisms (35.40%) low mastery, microscopy (32.40%) low mastery, reproduction (47.94%) low mastery and interactions (37.85%) low mastery.

The poor quality of education is reflected in the country's low scores in national assessment tests. On the average, the National Performance of High School Students in the 2012 NAT, fourth year students got an MPS of 48.90, an improved performance when compared with the previous years (44.33 in 2006 and 46.80 in 2005). Among the subjects taken, Science got the lowest mean percentage score of 40.53, while Math got 46.37, English got 51.80, Filipino got 51.27 and Araling Panlipunan got 54.22 (NETRC, 2013).

In international tests such as the Trends in International Mathematics and Science Study (TIMMS), the Philippines is among the worst participating countries. Out of 25 participating countries, the Philippines ranked 23rd in TIMMS' Math and Science in 2003. In 2008 TIMMS, even the science high schools that are recognized to be the best and the brightest in the country fared badly in Advanced Mathematics (SEPO Policy Brief, June 2011).

Among the factors which could be cited to account for the low performance in science of the Filipino students would include the lack of science culture and deficiencies regarding the school curriculum, the teaching learning process, teacher training, instructional materials like lacking of textbooks and science equipment (Batomalaque,2009). On the mentioned situations, the intervention materials are meant to enhance students' learning and to master the least learned concepts. To enhance science learning, ideally science teacher should include enhancement and enrichment activities.

Thus, the researcher would made five intervention materials to simplify the identified least learned concepts. The intervention materials would help the students deepen their knowledge and foster significant difference in the learning output among the grade 7 students.

Conceptual Framework

The development of strategic intervention materials is anchored on the concepts of Research and Development (R&D) model (Simbulan, 2006), SIM development and constructivism theory.

Research and Development (R&D) model of Simbulan (2006) was used in the development of strategic intervention materials. The concept that the learners could learn science concepts better, through instructional materials that promote active participation. The development of SIMs is an activity that teachers can do as an innovation. These materials can also provide enrichment, supplementary activities and remedial instruction so that students can learn better (Simbulan, 2006).

It contains the following stages: pre-development stage, development and post-development. The pre-development stage involves the conceptualization of the SIM. This includes the planning of topics to be considered, listing objectives, the making of Task Analysis Chart (TAC), the preparation and collection of the references.

The development stage involves the actual making of the SIM. This includes the writing of the materials considering the objectives, activities, assessments and enrichment activities. It also includes the organizing and presenting the materials in a clear and simple language with appropriate pictures. The researcher considers all available resources to provide for rich and

varied activities like the use of technology, experiential learning, differentiated instructions and remediation.

The post development is concerned with the evaluation, validation, tryout of the SIMs, revisions of the materials and the test of effectiveness. It also revises the materials into its final form. During the evaluation, the SIMs undergo evaluation by the panel of experts. They assessed the usability and functionality of each card of the SIM. The tryout group evaluated the SIM as to their stimulation of interest, ease of use and feelings toward the materials. Results of the evaluation by the experts and the tryout group were the bases in revising the SIM and improving them to their final form. The test of effectiveness of the SIMs, there were two groups namely: experimental and control groups.

The SIM development is based on the DepEd Order no.225, s.2009 which strengthens successful learning in Science. The Department of Education in its continuing effort to raise the quality of education aims to facilitate teachers in developing various intervention materials for remediation and enrichment of learning. Intervention is important especially when students have difficulty in understanding of the concepts. Intervention activities are designed to help teachers to provide extra support for students who are poor in their academic performance.

Strategic Intervention Materials (SIMs) refer to teaching aid introduced into the teaching methods to stimulate the activity of the students and thereby increasing their level of understanding. The word intervention means that the learning of the students is enhanced with the integration of the use of Strategic Intervention Materials (SIMs).

The following are the different Parts of the SIM called Cards: Guide Card, Activity Card, Assessment Card, Enrichment Card and Reference Card.

Guide Card, gives a preview of what students will learn, the overview and objectives can be found in this card. *Activity Card,* translates the focus skills into at least 3 activities. These include the different activities to be answered by the learners. *Assessment Card* provides exercises, drills and activities that allow students to assess their understanding of what they have learned. These are sort of evaluation to determine how far the learners understood the topic.

Enrichment Card, provides activities that reinforce the content of the lesson, provides opportunities for students to apply what they have learned. These are considered as supplement to the assessment activities to further enhance the learning of the learners. *Reference Card,* provides readings that relate content with students' life experiences, and provides a carefully researched list of resources.

Constructivist Theory by Bruner (1966) believed that learning is an active process in which learners construct new ideas or concepts based upon their current and past knowledge. Constructivism theorizes that learners actively construct their own understanding of the world around them by fitting their perceptions of the world into their existing knowledge and understanding. Constructivism theorists generally advocate that learners must construct their own knowledge to solve problems presented by the environment.

Constructivism as a model or worldview supports that learning is an active, practical process. The learner is an information constructor. Individuals actively construct or create their own subjective illustrations of objective reality. New information is associated to prior knowledge, thus intellectual representations are subjective.

Figure 1 shows the framework of the study. It consists of two boxes. The first box shows the bases in making the strategic intervention materials and the other box shows the development, parts and the identified topics of Strategic Intervention Materials in Grade 7 Science (Biology).

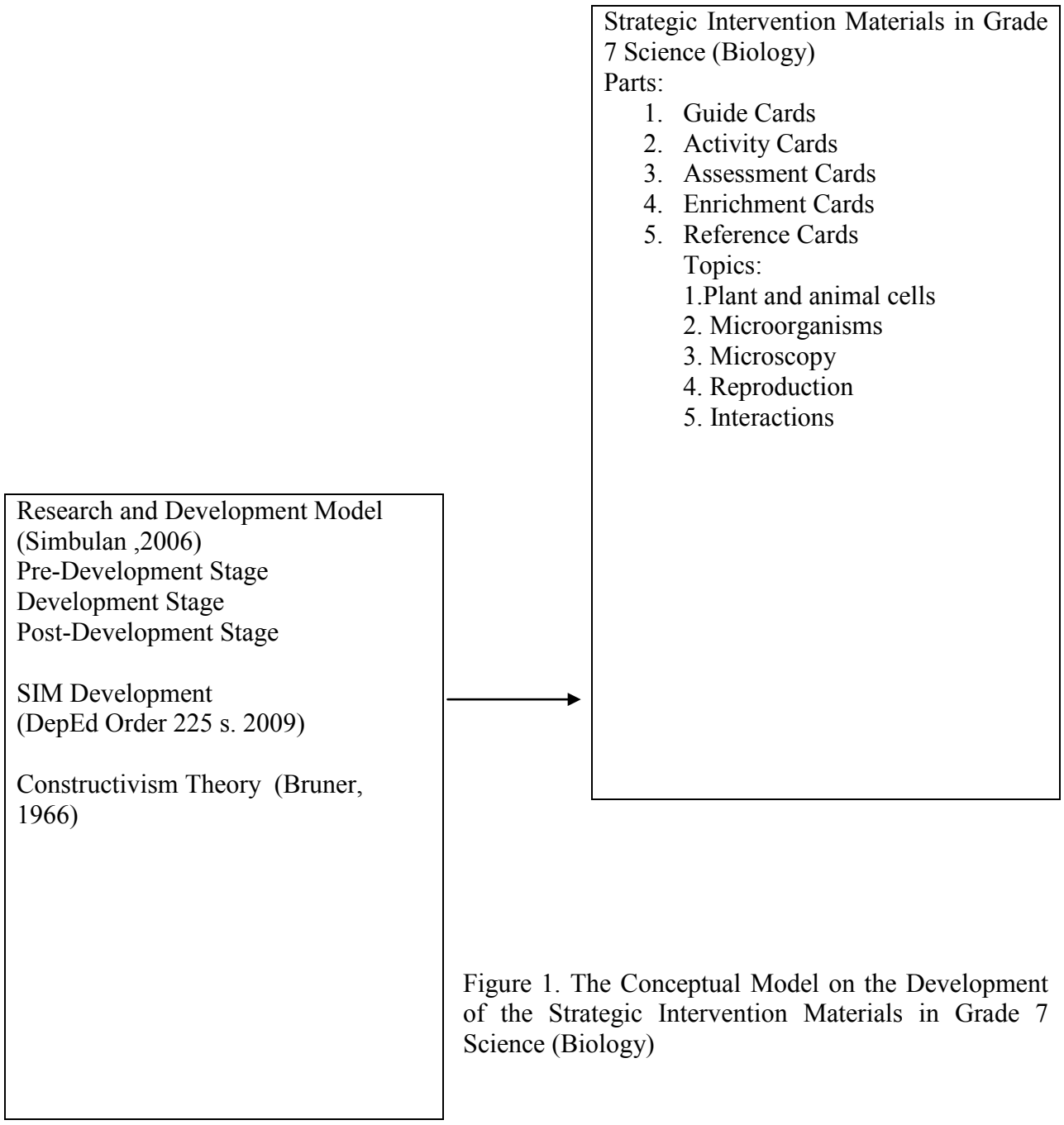


Figure 1. The Conceptual Model on the Development of the Strategic Intervention Materials in Grade 7 Science (Biology)

Statement of Purpose

The main objective of this study was to develop, validate, revise and to test the effectiveness of Strategic Intervention Materials (SIM) to help the students master the least learned competencies in Grade 7 Science (Biology). This was conducted in Digos City National High School, Digos City Division in Davao del Sur for the school year 2013-2014.

With this study, the researcher aims to:

1. design and develop Strategic Intervention Materials (SIM) in Grade 7 Science (Biology) ;

2. validate the designed Strategic Intervention Materials from the feedbacks of experts and opinions of students;

3. revise the Strategic Intervention Materials based on feedback from the panel of experts, potential teacher-users and the potential student-users; and

4. to test the effectiveness of the developed Strategic Intervention Materials (SIM) in Grade 7 Science (Biology).

Null Hypothesis

There is no significant difference in the academic achievement between those students taught in Grade 7 Science (Biology) with the integration of SIM and those students taught in Grade 7 Science (Biology) without the integration of SIM.

Significance of the Study

The developed strategic intervention materials would have meaningful and significant value to the grade 7 students, secondary science teachers, school administrators, parents, guidance counselor, science education program and other future researchers.

This study would help students deepen and enhance the least learned concepts in Grade 7 Science (Biology). The students would gain more knowledge in different science activities since they are going to answer different activities. It can encourage them to work individually since instructions are clearly specified and students can progress at their own pace. Therefore, students could develop greater responsibility for their own learning. Moreover, what one learns through visual interaction is recalled longer.

The teachers could help enrich the mastery level of the students. The SIM would help them become more artistic, innovative and develop their skill in teaching by making even one Strategic Intervention Material that would suit to the curiosity and essentials of the students. The SIM would add up enthusiasm and excitement to teaching and provides chances to be creative by improving their method of instruction in teaching Science.

Using the findings of this research, the DepEd administrators would be provided with insights that could guide them in planning and designing in-service trainings and seminar workshops for science teachers with emphasis on development of instructional materials like SIM. It could become their springboard for upgrading and enriching some strategies and approaches in teaching science that could update them in giving assessments nowadays.

Results could help and guide the parents to mentor their children in answering the Strategic Intervention Materials since these materials can be brought at home as part of the school-home agreement. The parents as partner educators, this would help increase their awareness in improving their children's science achievement.

Guidance counselors would made be aware of the existing needs in the programs and activities to address the conditions of the students who perform fairly in the lesson. This could also help them to conduct group counseling, interview and home visit especially on academic performance of the students.

This study would provide related information that could inspire science education students to produce instructional materials which are usable, purposeful and suitable to the different types of learners. This could also stimulate them to be more innovative especially in developing further instructional materials that will raise the quality of education.

To the BSU Graduate School, especially the Science Education Program, the developed SIM could serve as samples to explore and develop more of this type of instructional materials, which do not only cater to the teaching of Grade 7 Science (Biology) but on other branches of science as well.

Further, the findings of the study would also provide important information to other researchers as they seek insights and related studies about instructional materials especially on studies associated to this research work.

Delimitation of the Study

This study was delimited on the design, development, validation, revision and test of effectiveness of five (5) Strategic Intervention Materials (SIM) for the identified least learned concepts in Grade 7 Science (Biology).This was conducted in Digos City National High School during the school year 2013-2014.

The topics could in this study were delimited to plant and animal cells, microscopy, microorganisms, reproduction and interactions which were the five identified least learned concepts in Grade 7 Science (Biology). The standard format in making the Strategic Intervention Materials (SIM) was adopted, as prescribed in DepEd Memorandum Number 225 series of 2009 namely: Guide Card, Activity Card, Assessment Card, Enrichment and Reference Card. The researcher also used Simbulan's model for developing instructional materials following phases: Pre-Development Stage, Development Stage and Post-Development Stage.

The assessment instruments for validation utilized in the study, adopted the criteria set by the Department of Education on the features of the Strategic Intervention Materials and students' opinionnaire. The feedbacks by the experts, potential teacher-users and students were used as basis in the validation of the developed Strategic Intervention Materials in Grade 7 Science (Biology). The data were treated with percentages, frequency, mean, standard deviation, and t-test for independent samples at 0.05 level of significance.

Definition of Terms

The following are operational definitions of some terminologies to clearly define the terms.

Least Learned Concepts. Least Learned Concepts refer to the learning concepts identified as least learned in Grade 7 Science (Biology) based on the assessment and evaluation conducted to the grade 7 science teachers and grade 8 students. The said least learned concepts need intervention materials to facilitate the activities in a simple and very interactive way of learning. These were plant and animal cells (31.47%) low mastery, microorganisms (35.40%) low mastery, microscopy (32.40%) low mastery, reproduction (47.94%) low mastery and interactions (37.85%) low mastery.

Instructional Materials. Instructional materials are things or objects specifically prepared for efficient delivery of instruction thereby enhancing or fostering effective teaching and better learning (Simbulan, 2011). In this study, this refers to a strategic intervention material, a self-directed instructional materials developed by the researcher.

Intervention Materials. Intervention materials are instructional materials that the learning of the students are enhanced and enriched. In this study, these refer to learning package with the integration of the use of SIM together with the use of K-12 Science Curriculum Guide.

Strategic Intervention Materials (SIMs). Strategic Intervention Materials refer to the instructional materials that will stimulate students to do different activities on the least learned competencies in grade 7 science (Biology) and thereby increase their level of understanding. These materials also meant to reteach concepts or topics which are considered least mastered by the students. The basic parts of which are: Guide Card, Activity Card, Assessment Card, Enrichment Card and Reference Card as stated in DepED Memorandum 225 s. 2009. In this study, this refers to the self-directed instructional materials prepared by the researcher in learning the concepts of Grade 7 Science (Biology) particularly on animal and plant cell, microscopy, microorganisms, reproduction and interactions.

Test of Effectiveness. Test of Effectiveness is a methodology used to determine how effective and operational the developed instructional materials. In this study, this refer to the significant difference in the academic achievement between the experimental and control groups. Experimental group were students who would have the activities with Strategic Intervention Materials, while the control group were students who have the activities without Strategic Intervention Materials. To further determine the significant difference between the two groups, scores were treated using mean, standard deviation and t-test for independent sample at 0.05 significance level.

Chapter 2

Review of Literature

This chapter presents the review of related literature and studies that provide direct references in the conceptualization of the study. It is organized into the following sub-sections: on the development of instructional materials, on strategic intervention materials, test of effectiveness and constructivism.

On the Development of Instructional Materials

There are several advantages of using instructional materials. Teacher can vary the presentation of the lesson through instructional materials, thus, eliminating the monotony of the presentation of the lesson in the usual manner (Simbulan, 2011).

Prepared instructional materials have extensive value as they provide the students opportunities to learn even in the absence of their teachers. Simbulan emphasized the development and utilization of instructional materials, which promote modern approach to teaching and learning. Some of these instructional materials include workbooks, modules, lesson guides, work cards, activity cards, and manipulative cards.

Research and development conducted by Lumosad (2011) developed, validated, and revised lessons and activities in high school biology to develop critical thinking skills using 5E's instructional materials model for second year students. The study revealed that the panel of experts strongly agreed that the 5E's lessons content and content accuracy, clarity, and

appropriateness were provided very adequately. On the hand, the prospective teacher-users strongly agreed that the 5E's lessons were highly appealing and acceptable, highly practical and applicable, and highly relevant and useful. Furthermore, the prospective student-users strongly agreed that the 5E's lessons were very interesting, meaningful, enjoyable, easy and appealing.

The study of Potane (2012) designed, developed and validated teacher support materials for the design and conduct of Science Investigatory Projects (SIP) in Schools Division of Bukidnon for the School Year 2011-2012. The findings of the study revealed that the provisions were satisfied very adequately for content and content accuracy, clarity, and appropriateness of the material. As rated by teacher-users, the material was very much acceptable, applicable, and useful.

The use of teacher support materials guides the science teachers in their quest in improving science education by religiously conducting Science Investigatory Project (SIP) in the sciences that would enhance inquiry skills and values for lifelong learning among students.

Simbajon (2012) designed, developed and validated lessons in balance of nature integrating videos for high school biology students. The study revealed that the developed environmental lessons very adequately provided content and content accuracy, clarity and appropriateness, as evaluated by the panel of experts. The teacher-users evaluated that the developed environmental lessons' were suitable, usable, applicable and acceptable to teach High school Biology. Moreover, the student-users opined that the developed environmental lessons were very much appealing, enjoyable, useful, meaningful and easy.

Research and development conducted by Abadilla (2012) developed lessons and activities on environmental issues for Science Grade six integrating higher order thinking skills. Results revealed that the content and content accuracy, clarity and appropriateness of the lessons and activities on environmental issues were very adequately satisfied and provided, as assessed by the Panel of Experts. Likewise, the said lessons were highly acceptable, applicable, and usable, as assessed by the potential teacher-users. Moreover, the pupil-users opined the developed lessons were very much appealing, interesting, meaningful, useful, enjoyable and easy.

Activities for reading comprehension that integrates critical thinking skills using the concepts of climate change for grade six pupils were developed by Aban (2011). The findings of the study indicates that the activities are valid and can be used as additional resource to help teachers in developing reading comprehension and critical skills of the pupils while simultaneously teaching climate change.

Computer assisted language learning activities in teaching adjectives for second year classes were developed by Florino (2010). The findings of the study revealed that the constructed CALL activities in teaching adjectives are suitable to second year high school. Therefore this is a good material for teachers to use in teaching English for second year students.

The present study has similarity with the studies conducted in terms of research method. Their studies also dealt on how to develop and validate instructional materials. The development and validation of the instructional materials by the researchers cited underwent the same stages like pre-development, development and post development. The reviewed literature and studies guided the researcher in the conceptualization of the present study. These gave information on how the instructional materials were developed, validated and revised into its final form. The findings of these studies added inputs to design and develop instructional materials that could enhance the students' learning in a meaningful way. However, the present study conducts quasi-experimental study to test the effectiveness of the SIM.

The reviewed studies conducted on material development disclosed that supplementary materials could be developed by the teachers in their own field of specialization. Development and validation of quality instructional materials are good tools for motivating students' interest. Hence, if the instructional materials are well organized, well-constructed and presented properly, a successful teaching–learning can be achieved.

On Strategic Intervention Materials (SIM)

Strategic Intervention Materials can serve as learning materials for both students and teachers. They can serve as a primary source of science content, present specific views about the nature of scientific practices and how scientific knowledge is developed. Materials can also serve as a primary influence on how teachers should teach science (Kesidou & Roseman, 2002).

The criteria and areas to be considered in making the strategic intervention materials in science emphasized in DepED Memorandum Number 225 series of 2009. The parts of Strategic Intervention Materials (SIM) are guide card, activity card, assessment card, enrichment card and reference card. The topics should be competency-based, followed by Bloom's taxonomy, activities in line with content and skills, validated before classroom use; development materials based on least mastered competency, materials used improved mastery level and easy to copy.

Hermocilla (2013) developed Strategic Intervention Materials (SIM) in Biology. The study revealed that the developed Strategic Intervention Materials were very adequate in content accuracy, clarity and appropriateness, as rated by the experts. The materials were very much acceptable, applicable and useful, as rated by the potential teacher-users. The student-users rated the intervention materials as very much easy, appealing, enjoyable, useful and meaningful. The feedbacks given by the panel of experts, potential teacher-users, student-users and thesis committee were the bases for the revision of the Strategic Intervention Materials. These materials can be used as teaching aids in teaching Biology concepts.

Regarding the use of Strategic Intervention Materials in Science IV for the fourth year students, Soriano (2012) revealed that the fourth year students easily master the least mastered topics in Science IV using the intervention materials. The study advanced that using Strategic Intervention Materials foster significant effect to the learning process of the students.

The study of Blalock (2010) revealed that Strategic Intervention Materials is a competency-based academic support approach to help students in upper elementary, middle, high school and higher education to become independent and successful learner.

Test of Effectiveness

The study of Alcala (2012) investigated the effectiveness of Strategic Intervention Materials (SIM) in Mathematics for Grade I. The study revealed that the pupils learned effectively and master the least learned topics easily in Mathematics by using the Strategic Intervention Materials.

Soberano (2009) of Muntinlupa National High School, tested the effectiveness of Strategic Intervention Materials in Chemistry. The SIMs focusing on thirteen least mastered skills were developed with the help of nine experts. The experimental group composed of 33 fourth year students, while the other 33 fourth year students were the control group. The findings revealed that the Strategic Intervention Materials significantly contributed to the mastery of chemistry concepts of high school students.

Macabago (2009) developed, validated, revised and sought the effectiveness of SIM in Science 3 at Kalilangan Central Elementary School. Experts on the field of teaching science and on the construction of instructional materials evaluated the SIM. They used the guidelines set by the DepEd. Finding showed that the utilization of the SIMs greatly increase mastery of grade six pupils in identifying distinctive characteristics of planets in the solar system. The developed SIM was the entry in the national competition and was awarded as fourth place in the elementary level.

The present study designs, develops, validates, revises and tests the effectiveness of Strategic Intervention Materials in Grade 7 Science (Biology). It follows R&D procedure used in other studies in their development and validation process. Teachers in the real setting commonly used traditional approach in teaching the lesson. This could be one of the reasons why student's performance is low. To address this situation the researcher decides to develop Strategic Intervention Materials in Grade 7 Science (Biology). These developed materials may help the teachers provide better teaching to improve student's performance.

The literature reviewed had emphasized that teaching science to make it effective should be focused on learner-centered activity wherein the teachers are merely facilitators and the need to make instructional and intervention materials to make it available to the schools to be used by the teachers as teaching aid. The intervention materials help the learners enhance the mastery level in the least learned concepts in science.

Constructivist Learning Theory

This theory states that learning is an active process of creating meaning from different experiences. Therefore, students will learn best by trying to make sense of something of their own with the teacher as a guide to help them along the way. Teacher cannot pour information into student's brain and always expect them to process it and apply it correctly. The classroom is no longer a place where the teacher pours knowledge into passive students. In the constructivist model, the students are urged to be actively involved in their own process of learning.

Jonassen (1994) proposed that there are eight characteristics that differentiate constructivist learning environments. Constructivist learning environments provide multiple representations of reality. Multiple representations avoid oversimplification and represent the complexity of the real world. Constructivist learning environments emphasize knowledge construction instead of knowledge reproduction. Constructivist learning environments emphasize authentic tasks in a meaningful context rather than abstract instruction out of context. Constructivist learning environments provide learning environments such as real-world settings or case-based learning instead of predetermined sequences of instruction.

Constructivist learning environments encourage thoughtful reflection on experience. Constructivist learning environments enable context- and content- dependent knowledge construction. Finally, constructivist learning environments support collaborative construction of knowledge through social negotiation, not competition among learners for recognition.

The literature reviewed focused on the constructivists' view of learning that pointed out learning can be done through eliciting prior knowledge before the introduction of the new concepts. The teachers served as facilitators and discourage spoon-feeding. This could help students discover new ideas through their own ways and learning experiences could retain longer in their minds.

Chapter 3

Methodology

This chapter describes in details the procedure of the study which includes the research design, research locale, participants of the study, data gathering procedure, validation of the instrument and the test of effectiveness.

Research Design

Research and development was used by the researcher in this study. The outcome of this study was intended to improve the competency of the teachers in teaching science, especially in Grade 7 Science (Biology) in high school to attain quality learning of students through developing their critical thinking skills. Research and development products were designed to satisfy the needs of the teachers as well as the students. This research followed the stages in the preparation of the instructional materials adopted by Simbulan (2006). The stages were :(a) Pre-Development Stage; (b) Development Stage; and (c) Post Development Stage.

This study also included the Test of Effectiveness. In the test of effectiveness, a quasi-experimental posttest only research design was used. This is represented by the design, as follows:

Experimental Group	X	O
_ _		
Control Group	--X	O

Where:

_ _ _ _ _ _ _ _ _ (broken line) use of intact class

X= experimental group given the SIMs
--X= control group not exposed to SIMs
O= posttest

Research Locale

The study was conducted in Digos City National High School, Digos City, Davao del Sur. The school had 4 annex schools. It offered different curricula namely: the Basic Education Program (BEC), the Engineering and Science Education Program (ESEP), the Special Program in the Arts (SPA), the Special Program in Sports (SPS), the Technical-Vocational Program (Tech-Voc), and the Special Education (SPED). The average number of students every school year was about 8,000.

This school was one of the performing schools in the City Division of Digos and Region XI in terms of academics and extra-curricular activities which is headed by a Principal IV. Every year the school represented the region in the national level in Science Investigatory Project and Festival of Talents.

The school was facilitated with science and computer laboratories, audio-visual room, and materials and equipment for the technical courses. The average number of teaching and non-teaching personnel of this school was about 380 of which 44 were science teachers. Some of these teachers were scholarship grantees of Civil Service Commission and Bukidnon State University. Several teachers also are Division, Regional, and National Trainers in different subject areas like Science, Math, Filipino, TLE, English, and Araling Panlipunan.

Participants of the Study

The participants of this study composed of three (3) groups, namely: panel of experts, potential teacher-users and student try-out group.

The Panel of Experts

The Strategic Intervention Materials that the researcher developed were evaluated by the panel of experts. The panel of experts consisted of a college professor in Biology; a trainer in the K-12 program; a technology instruction professor; a research professor; and an education program supervisor in science who was also a trainer in the K to 12 program. These panel of experts contributed their ideas in the production of SIM.

The Potential Teacher-Users

The ten (10) Grade 7 Science teachers of Digos City National High School evaluated the strategic intervention materials that the researcher developed. These teachers composed of two (2) Master Teacher, two (2) Teacher III, two (2) Teacher II, and four (4) Teacher I. These potential teacher-users added their expertise in the production of SIMs.

The Student Try-Out Group

The sixty (60) grade 7 students in intact class of Digos City National High School were the participants of the study. They served as potential student-users being involved in the try out.

Data Gathering Procedure

The researcher followed the basic steps in research and development procedures in developing Strategic Intervention Materials to enhance science learning among grade 7 students with the use of Simbulan's Model (2006).

The following stages were carefully followed: Pre-Development Stage, which comprised needs assessment evaluation and design; Development Stage, which included the writing and construction of Strategic Intervention Materials; Post-Development Stage, which involved validation by experts, teacher-users and opinions of try-out users, the revision of the Strategic Intervention Materials in its final form and the test of effectiveness. The oppinionaires were used to find out the content accuracy, clarity, appropriateness, acceptability, applicability, usefulness of the Strategic Intervention Materials.

Stage 1: Pre-Development Stage

Needs Assessment

The researcher conducted focused group discussion and needs assessment survey to the grade 7 science teachers of Digos City National High School to determine the least learned concepts in Grade 7 Science (Biology). A 55-item multiple choice test was also conducted to 50 grade 8 students to determine the least learned concepts. There were top five topics considered as least learned competencies based from the results of the assessment and evaluation conducted in line with the K to 12 learning competencies namely: plant and animal cells (31.47%) low mastery, microorganisms (35.40%) low mastery, microscopy (32.40%) low mastery, reproduction (47.94%) low mastery and interactions (37.85%) low mastery.

Planning of the Strategic Intervention Materials

The Strategic Intervention Materials to enhance science learning among grade 7 students were created due to sufficient need of instructional materials to supplement the least learned in the formation of concepts in grade 7 science instruction in biology. The materials to be considered in planning the Strategic Intervention Materials were the K to 12 Toolkit.

Choosing the Topic

The choice of topics was done by conducting a based-line survey among the grade 7 science teachers at Digos City National High School. Lists of areas in Biology based from K to 12 Toolkit were selected from. The first five least learned topics in Biology that need remediation were considered in the design and development of Strategic Intervention Materials. Based from the results plant and animal cells (31.47%) low mastery, microorganisms (35.40%) low mastery, microscopy (32.40%) low mastery, reproduction (47.94%) low mastery and interactions (37.85%) low mastery are the least mastered competencies in Grade 7 Science (Biology).

Preparation of Task Analysis Chart (TAC)

The Task Analysis Chart (TAC) served as a guide in writing the Strategic Intervention Materials. According to Simbulan, (2006), a task analysis chart gives a picture on the skills to be developed, the instructional objectives to be attained, the number of days allocated for the try-out of the instructional materials. The TAC contained within the topics, biology concepts, objectives, practical tasks, time allotment, and related references to be used to develop the Strategic Intervention Materials.

Task Analysis Chart (TAC) of Strategic Intervention Material (SIM) in Grade 7 Science (Biology)
Topic: Cell
Title: The Power of Being a Small
Proponent: Mr. Ronald B. Dedace

Parts	Content Description	Components and Activities	Learning Competencies	Time Frame	References
Guide Card	The overview & objectives can be found in this part. It contains the overview of the topic about plant and animal cells. It provides insights on what to do in the succeeding activities.	Guide Card 1	a. Define cell b. Identify parts of the cell c. Differentiates plant and animal cells according to presence or absence of certain organelles	5 minutes	K-12 Science Curriculum Guide
Activity Cards	These include the different activities to be answered by the learners.	Activity Card 1: Cells Word Challenge Activity Card 2:Cell Parts and Functions(Power Point Presentation and Note Taking) Activity Card 3:Quiz on Parts and Functions		15 minutes 20 minutes 15 minutes	http//www.biologyjunction.com http://ph.images.search.yahoo.com/images/view/word+search+puzzle+cells http://www.cellsalive.com/quiz1.htm http//:www.slideshare.net/cell structure http://ph.images.search.yahoo.com/images/view/venn+diagram+on+cells

		(Power Point Presentation) Activity Card 4: What's my Difference? Activity Card 5: Match Me!		10 minutes 10 minutes	http://www.docstoc.com/docs/117027575/Quiz---cell-parts-and-their-functions
Assessment Cards	These are sort of evaluative to determine how far the learners understood the topic	Assessment Card 1: Label Me! Assessment Card 2: Name my Parts!		10 minutes 10 minutes	http://www.google.com.ph+cells http//www.biologyjunction.com http//:www.slideshare.net/cell structure
Enrichment Cards	These are considered as supplement to the assessment activities to further enhance the learning of the students	Enrichment Card 1: Cell City Analogy (Cooperative Learning) Enrichment Card 2: Crossword Puzzle (Think-Pair-Share) Enrichment Card 3: Modeling Cells (Video Tutorial and Cooperative Learning)		10 minutes 10 minutes 10 minutes	http//www.biologyjunction.com K to 12 Toolkit in Science http//:www.slideshare.net/cell structure http://www.youtube.com/watch?v=uhS6yt5t8i8

Reference Cards	These include the reference material from the different sources.				http://library.thinkquest.org/12413/structures.html http://www.syvum.com/cgi/online/serve.cgi/squizzes/biology/cell_functions.html?question_hide http://www.biologyjunction.com/cell_functions.htm K to 12 Work text in Science and Technology Links Discover Science 7 K to 12 Edition Microsoft Encarta 2010
Answer Key	The answers in all activities, assessment and enrichment cards can be seen in this part.		Answer Key (Separate Card)	10 minutes	

Task Analysis Chart (TAC) of Strategic Intervention Material (SIM) in Grade 7 Science (Biology)
Topic: Microscopy
Title: Microscope Mania
Proponent: Mr. Ronald B. Dedace

Parts	Content Description	Components and Activities	Learning Competencies	Time Frame	References
Guide Card	The overview & objectives can be found in this part. It contains the overview of the topic about microscopy. It provides insights on what to do in the succeeding activities.	Guide Card 1	1. Identify parts of the microscope and their functions. 2. Manipulate and handle the microscope effectively. 3. Observe objects/specimen under the microscope.	5 minutes	K-12 Science Curriculum Guide
Activity Cards	These include the different activities to be answered by the learners.	Activity Card 1: Micro Find Me! Activity Card 2: Label Me Activity Card 3: Micro Cryptogram		10 minutes 10 minutes 10 minutes	http://sciencespot.net/ www.biologycorner.comworksheetsmicroscopelabelling.html K to 12 Worktext in Science and Technology Links Discover Science 7 K to 12 Edition http://nhscience.lo

		Activity Card 4: Match Me! Activity Card 5: Power Point Presentation Note Taking		10 minutes 20 minutes	nestar.edu/bio/dropdrag/microscope2.htmindex. http://www.mc.maricopa.edu/johnson/labtools/Dmicroscope/quiz8.html
Assessment Cards	These are sort of evaluative to determine how far the learners understood the topic	Assessment Card 1: Manipulation Assessment Card 2: Tutorial Video and Note Taking		20 minutes 10 minutes	K to 12 Worktext in Science and Technology Links Discover Science 7 K to 12 Edition
Enrichment Cards	These are considered as supplement to the assessment activities to further enhance the learning of the students	Enrichment Card 1: Micro word Puzzle Enrichment Card 2: KWLH Chart		10 minutes 10 minutes	http://sciencespot.net/ K to 12 Worktext in Science and Technology Links Discover Science 7 K to 12 Edition
Reference Cards	These include the reference material from the different sources.				http://ph.images.search.yahoo.com/images/view/microscopewordsearch. http://ph.images.search.yahoo.com/images/view/parts+of+micoscope. Microsoft Encarta

					2010
Answer Key	The answers in all activities, assessment and enrichment cards can be seen in this part.		Answer Key (Separate Card)	10 minutes	

Task Analysis Chart (TAC) of Strategic Intervention Material (SIM) in Grade 7 Science (Biology)
Topic: Other Living Things besides Plants and Animals
Title: Micro-Organisms
Proponent: Mr. Ronald B. Dedace

Parts	Content Description	Components and Activities	Learning Competencies	Time Frame	References
Guide Card	The overview & objectives can be found in this part. It contains the overview of the topic about other living things besides plants and animals. It provides insights on what to do in the succeeding activities.	Guide Card 1	1. Describes the structures of microorganisms using a microscope. 2. Identifies beneficial and harmful microorganism.	5 minutes	K-12 Science Curriculum Guide

Activity Cards	These include the different activities to be answered by the learners.	Activity Card 1: The Words of Microorganisms Activity Card 2: Characteristics of Microbes(Power Point Presentation, Note Taking and Concept Map) Activity Card 3: Microorganisms Around Us (Tutorial Videos, Note Taking and Semantic Web) Activity Card 4: Group mates or Not? (Odd Man Out) Activity Card 5: Where I Belong? (Picture Analysis)		10 minutes 20 minutes 10 minutes 10 minutes 10 minutes	http://www.softschools.com/ K to 12 Worktext in Science and Technology Links Discover Science 7 K to 12 Edition K to 12 Worktext in Science and Technology Links Discover Science 7 K to 12 Edition K to 12 Worktext in Science and Technology Links Discover Science 7 K to 12 Edition K to 12 Worktext in Science and Technology Links Discover Science 7 K to 12 Edition
Assessment Cards	These are sort of evaluative to determine how far the learners	Assessment Card 1: Harmful or Beneficial? (Power Point presentation and Tutorial		10 minutes	K to 12 Worktext in Science and Technology Links Discover Science 7 K

	understood the topic	Videos) Assessment Card 2: Micro Puzzle		15 minutes	to 12 Edition http://www.softschool.com
Enrichment Cards	These are considered as supplement to the assessment activities to further enhance the learning of the students	Enrichment Card 1: The Microbes Around Me! (Collaborative Activity) Enrichment Card 2: Observing Microorganisms		15 minutes 15 minutes	K to 12 Worktext in Science and Technology Links Discover Science 7 K to 12 Edition K to 12 Worktext in Science and Technology Links
Reference Cards	These include the reference material from the different sources.				http://cronodon.com/BioTech/Bacteria.html http://schools-wikipedia.org/wp/b/Bacteria.htm http://www.botanical.com/botanical/mgmh/f/fungi-37.html http://global.britannica.com/EBchecked/topic/480085/protist Microsoft Encarta 2010
Answer Key	The answers in all activities,		Answer Key (Separate Card)	5 minutes	

	assessment and enrichment cards can be seen in this part.				

Task Analysis Chart (TAC) of Strategic Intervention Material (SIM) in Grade 7 Science (Biology)
Topic: Heredity: Inheritance and Variations
Title: The Continuity of Life
Proponent: Mr. Ronald B. Dedace

Parts	Content Description	Components and Activities	Learning Competencies	Time Frame	References
Guide Card	The overview & objectives can be found in this part. It contains the overview of the topic about heredity (inheritance and variations. It provides insights on what to do in the succeeding	Guide Card 1	1. Compares asexual and sexual reproduction. 2. Differentiates offspring resulting that from sexual reproduction in terms of similarities to parents. 3. Describes the process of fertilization.	5 Minutes	K-12 Science Curriculum Guide

	activities.				
Activity Cards	These include the different activities to be answered by the learners.	Activity Card 1: Picture Analysis Activity Card 2: Asexual Reproduction (Power Point Presentation and Note Taking) Activity Card 3: Word-Pic Up Fertilization (Video Tutorial) Activity Card 4: Comic Strip Activity Card 5: Reproduction: KWLH Chart		10 minutes 20 minutes 10 minutes 10 minutes 10 minutes	K to 12 Worktext in Science and Technology Links Discover Science 7 K to 12 Edition http://www.authorstream.com/Presentation/dtrewartha-322838-sexual-asexual-reproduction-life-science-education-ppt-powerpoint/ K to 12 Worktext in Science and Technology Links Discover Science 7 K to 12 Edition
Assessment Cards	These are sort of evaluative to determine how far the learners understood	Assessment Card 1: Crossword Reproduction (Think-Pair-Share)		10 minutes 10 minutes	K to 12 Worktext in Science and Technology Links Discover Science 7 K to

	the topic	Assessment Card 2: Comparing Concepts (Compare Organizer)			12 Edition
Enrichment Cards	These are considered as supplement to the assessment activities to further enhance the learning of the students	Enrichment Card 1: Asexual Reproduction in Plants (Collaborative Activity) Enrichment Card 2: The Structure of a Flowering Plant (Collaborative Activity)		15 minutes 15 minutes	K to 12 Worktext in Science and Technology Links Discover Science 7 K to 12 Edition
Reference Cards	These include the reference material from the different sources.				http://www.biotopics.co.uk/genes1/asexual_and_sexual_reproduction.html http://www.biotopics.co.uk/genes1/asexual_and_sexual_reproduction.html http://www.boundless.com/biology/animal-reproduction-and-development/reproduction-methods/asexual-reproduction-and-sexual-reproduction/ http://sciencecray.com/biology/

					human-biology/asexual-and-sexual-reproduction/ http://www.botany.uwc.ac.za/ecotree/flowers/flowerparts.htm http://www.primaryresources.co.uk/science/flower.htm http://www.amnh.org/learn/biodiversity_counts/ident_help/Parts_Plants/parts_of_flower.htm
Answer Key	The answers in all activities, assessment and enrichment cards can be seen in this part.		Answer Key (Separate Card)	5 minutes	

Task Analysis Chart (TAC) of Strategic Intervention Material (SIM) in Grade 7 Science (Biology)
Topic: Interactions among Organisms
Title: Interactions among Organisms
Proponent: Mr. Ronald B. Dedace

Parts	Content Description	Components and Activities	Learning Competencies	Time Frame	References
Guide Card	The overview & objectives can be found in this part. It contains the overview of the topic about interactions among organisms. It provides insights on what to do in the succeeding activities.	Guide Card 1	1. Identifies which of the things found in the environment are biotic or abiotic. 2. Describes the different ecological relationships found in the ecosystem. 3. Describes how energy is transferred through the feeding relationships. 4. Predicts the effect of changes in one population on other populations in the ecosystem.	5 minutes	K-12 Science Curriculum Guide
Activity Cards	These include the different activities to be answered by the learners.	Activity Card 1: Observing Biotic and Abiotic Factors (Cooperative Learning, Experiential		10 minutes	Science and Technology for the Modern World I

		Learning and Campus Field Trip) Activity Card 2: Picture Analysis (Power point Presentation) Activity Card 3: My Own Eco Photography (Campus Field Trip) Activity Card 4: Song Analysis (Think-Pair-Share) Activity Card 5: Interactions within Ecosystem (Video Tutorial and Note Taking)		10 minutes 15 minutes 10 minutes 10 minutes	http://www.youtube.com/watch?v=_y_nQheGGXg http:www.edquest.ca/ca/component/content/article/2a www.youtube.com http://www.edquest.ca/component/content/aricle/29
Assessment Cards	These are sort of evaluative to determine how far the learners understood the topic	Assessment Card 1: Which Symbiosis Is It? (Power Point Presentation, Picture Analysis and Situation Analysis) Assessment Card 2: Interconnectedness of Organisms		10 minutes 20 minutes	K to 12 Worktext in Science and Technology Links Discover Science 7 K to 12 Edition

		(Collaborative Activity)			
Enrichment Cards	These are considered as supplement to the assessment activities to further enhance the learning of the students	Enrichment Card 1: My Own Contribution (Action Plan and Journal Writing) Enrichment Card 2: Nursery Rhyme Interactions (Collaborative Activity and Simulation)		10 minutes 15 minutes	K to 12 Worktext in Science and Technology Links Discover Science 7 K to 12 Edition Science and Technology for the Modern World I
Reference Cards	These include the reference material from the different sources.				http://symbioticrelationship.org/ K to 12 Worktext in Science and Technology Links Discover Science 7 K to 12 Edition Science and Technology for the Modern World I Microsoft Encarta 2010
Answer Key	The answers in all activities, assessment		Answer Key (Separate Card)	5 minutes	

	and enrichment cards can be seen in this part.				

Identifying the Parts of Strategic Intervention Materials

The parts of Strategic Intervention Materials (SIM) were designed based from the DepEd Memorandum Number 225 s. 2009. The parts were as follows: Guide Card, Activity Card, Assessment Card, Enrichment Card and Reference Card. The different activities included in the Strategic Intervention Materials (SIMs) developed solely by the researcher. The activities were made colorful, simple, practical and interactive to suit the learners' needs and interests.

This stage included the writing of Strategic Intervention Materials (SIM) in grade 7 science (Biology). At first, the instructional objectives were stated in behavioral form. It followed the Bloom's taxonomy in the development of the objectives specifically the three domains, namely: cognitive, affective and psychomotor. It was specific, measurable, achievable, realistic and time-bound learning tasks. Each intervention material was attained in one hundred twenty (120) minutes, or in two (2) sessions by the learners.

In Figure 2, was the procedural model followed by the researcher in the development of five Strategic Intervention Materials (SIM) in Grade 7 Science (Biology). It followed three stages namely: Pre-Development Stage, Development Stage, and Post-Development.

Figure 2. The Procedural Model of the Research and Design

Stage 1: Pre-Development Stage

- Identifying the least learned topics
- Identification the Parts of the SIM
- Planning of Activities
- Task Analysis Chart (TAC) Preparation

Revision Stage

Stage 2: Development Stage

- Writing the Parts of Strategic Intervention Materials (SIM)

Stage 3: Post-Development Stage

- Evaluation of Strategic Intervention Materials by:

  Panel of Experts
  Potential Teacher-Users
  Prospective Student-Users

- Refinement and revision of Strategic Intervention Materials based on Comments and Suggestions of the evaluators

- Test of Effectiveness of the Strategic Intervention Materials

organized based on the sequence of the focus skills (in the Guide Card), have clear conditions, provide examples to concretize the concepts, particularly those drawn from real-life experience, students can complete independently, in pairs, or in small groups, allow students to make discoveries and formulate ideas on their own, guides and challenges students' thinking and learning, uses local data and situations and provides transition statements that recognize students' accomplishments.

Furthermore, it provides questions that guide the development of concepts/ focus skill, elicit the message or meaning that a student can take away from an activity/ experience, elicit an explanation, not one-word answers, establish the relationship between the topics and what students already know or are familiar to them, and develop the skills in the three domains.

3. Assessment Card. This is the third part of intervention material provides exercises, drills or activities that allow students to assess their understanding of what they have learned and correct errors when appropriate, monitor their learning and use feedback about their progress, formulated in standard test formats to give students practice in test-taking techniques, gives clear directions and provides an Answer Key in a separate card.
4. Enrichment Card. It provides activities that reinforce the content of the lesson, provides opportunities for students to apply what they have learned to other subject areas or in a new contexts and work independently or in groups to explore answers to their own questions.
5. Reference Card. This is the last part of intervention material, provides readings that relate content with students' life experiences, and provides a carefully researched list of resources that will reinforce concepts, skills learned, provide additional content not found in the textbook and students may refer to for further reading.

Stage 3. Post-Development Stage

To ensure the validity of the intervention materials and to determine whether it was appropriately done its features and content, whether the Strategic Intervention Materials meet the purpose, it was presented to a panel of experts and potential teacher-users for evaluation and later to the prospective student-users.

The Instrument for Evaluation

There were two sets instruments used in the evaluation and validation of the SIM. First, was the Checklist for Evaluating the Strategic Intervention Materials to be used by panel of experts and potential teacher-users using the guidelines set by the Department of Education in reviewing the intervention materials. The checklist has five features namely: Guide Card, Activity Card, Assessment Card, Enrichment Card and Reference Card. There are thirty (30) statements, which the evaluators checked as to whether the statements are evident or not evident. The answers to the checklist required the evaluator's to rate as to the functionality and usability of the materials. Comments and suggestions were also requested from the experts for the modification of the materials.

The second instrument was the validated Student's Opinionnaire constructed by Cajes (2011) who also developed instructional materials on indigenous manipulative materials in teaching measurement as to the developed SIM were appealing, interesting, challenging, easy to understand and enjoyable. The opinionnaire consisted of nine questions. The items asked about their interest, feelings and opinions toward the SIM. Some of the questions were modified to suit to the current study. The students used this after using all the prepared SIMs. They were asked to put check mark in the box for their answers.

Evaluation by the Panel of Experts

The developed strategic intervention materials were presented to the panel of experts for evaluation. The evaluators' educational qualifications, expertise and knowledge of the content were taken into consideration. They validated the materials by making substantial corrections on the content. Their assessments were used in the improvement of the developed SIMs.

Evaluation by the Potential Teacher-Users

The developed strategic intervention materials were presented to the ten (10) Grade 7 Science teachers for evaluation. These teachers were trained in the K-12 Curriculum and had been teaching for number of years. They validated the materials by making substantial corrections on the content. The comments and suggestions were also solicited from the teachers. Their assessments were used in the enrichment of the SIMs.

Evaluation by Prospective Student-Users

The developed strategic intervention materials were tried out to an intact 60 Grade 7 students of Digos City National High School. At the end of the tryout period for the materials, the students gave their evaluation by answering an opinionnaire checklist. They were requested to provide some comments and suggestions about their learning experiences with the SIMs. Results of the evaluation by the tryout group were merged and tallied using frequency counts and percentages.

Provisions for Revision

The revisions of the Strategic Intervention Materials (SIMs) in Grade 7 Science (Biology) were based on the evaluators' comments and suggestions. Basically, all the revisions were based from the rating, comments and suggestions of the experts, teacher-users and potential student-users.

Test of Effectiveness

For the test of effectiveness of the Strategic Intervention Materials in Grade 7 Science (Biology), quasi-experimental design was used. This design involved intact groups of students: the experimental group and the control group. For data analysis, forty four (44) students from the experimental was matched with forty one (41) from the control group. Activities were given to both groups but the integration of SIMs were introduced only to the experimental group. Posttest was given to both groups after conducting the different activities.

Treatment of Data

The results of the numerical evaluation of the panel of experts, potential teacher-users and the tryout group were treated using frequency counts and percentages. These were used to determine whether the criteria set for the developed strategic intervention materials were met. The results of posttest was treated using the descriptive statistics and t-test for independent sample at 0.05 level of significance.

In describing the academic achievement of students in Grade 7 Science (Biology), the guidelines on the rating system of basic education curriculum (DepEd Order No. 73, s 2012) was used. The said DepEd Order describes the academic achievement in terms of proficiency level as being adopted in this study.

Score Range	*Grade Range*	*Proficiency Level*	*Qualifying Statements*

41-50	90% and above	Advanced (A)	The student at this level exceeds the core requirements in terms of knowledge, skills and understandings, and can transfer them automatically and flexibly through authentic performance tasks
31-40	85-89%	Proficient (P)	The student at this level has developed the fundamental knowledge and skills and core understandings, and can transfer them independently through authentic performance tasks.
21-30	80-84%	Approaching Proficiency (AP)	The student at this level has developed the fundamental knowledge and skills and core understanding and with little guidance from the teacher and/ or with some assistance from peers, can transfer these understandings through authentic performance task.
11-20	75-79%	Developing (D)	The student at this level possess the minimum knowledge and skills and core understandings, but needs help throughout the performance of authentic tasks.
0-10	74% and below	Beginning (B)	The student at this level struggles with his/her understanding; prerequisite and fundamental knowledge and /or skills have not been acquired or developed adequately to aid understanding.

Chapter 4

Presentation, Analysis and Interpretation of Data

This chapter presents, analyzes, and interprets the data gathered during the conduct of the study. The presentation is discussed according to the development of the strategic intervention materials, evaluation by the panel of experts, potential teacher-users and the student tryout group, the revisions of the strategic intervention materials and the test of effectiveness.

Development of the Strategic Intervention Materials (SIM)

The learning objectives of the second quarter period as stipulated in the K-12 Curriculum Guide for Grade 7 Science (Biology) were the basis in developing the strategic intervention materials. The procedure in the development of the SIM, like any other instructional materials, followed three stages, namely: pre-development, development and post development.

The Task Analysis Chart (TAC) served as the framework and blueprint of the study. Included in the TAC were the learning contents, specific objectives, activities, the time frame and the references.

There were five strategic intervention materials developed SIM. For each SIM, technology was employed like power point presentation, video clips and audio materials wherein the researcher called it as SIMTECH. SIM 1 dealt on microscopy with three learning competencies: identify parts of the microscope and their functions; manipulate and handle the microscope effectively; and observe objects/specimen under microscope. To translate these competencies there were activities provided in each card. For the activity cards, the activities were micro find me, label me, micro cryptogram, match and picture analysis. For the assessment cards, there were two activities namely: manipulating the compound light microscope and viewing pond water. Micro puzzle and KWLH chart were the two activities under enrichment card.

SIM 2 focused on the topic about cells. In this topic the students were expected to differentiate plant and animal cell according to presence or absence of certain organelles and identifies cell structures and functions. Each card has activities to achieve the learning competencies. Cell word search, cell parts and functions quiz, what's my difference? and match me were among the activities in activity card. In the assessment card, label me and name my parts were the two activities. For the enrichment card, there were three namely: cell city analogy, crossword puzzle and making models.

Topic on microorganism was the focus in SIM 3. The students were expected to describe the structures of organisms using a microscope and identify beneficial and harmful microorganisms. Under activity card, there were five remediation activities namely: the words of microorganisms, characteristics of microbes, microorganisms around us, group mates or not and where I belong? To evaluate how far the students learn, harmful or beneficial and microbes puzzle were given to assess them. The microbes around me and observing microbes were the supplementary activities given.

The fourth SIM concentrated on heredity: inheritance and variations in which students were likely to compare asexual and sexual reproduction, describe the process of fertilization and differentiate offspring resulting that from sexual reproduction in terms of similarities to parents. In activity card, picture analysis, asexual reproduction, word-pic up, comic strip and KWLH chart were given as the start of the remediation. To determine how far the students understood the topic, they were assessed on crossword reproduction and comparing concepts. To supplement the assessment activities, students were enriched on asexual reproduction in plants and structure of a flowering plant activities respectively.

The last SIM centered on interactions among organisms. The students are expected to identify which of the things found in the environment are biotic or abiotic, describe the different ecological relationships found in the ecosystem, describe how energy is transferred through the feeding relationship and predict the effect of changes in one population on other populations in the ecosystem.

Evaluation of the Strategic Intervention Materials

The developed strategic intervention materials were evaluated by the panel of experts, potential teacher-users and by the student tryout group.

Evaluation by the Panel of Experts

The criteria set by the Department of Education on the evaluation of SIM were used by the panel of experts. Results are presented in Table 1. As shown in the Table 1, the experts unanimously agreed that the developed SIMs had met the criteria set for good intervention materials. This indicates that each card was functional and usable in teaching Grade 7 Science (Biology).

Table 1.
Results of the Evaluation Done by the Panel of Experts *(N=5)*

Parts of the SIM	Evident	Not Evident
Guide Card		
1. Gives a preview of what the students will learn.	100%	0
2. Stimulates interest in the topic.	100%	0
3. Presents the focus skill.		
3.1. mentions the learning competency	100%	0
3.2 states at least 3 sub-activities	100%	0
3.3 builds on prior knowledge and skills	100%	0
4. Cites briefly the activities	100%	0
5. Challenges the students in performing the tasks.	100%	0
Activity Card	100%	0
6. Translates the focus skills into at least 3 activities.		
7. Provides activities that:	100%	0
7.1. are organized based on the sequence of the focus skill in the Guide Card.		
7.2 have clear directions.	100%	0
7.3 provide examples to concretize the concepts, particularly those drawn from real-life experiences.	100%	0
7.4 students can complete independently, in pairs or in group.	100%	0
7.5 allow students to make discoveries and formulate ideas on their own.	80%	20%
7.6 guide and challenge student's thinking and learning.	100%	0
8. Provides transition statements that recognize student's accomplishment.	100%	0
9. Provides questions that:	100%	0
9.1. guide the development of concepts and skills.		
9.2 elicit an explanation, not one-word answer.	100%	0
9.3 establish the relationship between the topic and lesson and what students already know or are familiar to them.	100%	0
Assessment Card	100%	0
10. Provides exercises, drills and activities that allow students to:		
10.1 assess their understanding of what they have learned and correct errors when appropriate.		
10.2 monitor their learning and use feedbacks about their progress.	100%	0

11. Formulates in standard test formats to give students practice in test-taking techniques.	60%	40%
12. Gives clear instructions.	100%	0
13.Provides an Answer (in a separate card)	100%	0
Enrichment Card	100%	0
14. Provides activities that reinforce the content of the lesson.		
15. Provides opportunities for students to:	100%	0
15.1 apply what they have learned to other subject areas or in new contexts.		
15.2 work independently or in groups to explore answers or in new contexts.	100%	0
Reference Card		
16. Provides reading that relate content with student's life experiences.	100%	0
17.Provides carefully researched list of resources that:		
17.1 provide additional content not found in the textbook.	100%	0
17.2student may refer to for further reading.	100%	0
17.3 will reinforce concepts/skills learned	100%	0

Results showed that the evaluators rated the developed SIMs with 100% on the first part, which was the guide card. It means that the guide card gives a preview of what students would learn, stimulates interest on the topic, presents the focus skill, cites briefly the activities, and challenges the students in performing the tasks.

This showed that the SIMs provided activities that were organized with clear directions. The SIMs showed examples to concretize the concepts, particularly those drawn from actual life situations. The activities allowed students to make innovations, formulate ideas on their own, guide and challenge their thinking and learning. These were relevant with the concepts to be learned, based on the K-12 Curriculum Guide instructional objectives.

The SIMs allowed the students to complete the activities either independently, in pairs or in small group. This means, students need little guidance from the teachers and/or with some assistance from peers. Students have the chance to make discoveries and formulate thinking and learning.

The table also showed that the SIM provides assessments that were formulated in standard test formats providing the students practice in test taking techniques. The SIM also provided drills or exercises that allow students to assess their mastery of the skill and correct errors when appropriate. Through these exercises, drills or activities students can monitor their learning and use feedbacks about their progress. These feedbacks and monitoring on student's progress serve as guide to the teachers.

The results further revealed that enrichment activities strengthened the content of the lesson. These enrichment activities provided prospects for students to relate and apply what they have learned to other subject areas or in new contexts and work independently or in groups to explore answers to their own questions. These are considered as supplement to the assessment activities to further enhance the learning of the students.

Furthermore, the SIM provided a carefully and well-researched list of references. This could help the students strengthen concepts and skills that they have learned. It also included supplementary useful content not found in the schoolbooks.

The present results as evaluated by the panel of experts are similar to the works of Hermocilla (2013), Potane (2012), Simbajon (2012), Abadila (2012), Soriano (2012), Lumosad (2011), Aban (2011) and Florino Jr. (2010) which disclosed that the developed SIMs were appropriate, acceptable, applicable, highly relevant, usable, functional and useful. This means that the activities can be used as additional resources to help teachers.

The researcher had a one-on-one conversation with each of the experts as to their comments and suggestions for the SIM. Constructive comments about the functionality and usability of the SIM were given. Some of the remarks were written and rest were just stated orally. Some of the comments were reflected in the frame.

Frame 1.Comments of the Panel of Experts

"Very detailed and exhaustive exploration of various topics. Shows diligent effort to elicit learner engagement."
"All concepts were cross-check with the K-12 Curriculum Guide."
"I just hope that this SIM could really be of great help to your students and teachers for greater learning effectiveness."
"Excellent task."
"If cooperative learning is used, how will you assess the performance of each member from a group activity?"

The experts motivated and challenged the researcher to work added and develop other instructional materials in Grade 7 Science. These could help develop student's skills, as well as, interest in science. The commentaries were established in the results of the validation. They asserted that the materials were suitable for the concepts of Grade 7 Science (Biology). These could help students understand the concepts better.

The panel of experts also gave their suggestions and recommendations for the modification of the materials. Some of the suggestions were written in the materials while the rest were in the evaluation sheets. Remarks and recommendations were reflected in the revisions together with the opinions of potential teacher-users and student tryout group. There were no major modifications on the SIM. Some slight revisions were suggested.

In addition, the SIMs were functional and usable. It was easy to use and the contents followed to the learning guides set by the Department of Education. The activities in the developed SIM can bring out student's prior knowledge about the least learned concepts. The activities can be carried out by students with little teacher's supervision or they can complete independently, in pairs or in small group.

Furthermore, the learning activities in SIMs deepen the understanding level of the students. The questions were well-developed, it used clear and standard-sized print, and it provided directions that were clear and easy to follow and stated the directions at an appropriate

level of difficulty. The students were stimulated to learn independently to explore new contexts and it provided lists of references in line with the content and skills.

Strategic Intervention Materials can serve as learning materials for both students and teachers. They can serve as a primary source of science content, present specific views about the nature of scientific practices and how scientific knowledge is developed. Materials can also serve as a primary influence on how teachers should teach science (Kesidou & Roseman, 2002). The Strategic Intervention Material is a competency-based academic support approach to help students in upper elementary, middle, high school and higher education to become independent and successful learner (Blalock (2010).

Generally, the developed SIM conformed to the DepED Memorandum Number 225 series of 2009 that the parts of the SIM were competency-based, followed by Bloom's taxonomy, activities in line with content and skills, validated before classroom use, development materials based on least mastered competency, materials used improved mastery level and easy to copy.

Evaluation by the Potential Teacher-Users

The criteria set by the Department of Education on the evaluation of SIM were used by the potential teacher-users. Results are presented in Table 2.

Table 2.

Results of the Evaluation Done by the Potential Teacher-Users *(N=10)*

Parts of the SIM	Evident	Not Evident
Guide Card		
1. Gives a preview of what the students will learn.	100%	0
2. Stimulates interest in the topic.	100%	0
3. Presents the focus skill.		
3.1. mentions the learning competency	100%	0
3.2 states at least 3 sub-activities	100%	0
3.3 builds on prior knowledge and skills	100%	0
4. Cites briefly the activities	100%	0
5. Challenges the students in performing the tasks.	100%	0
Activity Card	100%	0
6. Translates the focus skills into at least 3 activities.		
7. Provides activities that:	100%	0
7.1. are organized based on the sequence of the focus skill in the Guide Card.		
7.2 have clear directions.	100%	0
7.3 provide examples to concretize the concepts, particularly those drawn from real-life experiences.	80%	20%
7.4 students can complete independently, in pairs or in group.	100%	0
7.5 allow students to make discoveries and formulate ideas on their own.	90%	10%
7.6 guide and challenge student's thinking and learning.	100%	0
8. Provides transition statements that recognize student's	100%	0

accomplishment.		
9. Provides questions that:	100%	0
9.1. guide the development of concepts and skills.		
9.2 elicit an explanation, not one-word answer.	100%	0
9.3 establish the relationship between the topic and lesson and what students already know or are familiar to them.	100%	0
Assessment Card	100%	0
10. Provides exercises, drills and activities that allow students to:		
10.1 assess their understanding of what they have learned and correct errors when appropriate.		
10.2 monitor their learning and use feedbacks about their progress.	100%	0
11. Formulates in standard test formats to give students practice in test-taking techniques.	100%	0
12. Gives clear instructions.	100%	0
13.Provides an Answer (in a separate card)	100%	0
Enrichment Card	100%	0
14. Provides activities that reinforce the content of the lesson.		
15. Provides opportunities for students to:	100%	0
15.1 apply what they have learned to other subject areas or in new contexts.		
15.2 work independently or in groups to explore answers or in new contexts.	100%	0
Reference Card		
16. Provides reading that relate content with student's life experiences.	100%	0
17.Provides carefully researched list of resources that:		
17.1 provide additional content not found in the textbook.	100%	0
17.2 student may refer to for further reading.	100%	0
17.3 will reinforce concepts/skills learned	100%	0

As shown in the Table 2, the teachers unanimously agreed that the developed SIMs have met the criteria set for good intervention materials. This indicates that each card is functional and usable in teaching Grade 7 Science (Biology).

Results showed that the evaluators rated the developed SIMs with 100% on the first feature, which was the guide card. It means that the guide card gave a preview of what students would learn, stimulates interest on the topic, presented the focus skill, cited briefly the activities, and challenged the students in performing the tasks.

This showed that the SIM provided activities that were organized and have clear directions. The SIM evidently showed examples to concretize the concepts, particularly those drawn from actual life situations. The activities allowed students to make innovations, formulate ideas on their own, guide and challenge their thinking and learning. These were relevant to the concepts to be learned and based on the K-12 Curriculum Guide instructional objectives.

The table also showed that the SIM provided assessments that were formulated in standard test formats providing the students practice in test taking techniques. The SIM also provided drills or exercises that allow students to assess their mastery of the skill and correct errors when appropriate.

The results further revealed that enrichment activities strengthened the content of the lesson. These enrichment activities provided prospects for students to relate what they have learned to other subject areas or in new contexts. The SIM also provided a carefully and well-researched list of references. This could help the students strengthen concepts and skills that they have learned. It also included supplementary useful content not found in the schoolbooks.

The present results as evaluated by the potential teacher-users are similar to the works of Hermocilla (2013), Soriano (2012), Potane (2012), Simbajon (2012), Abadila (2012) Lumosad (2011), Aban (2011) and Florino Jr. (2010) that the developed SIMs were appropriate, acceptable, applicable, highly relevant and useful. This means that the activities can be used as additional resources to help teachers.

Constructive comments about the functionality and usability of the SIM were given. Some of the remarks were written and rest were just stated orally. Some of the comments were reflected in the frame.

Frame 2. Comments of the Potential Teacher-Users

"The Strategic Intervention Materials in Science developed by the researcher can be a response to the inadequacy of books and related materials in the said subject."
"SIM is very precise, brief but very factual. It enables the students to engulf knowledge in its simpler form."
"The activities provided will stimulate the learners' interest. More fun and enjoyable to work while learning."
"The researcher has presented his instruction materials in a clear and challenging manner that learners could think, discover and formulate ideas on their own."
"It is an appropriate material to support K-12 module in Biology to enhance learning."
"The SIM is well made. This could help the Grade 7 students in further learning the science of Biology."

The teachers encouraged and challenged the researcher to work added and develop other instructional materials in Grade 7 Science. These could help develop student's skills, as well as, interest in science. The commentaries were established in the results of the validation. They asserted that the materials were suitable for the concepts of Grade 7 Science (Biology). These could help students understand the concepts better.

The potential teacher-users also gave their suggestions and recommendations for the modification of the materials. Some of the suggestions were written in the materials while the rest were in the evaluation sheets. Remarks and recommendations were reflected in the revisions together with the opinions of the tryout group. There were no major modifications on the SIM. Some slight revisions were suggested.

In addition, the SIMs were functional and usable. It was easy to use and the contents followed to the learning guides set by the Department of Education. The activities in the developed SIM can bring out student's prior knowledge about the least learned concepts. The activities can be carried out by students with little teacher's supervision or they can complete independently, in pairs or in small group.

Furthermore, the learning activities in SIMs deepen the understanding level of the students. The questions were well-developed, it used clear and standard-sized print, and it provided directions that were clear and easy to follow and stated the directions at an appropriate level of difficulty. The students were stimulated to learn independently to explore new contexts and it provided lists of references in line with the content and skills.

Strategic Intervention Materials can serve as learning materials for both students and teachers. They can serve as a primary source of science content, present specific views about the nature of scientific practices and how scientific knowledge is developed. Materials can also serve as a primary influence on how teachers should teach science (Kesidou & Roseman, 2002). The Strategic Intervention Material is a competency-based academic support approach to help students in upper elementary, middle, high school and higher education to become independent and successful learner (Blalock (2010).

Generally, the developed SIM conformed to the DepED Memorandum Number 225 series of 2009 that the parts of the SIM were competency-based, followed by Bloom's taxonomy, activities in line with content and skills, validated before classroom use, development materials based on least mastered competency, materials used improved mastery level and easy to copy.

Evaluation by the Student Tryout Group

The researcher personally managed the tryout of the SIMs. The principal of the school gave the researcher enough time to conduct the study and extend help in the reproduction of the SIM. The researcher made use of the two (2) hours per day for seven (7) days in conducting the study. The validation by the tryout group completed its targeted days.

Since it was the first time for the users to come across with the instructional materials, the researcher gave an orientation on what the materials were about and how to use these. Guidelines before the full utilization of the SIMs were needed. The features of the five cards and the directions on how to go about it were highlighted. The students were told that they could approach the researcher on whatever problems and inquiries they want to know. It was also stressed that in using the SIM, they were to learn at their own pace and time.

As observed, the students were very motivated and excited to receive a copy of the SIM. Upon receiving the material, the students excitedly read them. Sixty (60) students were taken as the tryout group before they were asked to evaluate the SIMs using the checklist.

Table 3 shows the result of the evaluation by student tryout. As presented in the table, largely the tryout group found the SIM to be interesting, appealing, easy to understand, and enjoyable. This means that the SIM have met the conditions set for a good instructional materials.

Table 3.

Result of the Students' Opinionnaire on Strategic Intervention Materials (n=60)

Description	Yes	No
1. Are the SIMs appealing and interesting?	95%	5%

2.	Are the drawings or illustrations clear?	85%	15%
3.	Are the words and explanations in the SIMs easy to understand?	66%	34%
4.	Can you do the activities with less teacher supervision?	13%	87%
5.	Does getting the right answer on the activities encourage you to continue on the next activities?	92%	8%
6.	Did the SIMs give you a clear understanding of the concept?	83%	17%
7.	Did you like and enjoy using the strategic intervention materials?	97%	3%
8.	Are you encouraged to study science (Biology) more because of the SIMs?	85%	15%
9.	Would you like that your science teacher provides you with strategic intervention materials?	100%	0

The user's rating revealed a large percent approval that the SIM is interesting and appealing. This indicated that the general appearance of the SIM has caught the interest of the students. This could be credited to the fact that it was their first time to see such instructional materials. The SIMs looked attractive and enjoyable for the students.

Students asserted that the drawings or illustrations were clear. Contributory to the easy accumulation of learning on SIMS was the well-constructed drawings and illustrations. These students understand the concepts easily when there are drawings or illustrations that concretize the idea. The table further shows that most of the students agreed that the words and explanations used in the SIMs were easy to understand. This indicated that the students find the words and explanations easy and simple since these were prepared considering their level of understanding.

However, most of the students could not perform the activities with less teacher supervision. This implies that, some of the activities need to be revised to make it easier and simpler. It was evidently shown that students were exposed to the SIM for the first time. As observed during the conduct of study, students were given the chance to monitor their own progress and make corrections when necessary. Most of the students approved that getting the right answer on the activities encouraged them to continue to the next activities. This indicates that the SIMs have stimulated the students to learn their best since they could monitor their own progress and could see their results. They repeat reading the materials for better understanding of the concepts under consideration.

The students positively confirmed that they had fun using the strategic intervention materials and those they would like that their teachers provide them with other SIMs. They enjoyed the learning experiences. They find these easy to understand and perform.

Using SIMs encouraged the students to study science (Biology) more. This indicates that the students are looking forward to learn science (Biology) more with the use of SIMs and that they would prefer if these materials were designed and developed by their teachers. This indicates that the SIMs are good example of these teacher-prepared materials that could help facilitate better learning of science concepts.

On the other hand, student tryout unanimously like that their science teacher provides them with strategic intervention materials. This means, SIMs are essential instructional materials intended for remediation for those students who performed low in class.

The present results as evaluated by the student-users are similar to the works of Hermocilla (2013), Soriano (2012), Potane (2012), Simbajon (2012), Abadila (2012) Lumosad (2011), Aban (2011) and Florino Jr. (2010) that the developed SIMs were appealing, enjoyable,

useful, meaningful and easy. This means, if the instructional materials are well organized, well-constructed and presented properly, a successful teaching-learning can be achieved.

After answering the checklist, the students were requested to write as to their opinions and feelings about the SIMs. The comments are presented topically: their learning experiences in using SIMs and what they liked best in SIMs.

Frame 3. Students' comments on their experiences and like best with the SIMs

"The illustrations and drawings of the SIMs are very attractive and clear. It helps me answer the questions easily."
"My learning experience in using SIMs is to get the right answer and I am happy to answer the SIMs."
"I like and enjoy using the SIMs and I encouraged to study more in science because of the SIMs."
"I enjoyed answering the puzzles and the videos are interesting."
"I learn to manipulate the microscope and I experience to handle the microscope effectively."
"The words and explanations in the SIMs are easy to understand."
"I like solving puzzles in the SIMs."
"With the answer key, I could easily check my answer."
"There are videos, audio and power point presentation given".
"The activities are easy to answer compared to books."
"The drawings are colorful and attractive."
"I like the campus field trip and taking photos of different organisms."

As observed, the students were enthusiastic and eager to work on the SIMs. At first, they thought it was very hard, but as they go along the materials, they found it very enjoyable and easy to answer. The presentations of the concepts, as well as the illustrative drawings contributed much to the understanding and concretizing the science concepts

The students' clearly differentiated the SIMs from books. The illustrations and drawings were clear and colorful. The activities were drawn from real-life experiences to help concretize the concepts. Unlike SIMs, books do not provide answers to assessments. This indicates that, for an instructional material to be effective, it should be able to capture the interest of the students in order to learn the concepts.

Revision on the Strategic Intervention Materials

The comments and suggestions of the thesis committee, panel of experts, potential teacher-users as well as, the results of the students' opinionnaire were the bases for the revisions of some parts of the SIM. The following were the general comments and suggestions given:

Frame 4. Comments and suggestions by the thesis committee

"Make a table contents that include the rationale, introduction, objectives, how to use the SIM and title of each SIM should be placed."
"Improve cover page, make it colorful."
"Activity in each card should be placed in a separate page."
"Should contain objectives in each activity for every card."
"Give examples of how to answer the activity as part of giving hints."
"Place your name in each card."
"For every card of the SIM, place comments."
"Provide students with immediate feedback after each activity."

Frame 5. Comments and suggestions by the panel of experts

"Improve the directions of the activity cards."
"Have the reference lists, alphabetically arranged at the end of each lesson."
"Suggested color combinations are yellow, blue and black."
"Some pages do not follow color harmony."
"Make use of the standard font style and font size, some of the pages are too heavy for the eyes."
"For final roll-out, consider separate answer sheets so that original texts can be recycled."
"Follow standard how and where to place your name and other information."
"Prepare a teacher's manual which provides the rationale of the material, the objectives, the topics covered, instructions how to do the activities, how is learning assessed, added information and lists of references."

Frame 6. Comments and suggestions by the potential teacher-users

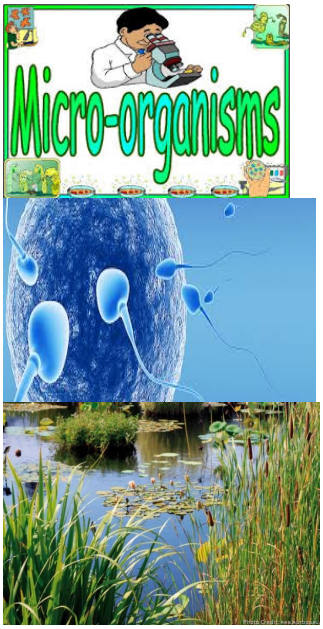
"Instructions must be stated clearly to avoid ambiguity in computing magnification. Magnification of eyepiece and objectives must be emphasized."
"For microscope picture, find another with high pixel or definition."
"No golgi body and centrioles given on the parts and functions of organelles."
"Add some activity cards that connect the concepts to real life situations."
"SIM could not sustain the long term process of knowledge of students, it is limited but very informative."

Some of the revisions were shown in frames 7-10 showing the original form and revised form. These revisions were also true to other features of the SIM. In frame 7, it showed the revisions on the improvement of the cover page like the suggested colors, SIM titles and writing the researcher's name. In frame 8 showed the original and revised forms, that the activity in each card should be placed in a separate page because some of the pages are too heavy for the eyes. This means, make use of the standard font style and font size

Revisions on the SIM based on the suggestions and comments from the panel of experts, teacher-users and the thesis committee

Frame 7
Original Form
Strategic Intervention Materials (SIM) in Grade 7 Science (Biology)





Revised Form
Strategic Intervention Materials (SIM) in Grade 7 Science (Biology)

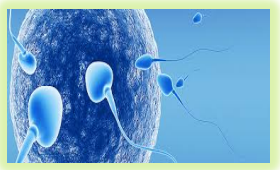


MICROSCOPE MANIA! RONALD B. DEDACE



POWER OF BEING SMALL RONALD B. DEDACE

MICROORGANISMS RONALD B. DEDACE



HERIDITY: INHERITANCE & VARIATIONS

INTERACTIONS AMONG ORGANISMS



RONALD B. DEDACE

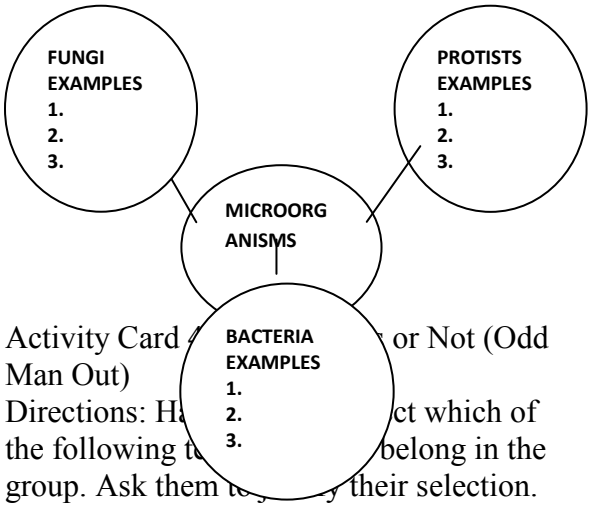
Revisions on the SIM based on the suggestions and comments from the panel of experts, teacher-users and the thesis committee

Frame 8

Original Form

Activity Card 3. Microorganisms around Us (SIMTECH, TUTORIAL VIDEOS AND NOTE TAKING)

Ask the students to extend the semantic web by supplying pertinent information on the three of groups of microorganisms.



Activity Card / or Not (Odd Man Out)

Directions: H ct which of the following t belong in the group. Ask them t their selection.

1. Ringworm, dandruff, Salmonella typhi, Yeast

Justification:

_____

2. Paramecium, Bracket fungi, Stentor, Kelp

Justification:

_____

3. Amoeba, Coccus, Baccilus, Spirillum

Justification:

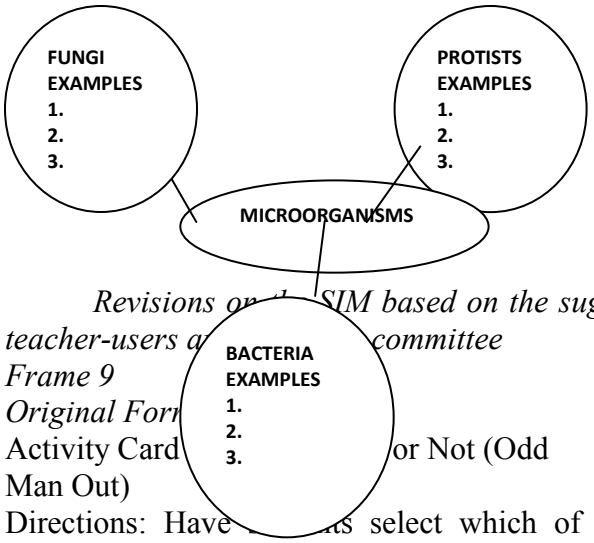
_____

Revised Form

Activity Card 3. Microorganisms around Us (SIMTECH, TUTORIAL VIDEOS AND NOTE TAKING)

Objective: In this activity with the integration of SIMTECH, students are expected to enumerate and be familiar with the different microorganisms around us.

Ask the students to extend the semantic web by supplying pertinent information on the three of groups of microorganisms.



Revisions on the SIM based on the suggestions and comments from the panel of experts, teacher-users and the thesis committee

Frame 9

Original Form

Activity Card [illegible]or Not (Odd Man Out)

Directions: Have [illegible]s select which of the following terms does not belong in the group. Ask them to justify their selection.

1. Ringworm, dandruff, Salmonella typhi, Yeast

Justification:

_____

2. Paramecium, Bracket fungi, Stentor, Kelp

Justification:

_____

3. Amoeba, Coccus, Baccilus, Spirillum

Justification:

_____

Revised Form

Activity Card 4. Group mates or Not (Odd Man Out)

Objective: In this activity, students are expected to classify microorganisms according to their group.

Directions: Have students select which of the following terms does not belong in the group. Ask them to justify their selection.

1. Ringworm, dandruff, Salmonella typhi, Yeast

Justification:

_____

2. Paramecium, Bracket fungi, Stentor, Kelp

Justification:

_____

3. Amoeba, Coccus, Baccilus, Spirillum

Justification:

_____

Choices for the Justification

1. Absorb nutrients from outside their bodies.
2. Get nutrients and energy by absorbing/ digesting the surface they live on.
3. Some get nutrients and energy by eating other organisms.

Comments:

_____

Revisions on the SIM based on the suggestions and comments from the panel of experts, teacher-users and the thesis committee

Frame 10
Original Form
ACTIVITY CARD 1. MICRO FIND ME!
DIRECTIONS: Find and encircle all the terms related with the microscope. The words are arranged vertically, horizontally and diagonally.

EYE EYEPIECE
ELECTRON

E	Y	E	P	I	E	C	E	N	R	L
L	Y	O	O	E	X	R	J	I	A	K
E	M	E	N	N	C	S	S	E	G	L
C	A	Z	P	V	K	E	R	L	D	H
T	G	J	E	H	E	T	I	E	L	I
R	N	E	N	L	R	X	N	P	S	E
O	I	Q	O	W	N	A	L	E	E	A
N	F	C	K	I	Z	Y	G	E	M	Y

Objective: In this activity, students are expected to be familiar with terms related with the microscope. These terms will be used in the preceding activity.
DIRECTIONS**:** Find and encircle all the terms related with the microscope. The words are arranged vertically, horizontally and diagonally.

E	Y	E	P	I	E	C	E	N	R	L
L	Y	O	O	E	X	R	J	I	A	K
E	M	E	N	N	C	S	S	E	G	L
C	A	Z	P	V	K	E	R	L	D	H
T	G	J	E	H	E	T	I	E	L	I
R	N	E	N	L	R	X	N	P	S	E
O	I	Q	O	W	N	A	L	E	E	A
N	F	C	K	I	Z	Y	G	E	M	Y

EYEPIECE
EYE
ELECTRON

Comments:
_____

Revised Form
ACTIVITY CARD 1. MICRO FIND ME!

On the other hand, frames 9 and 10 showed the original and revised forms, that for every card of the SIM place comments. These comments will provide students with immediate feedback after each activity. It contained the objective of the activity that would further guide the students in answering the activity. In addition, giving examples of how to answer the activity were given. These examples served as part of giving hints that would help students to perform better in answering the activity.

Basically, there were no major modifications on the SIMs. Some slight revisions were suggested by thesis committee, panel of experts and potential teacher-users. As a whole, the SIMs were functional and usable. It was easy to use and contents followed to the learning guide set by the DepEd.

Test of Effectiveness of the Developed SIM in Grade 7 Science

To further determine the effectiveness of the SIM, scores of both experimental and control groups were scored to determine its level of proficiency. The researcher used the guidelines on the rating system of basic education curriculum (DepEd Order No. 73, s. 2012).

Table 4 shows the posttest achievement test scores of the experimental group and of the control group and their level of proficiency. It is observed that the scores of the experimental group clustered between beginning to approaching proficient level but, the peak was in the developing level.

Table 4.
Posttest Achievement Test Scores of the Experimental Group and of the Control Group

		Frequency Distribution		
Level of Proficiency		Experimental		Control
Advanced (A)		0		0
Proficient (P)		8		0
Approaching Proficiency (AP)		13		9
Developing (D)		22		29
Beginning (B)		1		3
Achievement Scores	Mean	21.20	7.18	16.95
	Sd			6.05
Proficiency Level		Approaching Proficiency (AP)		Developing (D)
	N	44		41
Test of Comparison between the Experimental Group and the Control using t-test		t-value= 2.96 p-value= 0.004*		

*Significant at 0.05 level

It is observed that the scores of the experimental group were scattered into four (4) levels of proficiency. One (1) student got the academic grade range of 74% and below with the level of proficiency of Beginning (B). This means, this student at this level struggle with his/her understanding; pre requisite and fundamental knowledge and/ or skills have not been acquired or developed adequately to aid understanding. This implies that these students need more remediation time in order to cope up with their academic performance.

Twenty two (22) students belong to Developing (D) as their level of proficiency with the academic grade range of 75-79%. These students at this level possess the minimum knowledge and skills and core understandings, but need help throughout the performance of authentic tasks.

These means, these students need supervision by the teacher in doing all the activities. However, thirteen (13) students got an academic grade range of 80-84% with Approaching Proficient (AP) as their level of proficiency. These students at this level have developed the fundamental knowledge and skills and core understandings and, with little guidance from the teacher and/or with some assistance from peers, can transfer these understandings through authentic performance tasks. This means, these students can do the activities with less teacher supervision.

Eight (8) students performed Proficient (P) with an academic grade range of 85-89%. The students at this level have developed the fundamental knowledge and skills and core understandings, and can transfer them independently through authentic performance tasks. This implies that these students need not remediation at all because they performed better in the activities.

On the other hand, majority of the scores of the control group got an average grade range of 75-79% with the level of proficiency Developing (D). This means, students at this level possess the minimum knowledge and skills and core understandings, but needs help throughout the performance of authentic tasks. These students need more remediation time and intervention for them to cope up with their academic performance and improve their level of proficiency.

Data in Table 4 further show that the obtained achievement scores in the test of the experimental group, which was taught in Grade 7 Science (Biology) with the SIM, had achieved Approaching Proficiency (AP) (M=21.20) compared with the achievement scores of the control group which was taught in Grade 7 Science (Biology) without the SIM. The control group had achieved Developing (D) proficiency (M=16.95).

The standard deviation of the distribution of the achievement scores of those in the experimental group was less scattered (s.d=7.18), as compared with that of the control group which was more scattered (s.d-6.05). There was more variation in the distribution of the achievement scores of those students in the control group than those students in the experimental group.

The finding indicates that the experimental had Approaching Proficiency (AP) level. This means, that the students in the experimental group have developed the fundamental knowledge and skills and core understandings and, with little guidance from the teacher and/or with some assistance from peers, can transfer these understandings through authentic performance tasks. This means, these students can do the activities with less teacher supervision. On the other hand, the students in the control group had Developing (D) proficiency level. This means that the said students at this level possess the minimum knowledge and skills and core understandings, but need help throughout the performance of authentic tasks. These means, these students need supervision by the teacher in doing all the activities.

To test the difference in the posttest scores between the experimental group and the control group, the t-test for independent samples was used at 0.05 level of significance. The data could be found in Table 4. The data in the Table show that the computed t-value (t=2.96) was significant. This was based on the computed probability value (p=0.004), which was less than the 0.05 level of significance being set earlier. Based on findings, the null hypothesis which states that there is no significant difference in the academic achievement between those students taught in Grade 7 Science (Biology) with the integration of SIM and those students taught in Grade 7 Science (Biology) without the integration of SIM, is rejected.

There is significant difference in the academic achievement in Grade 7 Science (Biology) between the students taught with integration of SIM and the students taught without the

integration of SIM. This finding shows that the developed SIM in Grade 7 Science (Biology) helped develop the proficiency level in Science of the students who had used the said SIM.

In spite of the use of SIM, the academic achievement in Grade 7 Science (Biology) of the students could still be attributed to other factors which had not been investigated in this research. It could be possible that some student factors such as motivation to learn and attitude towards learning, and others had influenced their academic achievement. Also, it could be possible that there are teacher factors that contribute aside from the environmental factors. Nevertheless, as far as this research, the developed SIM could enhance the academic achievement of students, in Grade 7 Science (Biology).

The present findings are similar to the studies conducted by Alcala (2012), Soriano (2012), Soberano (2009), and Macabago (2009) which the Strategic Intervention Materials significantly contributed to the mastery of least learned concepts. Furthermore, SIMs foster significant effect to the learning process of the students.

Chapter 5

Summary, Conclusion and Recommendations

This chapter presents the summary, the findings, the conclusions and the recommendations of the study.

Summary

This study developed, validated and tested the effectiveness of strategic intervention materials (SIM) in Grade 7 Science (Biology). This was conducted in Digos City National High School during the school year 2013-2014. The strategic intervention materials covered the second quarter lessons, these include: microscopy, cells, reproduction, microorganisms and interactions among organisms. The objectives and the posttest were based on the K-12 Curriculum Guide. The developed SIM had undergone a careful process of construction which followed the three stages, namely: pre-development, development, and post development. It was validated by the panel of experts for its functionality and usability to the identified users.

The comments and suggestions of the panel of experts and of the teacher-users were the bases for the improvement of the developed strategic intervention materials before the tryout. The material was tried out to a heterogeneously group of sixty (60) grade 7 students of Digos City National High School. The results and opinions were the bases for the final revisions in preparation for the test of effectiveness.

To test the effectiveness of the material, a quasi-experimental posttest research design was conducted to two groups of grade 7 students in Digos City National High School. The

experimental group consisted of forty four (44) students; while, the control group consisted of forty one (41) students.

Findings

The findings of the study revealed the following:

1. The developed strategic intervention materials for Grade 7 Science (Biology) met the set criteria on functionality and usability in the following parts: guide card, activity card, assessment card, enrichment card, and reference card. The tryout group find the strategic intervention materials appealing, interesting, challenging, easy to understand and enjoyable.
2. The developed strategic intervention materials for Grade 7 Science (Biology) were developed adopting the three-stage model for its design and development. The suggestions, comments and recommendations given by the thesis committee, panel of experts, potential teacher-users and the feedback from the tryout group were the bases for the revision of the strategic intervention materials in preparation for the test of effectiveness.
3. There is, statistically significant difference in the academic achievement in Grade 7 Science (Biology) between the experimental group taught in Grade 7 Science (Biology) integrating the developed SIM and the control group taught in Grade 7 Science (Biology) without integrating the developed SIM.

Conclusions

Based from the findings, the following conclusions were drawn:

1. The developed strategic intervention materials can be used by teachers and students in teaching and learning the topics in Grade 7 Science (Biology).
2. The developed strategic intervention materials (SIM), are functional, usable, appealing, interesting, challenging, easy to understand and enjoyable. Hence, the developed SIMs could be utilized as instructional materials in teaching Grade 7 Science (Biology).
3. Integration of Strategic Intervention Materials (SIM) in Grade 7 Science could enhance the academic achievement of Biology students.

Recommendations

Based from the findings and conclusions of the study, the following recommendations are drawn:

1. Science teachers can use the strategic intervention materials made by the researcher to re-teach the concepts and skills and help the students master the competency-based skill.
2. Seminars and in-service training can be conducted in the division level regarding development and implementation of the strategic intervention materials in the classroom.
3. Science teachers can develop more strategic intervention materials for the remaining lessons which were not included in researcher's SIMS.

4. Strategic intervention materials for other subjects can be made to address the least mastered skills.
5. A similar study may be conducted covering a bigger number of respondents in another venue.

References

Abadilla,Editha G.(2012) Lessons and Activities on Environmental Issues Integrating Higher Order Thinking Skills (HOTS) for Grade Six.

Aban, Gemma D. (2011) Activities for Reading Comprehension Integrating Critical Thinking Skills.

Alcala, Loreen L. (2012) Development and Validation of Strategic Intervention Materials in Mathematics of Grade I Pupils in the Division of Butuan City.

Batomalaque, Antonio E. Basic Science Development Program of the Philippines for the International Cooperation. Retrieved from http://www.criced.tsukuba.ac.jp/pdf/09.June 10, 2013.

Blalock, G.C. Strategic Intervention Materials Model 6. Transition Project: Education-Transition Consulting UC. Retrieved from www.ku.crl.org.pdf.File Format on June 10, 2013.

Bruner, J. (1966). Toward a Theory of Instruction. Cambridge, MA: Harvard University Press.

Bruner, J. (1996). The Culture of Education, Cambridge, MA: Harvard University Press.

Cajes, M.L. (2011). Development of Indigenous Manipulative Materials in Teaching Measurement.

Curriculum Guide Science version as of January 31, 2012 .Retrieved from http://www.gov.ph/downloads/SCIENCE-K-12-Curriculum-Guides.pdf.
http://www.gov.ph/downloads/2012/201209-K-to-12-Toolkit.pdf.
http://www.gov.ph/2010/11/02/briefer-on-the-enhanced-k12-basic- education-program/.
http://www.scribd.com/doc-K-to-12-The-Key-to-12-Quality-pdf. Retrieved on June 20, 2013.

DepEd Memorandum Number 225 series of 2009 available at http://www.deped.gov.ph. Retrieved on June 10, 2013.

Ellis, Arthur B. (1993) Teaching General Chemistry: A Materials Science Companion. Available at http://eric.ed.gov/?id=Ed376081. Retrieved on July 25, 2013.

Florino, Melanio R. Jr. (2010) Computer Assisted Language Learning Activities in Teaching Adjectives.

Hermocilla, Aldin A. (2013) Strategic Intervention Materials (SIM) in Biology.

Jonassen, E. (1994). *Constructivism in education*. Oxford, England: Pergamon Press. p. 162.

Kesiduo,S. and Roseman J.E.(2002) How Well do Middle School of Science Programs Measure up? Journal of Research in Science Teaching.

Lumosad,Marilou V.(2011)Lessons and Activities in High School Biology to Develop Critical Thinking Skills Using 5E's Instructional Model.

Macabago, S.M. (2010). Development of Science Intervention Materials. (An action research) Division of Bukidnon, Malaybalay City.

National Education Testing and Research Center (NETRC). http://www.deped.gov.ph/index.php/component/content/article/2-general/381-department-of-education-facts-and-figures and http://netrc.sysportal.net/Frame.aspx?id=2027. Retrieved on February 10, 2013.

Potane, Joel D. (2012) Teacher Support Materials (TSM) for the Design and Conduct of Science Investigation Projects (SIP).

Senate Economic Planning Office (SEPO) Policy Brief (June 2011). Available at http://www.senate.gov.ph/publications 2003 and 2008 TIMMS. Retrieved on July 10, 2013.

Simbajon, Ruth B. (2012) Lessons in Biology of Nature Integrating Videos for High School Biology

Simbulan, Sol G. (2011) Methods of Research (How to Write a Research Paper)

Soriano, Abraham P. (2012) The Efficacy of Strategic Intervention Materials with Physics and Mathematics Remediation to the Achievement of Selected Fourth Year Students of Las Nieves.

Curriculum Vitae

A. Personal Background

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B. Educational Background

Elementary: Guinsang-an Elementary School
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SUSTAINABLE COASTAL GOVERNANCE: COASTAL SCIENCE AND SOCIO-ECOLOGICAL INDICATOR SYSTEMS

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Abstract

There are recognized in Latvia the lack of locally based coastal research knowledge and its interpretation into municipal safety and socio-economic development planning from one side as well as correspondingly also only land based and sectorial interests oriented coastal municipalities' governance practice from other side. Coastal governance practice development problems at the local level are to be seen at both ends of governance cycle – science and policy**.** Overall objective is to create, apply/test and use applicable system for integrated coastal science transfer into integrated coastal management (ICM) policy, esp. at the local municipal level, but also other vertical governance levels within country.
Principal integration approach is necessary at any step of the process to be realized - from coastal science to municipal monitoring and sustainability indicators into ICM. This has been started to test step-wise during realization of various research and development projects: to translate and integrate academic coastal science based results into to be designed an applied municipal land-water boundary monitoring and indicator system. There was designed indicator system proposal for Saulkrasti municipality and fully implemented, being used now for supervision of mandatory municipal Sustainable development strategy. Proposal and project for coastal indicators observatory system has been developed for sea-land border area admin territory, respecting all types of coastal components as for highly specific socio-ecological systems.

Keywords: coastal governance, socio-ecological systems, indicator system, climate change governance, complementary instruments

1. Introduction

Integrated coastal management (ICM) has been long standing recommended research/model practice and EU requirements approach and even principle for coastal areas development, but still being comparatively new tradition as barely used in the country and even region. ICM studies in Latvia do recognize several quite known general problem fields - missing work with/within whole governance process cycle and real stakeholders partnership/ownership approaches, one sided (mainly land based) and sector based planning approach to coastal areas, and often not tackling coast as one administrative territory and its development resource as not being perceived as complex socio-ecological systems. Subsequently, there should be basically confirmed the need for sustainable coastal **governance** (SCG) **understanding and collaboration** at all sectors, levels, target groups dimensions complementary.

Basic solutions for mentioned problems do requires for both, decision-makers/planners and society with general/specific groups, to have necessary **coastal communication** developments – information, education, participation and behavior - and starting first with quantitative and qualitative information assessment of governance particularly and for coastal sustainability in general. Coastal research, having especially socio-economic part as well, shall be transferred into ICM info-decisions.

Such mostly missing information may be gained from systematic and regularly met measurements of strictly defined parameters, which form the indicator system for SCG. The main results of research refers on **construction of indicators** itself and on **building of indicator systems** as a management and communication tool for coastal integrated planning and management. Principal integration approach is necessary at any step of the process to be realized - from coastal science to municipal monitoring and sustainability indicators into ICM.

This has been started to test step-wise during realization of various research and development projects: to translate and integrate academic coastal science based results into to be designed an applied municipal land-water boundary monitoring and indicator system; to integrate this auditing knowledge into the whole municipal coastal governance cycle process/products with innovating and facilitating ICM decision-making and policy renewal, complementary instruments based planning and implementation; to design an integrated coastal science and governance communication content/products and to prepare stakeholders participated communication process with integrated instruments development.

Most advanced coastal management process and content assessment status in Latvia has been reached at Saulkrasti coastal municipality (table 1, below), where **indicator system proposal** was elaborated after interdisciplinary studies done and formally approved/implemented by municipality to be used both for information acquisition and structuring in the planning process and as a part of supervision of municipal Sustainable development strategy, as now formally/legally required planning document in Latvia at all governance levels.

2. Framework, general approaches and methods

The indicator systems (IS) for sustainable development governance (SDG) had been developing initially on the basis of environmental indicators, later environmental, social and economic dimensions gradually became more evenly balanced and were more often supplemented by the fourth dimension – the governance dimension. Important contribution for practically applicable IS has been given by FAO producing theoretical outlines and practice conclusions. The IS formation models were based upon functional analysis of system to be researched (Bossel, 2001) or the problem analysis of the territory (Rydin et al., 2003), but were randomly linked with the governance of the territory and consequently with the content of official development planning documents, e.g. process of making governance decisions, however now step-wise being more and more under detailed investigation and practice application (Bowen, 2003,; Becker, 2005; Moldan, 2012). The indicator system for the measurement of coastal sustainability differs from the general

system with its spatial character: coast is formed by coastline with related set of other geo-spatial elements (Clark, 1997). Therefore, the indicator system, by the help of which, the coastal sustainability is assessed, must at least be capable of distinguishing the coast from the hinterland and compare them among themselves, clarifying the origin of impacts that determine the condition of coast and development tendencies and provide insight about how coastal impacts are distributed along the governance territory.

Following the character of spatial distribution of data, four main types of defining coastal areas can be distinguished (Marti X. et al, 2007): administrative- territorial, coordination character, geometric buffer and combined one that contains features of locus and administrative territorial ones. It is worthwhile to distinguish the fifth type as well- according to planning elements in Latvian circumstances. The character of data determines not only types of coastal definition, but also the spatial relationships of indicators with the coast: special coastal indicators, decisive coastal indicators, characterizing elements not specific to the coast, but where it is possible, spatially correctly evaluate coastal related impacts and relatively decisive coastal indicators, where the spatial distribution of data is "unclear", not allowing to estimate these impacts correctly, but our common knowledge about territory allow evaluate them in qualitative way.

According to the general purpose, there were selected related set of complementary research methods representing both academic and applied studies, and, elaborated traditional step-wise research and development (R&D) process approach in order to construct and test separate SDG indicator systems (IS) application in the governance process. Working with design and construction of it should be recognized and taken as overall approach for R&D work, that municipal IS building requires integration of the IS into development planning/management process and development planning documentation finally, for eventual approval by municipal Council.

The following main groups of research methods were complementary used: (1) **case study research** (CSR), which implies acquisition of thematically coordinated information during the field studies [26] using the analysis of socio-economic and natural environment data, document studies, field observations, interviews with target group representatives and focus groups, inquiries (not all methods must be included for particular specific study); (2) **approbation research,** using all various possibilities of testing R&D results; (3) **expert interviews** beyond the CSR frame.

Coastal studies of corresponding indicator systems (coastal, climate change governance, coastal risk etc.) has been realized at several municipalities using case study research method (including interviews, questionnaires, document analysis etc.) for revealing the link between the planning documents (mandatory for all stages of governance) and the evaluation of the possibilities for using the indicator system method, and for research of communicative function of indicators. Each CSR case included 30 – 50 interviews and at least 1-2 focus groups.. The expert interviews (altogether 15) were complementary with CSR and the interviews included also information about the aspects of integrated planning and indicator usage in elaboration of municipal development planning documents. Also three types of approbations have been employed: in seminars of practical research, in the planning process and the full scale approbation at the Saulkrasti municipality – IS for coastal municipal sustainable development governance.

SDG indicators as coastal social-ecological systems must be viewed as the product of multidisciplinary coastal research as per general framework proposal to be seen at the figure 1. Based upon usage of indicator system, the approach of assessment and reflection of specialized sustainability aspects was approbated from **thematic and territorial viewpoint.** From thematic viewpoint, it has resulted in elaboration of indicator systems, e.g. Climate change adaptation strategy in the district of Salacgrīva; description of specific sector of economics - the governance of health and environmental-friendly life cycle of food" in the district of Salacgrīva. From territorial viewpoint, the proposals have been elaborated for indicator systems focusing on: evaluation of sustainability of Latvian coast, by adapting DEDUCE indicator system to the circumstances of Latvia; evaluation of coastal risks communication in the district of Saulkrasti.

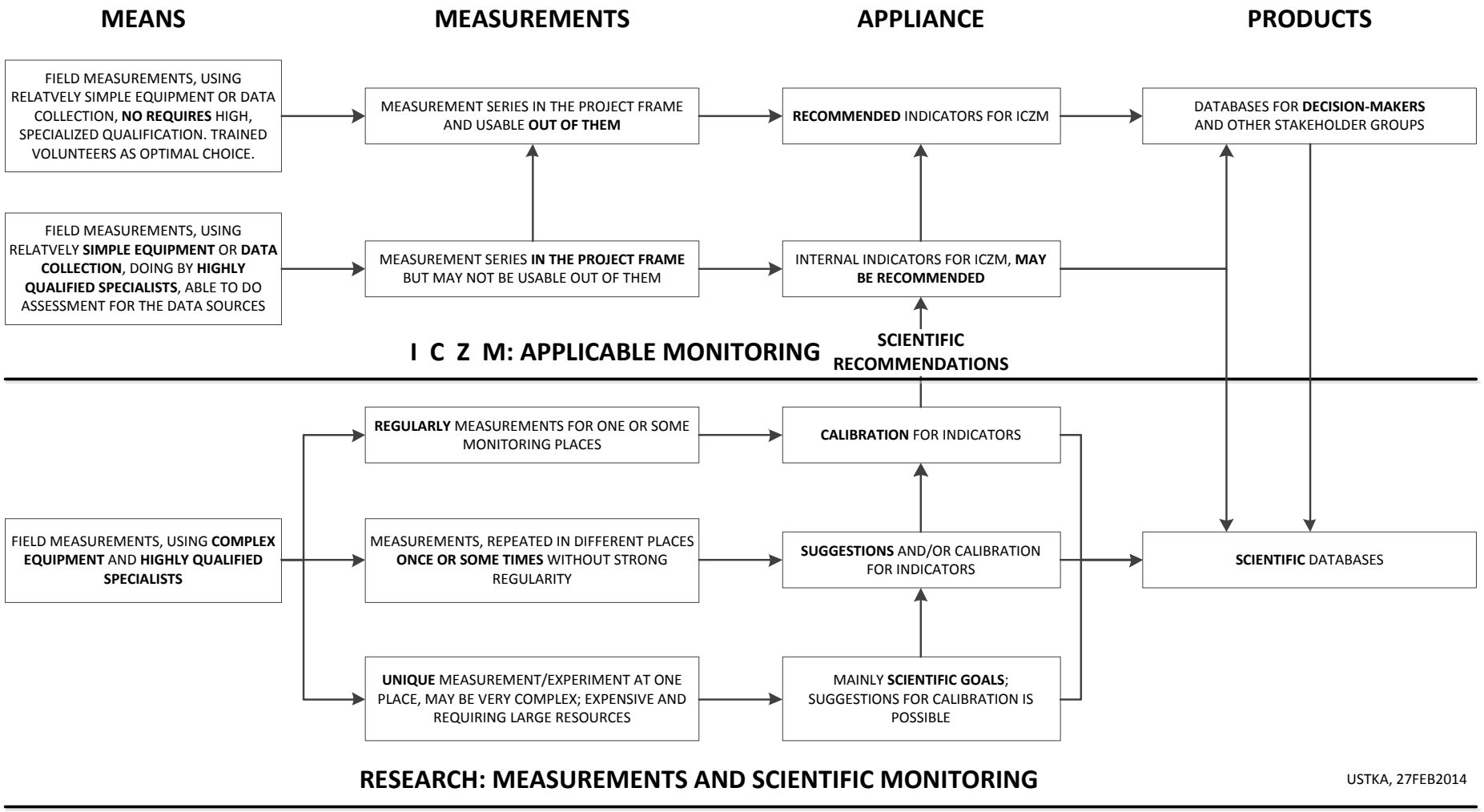


Fig.1. SDG indicators as product of multidisciplinary research process

3. Results and discussion

IS development studies have been planned as R&D program – having academic and applied research components and afterwards preparing policy initiatives and testing them into municipal practice in joint collaboration with municipal governance and as possible also with necessary participation of all main stakeholders groups. The final step was full scale testing and legal application of SDG IS for Saulkrasti municipality.

3.1 Coastal indicator systems developments

Initially, already in 2007 the complex overview was produced about condition of **coastal sustainability** of the country, using readings from indicator system. The summary of the assessment of coastal sustainability of Latvia in accordance with the data obtained from EU DEDUCE project is following:

- The difference between Latvian coast and hinterland, on the whole, are insignificant, only certain indicators show significant peculiarities;
- Development activities are concentrated in restricted areas, mainly associated with the influence areas of large cities. The rest of the territory is scarcely inhabited, with poor infrastructure and development of economic activities;
- Conservation currently prevails upon the development therefore it cannot be asserted that Latvian coast is characterized by sustainable development. Here the essential difference from the initial assumption of the project is seen and the actual situation in majority of project member states with respect to the coast as the place of problem concentration, which is associated intensive use of coastal areas with excess of anthropogenic pressures and demands immediate and complex coastal protection;
- Coastal areas have considerable potential for development of economic activities and welfare, even considering the necessary requirements of sustainability principle and the related restrictions of usage of ecosystem services.
- The peculiarity of the Latvian coast is the existence of two types of extremely different coastal zones: urban and rural/ small town type territories.
- Problematic is the situation in capital city Riga: agglomeration bordering with the sea, but the main activities are slightly removed inland; the impacts on the sea take place through the River Daugava and the port, as well as in the summer season through the migration of residents in search of coastal services in the direction of Jūrmala.

Good adaptive SCG shall have to possess both, not only top-down, but also bottom-up, from local municipal level and public monitoring build, indicator systems, being characterized by horizontal integration and vertical integration across management levels and respecting specific characteristics of coastal area via some developed typology, using physical and socio-economical characteristics, as for specific socio-ecological system, requiring also comparison with wider reference territories for obtaining real impacts of/to sea-land border area.

Reviewing problem situations in relation towards sustainability dimensions, it can be seen, that there are three different types of problem fields and correspondingly, indicators can be divided into 3 groups according to these types:

- **sub-sectoral** indicators – describe certain course of action, related to certain sector within one sustainability dimension,
- **sectoral** (or one-dimension) indicators – describe course of action or its group, related to the whole sustainability dimension,
- **integrative** indicators – describe courses of action related to integrative problem areas, i.e., are referred to at least two sustainability dimensions.

Examining all the system on the whole, the fourth group can also be identified - **integral** also strategic indicators – describe the main and the general indicators of the governed system that characterizes the given governance system on the whole and/or in comparison with similar systems.

The interconnectedness of indicators is determined by indicator integrativity, which characterizes the relationships of certain indicators with sustainability dimensions and their interaction areas that allow formation of balanced indicator systems for sustainable development planning, supervision and assessment.

Coastal **indicators observatory system** could be developed for sea-land border area admin territory and even for several countries (or later the whole region), being „bottom-up" build (starting from local level) as set of indicator systems, characterized by vertical integration. Additionally, for ICM must be respected the specific characteristics of coastal area through creating of some typology, using physical and socio-economical characteristics, since coastal areas are specific socio-ecological systems, requiring comparison with wider reference area for obtaining of real impacts from presence of sea-land border. At the beginning, this system may include morphologically relatively homogenous coastal areas. Coastal observatory could be built on basis of multidisciplinary indicator system DEDUCE. System must be deeper adapted depending on the specific characteristics of coastal area and information storage and production peculiarities at different countries. System shall be a reliable source of information and interdisciplinary decision making on Baltic region coastal problems/development for all stakeholders, incl. NGO's and wider society, too.

3.2 Coastal climate change adaptation governance instruments

ICM is directly linked with the planning and actions for climate change adaptation.The climate changes significantly affect the provision of services for the coastal territories and there is a need to improve management practice, particularly first of all with top-down basic approaches by municipalities – to find principles and appropriate structural frameworks for integration of climate change adaptation issues within both types of statutory municipal documents - municipal long term Sustainable development strategy and medium and short term Action programs/plans (being now under this R&D program and at the testing phase now). ICM being directly linked with the planning/actions for climate change adaptation do require mutual integration.

Municipal climate change governance (MCCG) should simultaneously achieve synergistic relationship between environmental quality issues and local socio-economic development tasks, and not forgetting about sustainability governance dimension. Finally, the monitoring system should be based on indicator approach (there are test version of IS for Salacgriva municipality designed during our R&D project).

However, disciplinary climate change adaptation (CCA) planning is a very new field of municipal governance, which, at this moment only Salacgriva municipality has got one (CCA Strategy, 2011). Three Latvian coastal cities (Riga, Jurmala and Liepaja) have signed the covenant of mayors and elaborated sustainable energy action plans, but other /rural coastal municipalities are not such active. To implement climate change adaptation related action **disciplinary and/or integrated**, the well defined and elaborated **set of municipal governance instruments** shall be on place, containing all six principal groups of instruments.

MCCG instrument groups comprise all traditionally known ones: political and legislative; administrative and institutional; planning; economic and fiscal; infrastructure development; and, especially, communication instruments (besides 4 basic complementary instruments of communication incl. also such known tools like advisory activities, voluntary agreements etc). Particular group of MG instruments are monitoring tools (incl. Indicators), being cross-instrumental. Currently one can see that (1) not all of these instrument groups are actively used even in overall MG, (2) the application of these instruments are not still recognized for MCCG, (3) in case some of instruments are recognized, there is no yet **complementary and integrated application** of them. The study shows that the essential issue is working both professionally and individually with particular MCCG communication instruments - environmental information, and education & training, participation and environment/climate friendly behavior - complementary

development and implementation, and contributing to ensure coherent activities of the MCCG Communication network involved actors.

Integration principle within municipal CCG shall include 5 "complementary dimensions" as for our **collaboration governance model:** (1) integration of all groups of instruments, (2) integrative stakeholders participatory process, (3) horizontal integration among thematic sectors and vertical integration among administrative levels, and (4) integrative monitoring (incl. governance indicators), (5) integration of governance communication all components in order to facilitate of the above mentioned integration processes and contents.

3.3 Indicator system for municipal sustainable development governance

Lets look at the particular case of local municipality and its sustainable development planning, but being also a coastal territory. In 2012 the fully functioning system of indicators for the governance of sustainable development has been for the first time produced and implemented in Latvia as the direct supervision instrument for the governance and strategy progress for the usage in the governance practice of the local municipality - Saulkrasti municipality - as structured list of indicators, grouping them into sustainability dimensions and integrative problem areas (in total 67 indicators; see at table 1 below), being as a formal/mandatory part of the municipal sustainable development strategy. The manual of usage of indicator system and indicators for sustainable governance monitoring was produced and personal were trained. Every two years the full-scale assessment of sustainable development governance will take place and municipal Sustainability review will be produced as innovative policy document in Latvia.

Table 1. Sustainable development governance indicator system for Saulkrasti coastal municipality. (Names of thematic groups underlined)

Integral (strategical) indicators (I)
I1. Number of inhabitants
I1.1. Number of declared and sesonal inhabitants
I2. Complex indexes
I2.1. Area development index; complex index
I2.2. Area atractivity index; complex index
Nature environment (D)
D1. Status of the „Green web"
D1.1. Forest area dynamics: hectares per year, ratio, %
D1.2. Wood-cutten permissions out of wood: permissions per year
D1.3. Financing for green area maintenance: EUR per year, EUR/1000m^2
D2. Real and potential loads on environment by public utilities
D2.1. Collected ammount of waste: cu.metres per year
D2.2. Satisfaction of population by waste management: opinions, %
D2.3. Household provision of centralized water supply and sewerage: %, part of territory, %
D2.4. Sewage treatment plant emissions to water: main pollutant groups, % tons per year
D2.5. Financial resources for the development of public utility: thsd. EUR, % of budget
D3. Air quality and impact on climate changes
D3.1. Fuel uses by type municipal and industrial sector: tons per year, % of overall
D3.2. Greenhouse gas emissions from municipal and industrial sector: tons per year
D3.4. Air quality by lichenoindication: index
D4. Surface water quality, coastal zone
D4.1. Swimming water quality in the sea: excess, % of measurement
D4.2. River water quality by bioindication: index
D5. Land use for development
D5.1. Building permissions and their types: number by types

D5.2. Natural base land transformation: hectares per year, % woodlands, agr.lands.
D6. Natural risks
D6.1. Number of stormy days: number per year
D6.2. Coastal erosion: metres per year
D7. Common indications
D7.1. Population opinion on the state of the environment: opinions % change of opinions, %

Economic environment (E)

E1. Economically active people
E1.1. Dependency ratios at declared inhabitants: young-age dependency, age dependency, %
E2. Budget of municipality
E2.1. Structure of municipality budget: total, EUR; % by main positions
E2.2 Realised infrastructure projects, financing: EUR per year
E3. Entrepeneurship and employers
E3.1. Companies registration dynamics: number per year
E3.2. Economically active market sector statistical units by kind of activity: number
E3.3. Occupied posts: number
E4. Traffic routes
E4.1. Proportion of hard-covered roads in all network of roads: %; km/sq.km
E4.2. Registered vehicles: number by types
E4.3. Public transport traffic: number of passengers, lines
E4.4. Cycle path lenght: km
E5. Local port development
E5.1. Cargo turnover in Skulte and Salacgrīva ports: tons per year
E5.2. Ship entries in Skulte ports: number, BRT
E5.3. Investments for port development: mio. EUR per year
E6. Tourism characteristics
E6.1. Number of tourism services and distribution by types of them, %
E6.2. Characteristics of tourism services: beds, bed load %; level of prices
E6.3. Staff at tourism industry: number
E6.4. Tourism information center: financial resources, eur, number of attendance
E6.5. Environmental friendly tourism accomodations, number and % from total
E6.6. Opinions for coastal improvement and tourism services, % distribution

Social environment (S)

S1. Health care characteristics
S1.1. Opinions for health services, % distribution
S1.2. Family doctor workload: registered patients
S2. Supporting for cultural environment
S2.1. Municipal funding for supporting of cultural heritage: eur per year
S2.2. cultural events: municipal funding: eur per year, number of events
S3. Social care and social security
S3.1. Unemployment and their dynamic, % of working-age people, number
S3.2. Benefit costs: eur per year, number of supported people
S3.3. Crime statistics, % by main positions
S4. Education system
S4.1. Number o pupils in the “key” classes
S4.2. Mutual payments among the municipalities for education services, thsd. eur
S4.3. Interest education attendance, number of pupils
S5. Household life quality
S5.1. Habitat comfort level: % by services
S5.2. Public services accessibility: assessment by questionnaire
S5.3. Average incomes per capita: eur
S5.4. Long-term migration: number, balance

Governance and communication (P)
P1. Municipal governance
P1.1. Opinion for municipal management, % by types
P1.2. Opinion for municipal communication, % by types
P1.3. Opinion for municipal planning, % by types
P2. Municipal information and communication
P2.1. Municipal websites number of unique visitors
P2.2. Local newspaper, circulation
P2.3. Applications received and discharged number of information activities
P3. Activieties in nongovernmental sector
P3.1. Registered NGO's, number
P3.2. Local governments and NGO cooperation: projects per year; municipal co-financing, EUR

4. Conclusions

ICM studies in Latvia still recognize various traditional problem fields, but particularly - missing complex socio-ecological system approach and the coast as local whole development resource approach. There is to be stated basic need for sustainable coastal governance (SCG) understanding and collaboration at all sectors, levels, target group dimensions complementary and mandatory development of coastal communication complementary instruments – information, education, participation and behavior.

The climate change effects are increasingly impacting both sides of coastal border areas requesting skills & knowledge development within local communities in sustainable usage of nature resources and its relations to socio-economic factors as well as design and disciplinary and/or integrative development of climate change adaptation planning within municipal sustainable development strategy and medium/short term action plans.

Requirements have been elaborated for construction of coastal municipal indicators itself and building of indicator systems (IS) as a immediate necessary tool for SCG. At Saulkrasti municipality IS proposal was designed and fully implemented being used now for supervision of municipal Sustainable development strategy. Coastal indicators observatory system shall be developed for sea-land border area admin territory, characterized by vertical levels complementary integration, respecting coastal area typology, using physical, socio-economical and governance characteristics as for understanding and collaboration for SCG as specific socio-ecological systems.

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5. Literature

1. Becker J. (2005) Measuring Progress Towards Sustainable Development: an Ecological Framework for Selecting Indicators. Local Environment. Vol.10, No. 1, 87–101, February 2005.
2. Bossel, H. (2001) Assessing viability and sustainability: a systems-based approach for deriving comprehensive indicator sets. Conservation Ecology 5(2):12.
3. Bowen R., Riley C. (2003) Socio-economic indicators and integrated coastal management. Ocean & Coastal Management 46 (2003) 299–312
4. Ernšteins R., Lontone-Ieviņa A., Kauliņš J., Strazdiņš J. Kudreņickis I., Zīlniece I., Ķepals A. (2014) Municipal climate change adaptation governance in Latvia: cross-sectoral and multi-instrumental understanding. Regional Formation Studies (Nr.3 (14); 40.-52.p.
5. Ernšteins R., Kauliņš J., Līce E., Štāls A. (2011). Integrated coastal management for local municipalities in Latvia: sustainability governance and indicator system. WIT transaction to The Built Environment, vol.149, p.29-40.

6. Fröhlich J., and J.Knielingj. (2013) Conceptualizing Climate Change Governance. In: J.Knieling and W.Leal Filho (eds). Climate Change Governance, Climate Change Management, DOI: 10.1007/978-3-642-29831-8_2 , Springer-Verlag Berlin, pp 9-26
7. Hezri A., Dovers S. (2006) Sustainability indicators, policy and governance: Issues for ecological economics. Ecological Economics 60 (2006) 86 – 99
8. Marti X., Lescrauvaet A-K., Borg M., Valls M. (ed.). (2007) Indicators Guidelines: To adopt an indicators-based approach to evaluate coastal sustainable development. DEDUCE Consortium, Interreg IIIc, Barcelona, 2007. 98p.
9. Moldan B., Janoušková S., Hák T. (2012) How to understand and measure environmental sustainability: Indicators and targets. Ecological Indicators 17 (2012) 4–13
10. Pohlmann A. (2011): Local Climate Change Governance, in: Engels, A (ed.), Global Transformation towards Low Carbon Society, 5 (Working Paper Series), Hamburg

Sustainable place-attachment of urban loose spaces

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Abstract: Prioritizing the design task according to the actual need of the user group rather than imposing any system which may not help them in reality is very important in urban sustainability from both environment and social arena. Social sustainability with the name of 'place attachment' is as important as environmental and economic sustainability in development issues. Community based design can play a very important role where people can educate themselves and can creatively transfer their places based on their own demand. This research analyses the current urban loose spaces from several location in the world and tried to find out some strategies for the neighbourhood in order to create the loose spaces attached to the people in Dhaka city context. Some case studies placed here as the reflection of the solution example and demonstrate how the community involvement can inspire designers to create integrated urban environments to actually achieve mainstream sustainability.

Key words: Place attachment, loose spaces, bioclimatic design, sustainability, green-urbanism

1. Introduction

Individuals, households, and communities are essential partners in sustainable development efforts(Weisburd, Zeitlin, & Diene). The first goal of any design solution is to satisfy the needs of the user group. During this process, to educate the client about design and about themselves, bringing out through their new space things they didn't even know about themselves, and create for them a space more wonderful then they could even have dreamed of (Holtzman, 2011) should be the main approach of community design.

Cities around the world increasingly lack decent affordable housing, public spaces not controlled by private interests and cultural spaces free from corporate influence (Bloom & Bromberg, 2004). Dhaka, the capital city of Bangladesh is none other than that. Due to the increasing number of population migrating to Dhaka city every year, it is going through a rapid growth of urbanization and consequently the new settlement, housing and slum areas are upward as well. This rapid growth has led poorly planned development, which has severely affected the environment of the city. High residential density is an important element of the compact city concept alongside mixed land uses, well-connected urban layouts, and easily accessible public transport networks (Dempsey, Brown, & Bramley, 2012). However, this concept is barely seen in Dhaka city. Because of the very high price and scarcity of land, the city is developing city centre vertically and northern horizontally mostly. The old and new developing areas often have left over or unplanned or least design spaces which become loose due to not controlled by private or government interests. Different research teams within the consortium examined and tested the claims that high-density, more compact and mixed-use urban forms are generally more sustainable than low-density, single use forms and those aspects of social sustainability claimed to be influenced by the built environment at this scale. (Dempsey et al., 2012). JDS Architects said 'we believe that architecture must shift its focus from 'sustain' to 'ability', abandoning the ambiguity, guilt and compromise characteristic of too much sustainable design today, and demanding instead precise, beautiful

and systematic instigation for change' (Mostafavi, 2010). Taking the idea, this research paper is looking for more able strategies which can sustain significantly.

1.1 Research question

a) Reasons behind making a loose space?
b) What are the sustainable properties and process to make a loose space participatory by the community through place attachment?

1.2 Significance of the Study

Not only for the developing world, but also for the developed world, social sustainability is highly recognized by the media and thought of resource persons. The loose spaces can be participatory through an understanding of the community people that they also can contribute enough to the enhancement of the social and environmental sustainable precinct by the self-organizing networks (Ebeneku-Anim, Jacobson, McRoberts, & Munyura, 2006). The sceptical urban development in Dhaka city often does not have any proper solutions for the loose/least designed/public spaces. The main significance of this research study is to address the issue and diverse potential social aspects using the term 'mainstream sustainability', there will be some suggestions made which can be of useful for planners and designers in community level build form development.

1.3 Aims of the research

This research aims to address the issue of identifying loose spaces and make it participatory by the community through some case studies both locally and internationally and to propose some potential framework including bioclimatic design, community based design and sustainable design that can be taken under design consideration. To address the terms 'lack of sense of attachment to place', 'lack of collective action and participation', 'lack of social cohesion' will be part of the research.

1.4 Background

Loose space and place attachment are commonly used in urban land use issues. Dhaka, the capital city of Bangladesh is one of the most densely populated cities in the world. Culturally, politically, socially, economically it has always been the centre of attraction. Due to the capital city and the main business district, people from all over the country come here and seek for settlement and livelihood. Thus the city became extremely contested for urban planning on space and form arena.

Due to the development of lots of informal settlement in the city, it is causing inefficient use of loose spaces as well. Most of the informal settlements are being developed on the government vacant land and wetlands inside or in the periphery of the city which have been reserved by the government for different purposes (Islam, 2007). The close distance among the build forms and inefficient use of that space often create loose spaces which are environmentally and socially alarming. Improper and confused uses make them more unfriendly to the community. In order to increase the efficiency of these loose spaces, there is a need to develop some proper guidelines to create place attachment to the community they belong. To make it sustainable, some issues like proper biodiversity, bioclimatic, ventilation, daylight provision, accessibility needs to be addressed.

On the other hand it's not a usual scenario that people in the society want to engage themself financially in such kind of community development due to lack of the feeling of ownership pattern and insecurity of authority. However, in the world there are many examples of strong social capital in urban communities, where people work together in various types of neighbourhood associations and grassroots organisations to find creative solutions. These individuals take care of each other through small-scale loan schemes, shared labour or by expanding the definition of family (Ebeneku-Anim et al., 2006). This type of action and also voluntary participation could be followed in Dhaka city context to develop the place attachment.

1.5 Methods

Textual research has been employed as the central research method for this study which is basically a qualitative analysis. The initial execution of the research was around the literary works found on the particular topic in the scholar's report, journal, books, online information, and thesis on both conceptual and practical example arena to define the loose urban spaces. The current scenario analysis of the case city was the second part of the method. Then some case studies on the relevant field from different communities, in order to search some solution examples to examine how community approaches can contribute to the social and environment sustainability took place. The literature review and case studies were mostly from the recent works such as from last 10-15 years. Some of the cases are directly examined by the author. Evaluating some comparisons and benchmarking issues were the next step of the research. After that, preparation of strategic idea and conclusion marks, along with short reasons and explanation from the findings of the case studies, were made.

Topic analysis		
Literature review	Conceptual	Scholar's report
		Journal
		Books
		Online information
		Thesis
	Example	Different country
Current scenario analysis	Case city	
Comparison and benchmarking between cases		
Own idea develop		
Discussion		
Conclusion marks		

Table 1: Research method

2. Literature review

'Community based sustainable design approach' has been an active area of research. Mostly conceptual based research is still leading. Some practice oriented examples are taken here as well as literature review. There are many neighbourhoods, where functions of any place are not clear enough because of their mixed use development and thus form-space relationship becomes loose. They can generate in different ways such as people can adopt themselves with the environment they have and another way is they can change according to their own need with the technology and design skill. In urban areas often people uses spaces in various ways which might not even designed for. Usually these activities are seen in the urban loose

spaces where may not have any fixed use type, such as unoccupied narrow or open spaces. People start using these spaces with their own decided activity. It's always not necessary these loose spaces are socially and environmentally healthy.

A thesis on 'Building Sustainable Urban Communities: Can a common participatory space offer a solution?' has been conducted on how a common participatory space has the potential to become a community hub, and to foster participatory dialogue, negotiation and decision-making within urban communities of poverty. After examining the current reality, including present development practices, this research found universal elements for a common participatory space. The study also examines the processes needed to engage community members in the cultivation, creation and maintenance of a common participatory space (Ebeneku-Anim et al., 2006).

Public space activists in Toronto Public Space Committee and Vancouver Public Space Network have taken the opportunity to build a variety of collaborative networks. The process of 'scaling up' has been part and parcel of a re-conceptualization of public space such that individual project related to 'a' public space are seen as part of a larger whole, a public space 'whole' is, by virtue of these connections and linkages, greater than the sum of its parts. The approach leads to the forging of further ties, and the recognition that the health and well being of 'a' given pubic space (a park or plaza, etc.) is intrinsically linked to the overall liveability of the city. (Pask, 2010).

Another research on 'Place identity: symbols of self in the urban fabric' stated that the icons of place attachment deserve special attention in urban design decisions because they contribute to place identity and ultimately to self identity, health, sense of community and sense of place. More specifically, the purpose was to explore and develop place identity and related concepts (R.Bruce Hull, Mark Lam, & Vigo, 1994).

In search for the definition of 'green urbanism' Lehman said in his publication 'Green Urbanism is by definition interdisciplinary; it requires the collaboration of landscape architects, engineers, urban planners, ecologists, transport planners, physicists, psychologists, sociologists, economists and other specialists, in addition to architects and urban designers' (Lehmann, 2011).

Grey space is defined as the built environment, incorporating buildings, pavements and roads. These were traditionally seen as being of limited benefit to biodiversity and were rarely ever designed with biodiversity considerations in mind (UEP, 2011). In the urban fabric, "Grey Spaces" occur in gaps of what is planned, controlled, financed by authorities or simply built by private developers in irregular or unplanned ways, occupying and setting up small businesses on land that has remained vacant for a long time or with poor accessibility or space used for dumping waste (Kayes, 2008).

A sustainable neighbourhood is a form of real traditional neighbourhood, which meets those same needs - for housing, workplaces, shopping, civic functions - but in formats that are compact, complete and connected, and ultimately more sustainable and satisfying (Milosovicova, 2008).

3. Cases of community based sustainable design:

3.1 (Place attachment) Praça Cantão, Favela Painting project:



Figure 1: Before (Painting, 2012)

Favelas ring Rio de Janeiro, Brazil's hillsides have been facing lack of social security since long. The community needed to engage themselves somehow to develop their own community and finally in 2007, Jeroen Koolhass and Dre Urhahn, of the Dutch partnership Hass&Hahn, conceived the Favela Painting Project to bring art and beauty to the built environment and engaged local youths to paint murals over 7000 sqm of the public square, thirty four surrounding houses, streets and the interior of a popular samba studio in the Santa Marta settlement (Smith, 2011). This engagement surely has done an improvement of social sustainability where people owned their sense of belongings.



Figure 2: Present look of Santa Marta, in the heart of Rio de Janeiro (Painting, 2012)

3.2 (Bio-climatic)Yoff Sustainable Wastewater System

Yoff is a rapidly urbanizing area in the dense city of Dakar, Senegal. The city service is not sufficient enough to support all of its population. The Community Infrastructure Project in Yoff, newly developed with CRESP Senegal and linked to CRESP's sustainable development program, is designed to respond to a network of community needs - social and cultural, physical and environmental (Weisburd et al.). A common practice found in there by the residents that they used to dump household waste water on the beach thus make the place abandoned and loose. For an arid community like Senegal, it was such a loss of water and also polluted coastal condition. In 2002, a branch of Environment and Development Action (ENDA), collaborated with Yoff residents designed and implemented a sustainable, gravity-fed wastewater system which collects household grey water in small settling tanks before sending it "downstream" to larger collection basins, or lagoons, where it is treated and purified with aquatic plants (Smith, 2011). The community created their own management committee to maintain the whole system.

3.3 (Developing loose space) Kibera Public Space Project

Kounkuey Design Initiative (KDI) is a non-profit design firm formed in 2006 to design and build physically, economically, and socially sustainable public spaces in informal settlements. The team of urban planners, architects, landscape architects, and graphic designers developed a community-driven process to build Productive Public Spaces (PPS), which use unoccupied waste spaces to address needs such as sanitation, environmental hazards, and income generation (Smith, 2011). They converted Kibera, a former waterlogged dumping site located on a highly polluted Ngong River tributary into new space where the productive space designs included a sheltered meeting space, play structure, community garden, and small-business to help mobilize the area's Pueblo Unido community.



Figure 3: Design invention by KDI that improved the physical, social and economic health of the community ("KIBERA PUBLIC SPACE PROJECT," 2006)

3.4 (Place attachment) Platform of Hope (Ashar Macha)

Korail is the biggest slum area in the Dhaka metropolitan with around 120,000 of population. Due to huge immense population density, there is barely any open space or community space for the residents. Very small scale loose spaces are even creating environmental pollution rather than helping the society by water clogging, waste dumping etc. Living with one of Korail's families, Khondaker Hasibul Kabir, an architect, landscape architect and lecturer at BRAC University, collaborated with the local Pervez family to initiate a new public space, the Platform of Hope (Smith, 2011). He designed and build 5.5 x 11 meter (18 x 36 ft) platform with mostly local material (bamboo, wood, rope) with the help of the community people, especially Parvez family. The place is design especially for the community children who can play, sing, dance and read there. Even the families also gather there for some relaxation looking over the lake in front. Despite of the fact that they have very low living and financial standard, yet the people of the community have the urge, skill and willingness to change their unhealthy surroundings. Thus the space become the hope for their better living hood and hence tied up the place by their soul.



Figure 4: (Left) The platform, built over Gulshan Lake, with Dhaka in background, (Right) from the water (Smith, 2011)

3.5 (How much attached to the community) Sydney Olympic park



Figure 5: Newington Armory, 'A surreal and fascinating cultural landscape that not many people know about' (Neeson, 2005)

The high budget and planning project Sydney Olympic Park was build for the Sydney 2000 Olympic Games. Due to the requirement of the project and also for the luxury of having huge area to develop about 432 hectare of area in the centre of Sydney, the site has lots of medium to big scale open spaces. The project has a very strong commitment to the environment which leads it to create bioclimatic, biodiversity, sustainable design. Often some spaces are intentionally designed in such a way so that it looks like carefully careless to keep it more natural. During the event time, the spaces are pretty much occupied with the user. However, the concern of this research was how much the loose spaces are attached to the surrounding community.

From the start, its redevelopment posted the challenge of rehabilitation of large tracts of degraded land and integrating of the natural and built environments (Authority, 1995). The Authority of the Olympic Park was committed to manage the remediated landfills and leachate systems to ensure:

1. Their integrity is maintained
2. Human health and the environment is protected
3. Statutory compliance is achieved ("Remediation Fact Sheet,")



Figure 6: Designed connecting or loose space?

The huge open spaces receive maximum sunlight, air, flora and fauna. The connectivity from the surrounding neighbourhoods (Newington, Auburn, Parramatta) to the main park land is quite far, which often doesn't encourage people well enough to go to the place and enjoy themselves. Thus the spaces are becoming loose when there is no event going on. Another identified issue was the less frequency of the transport. During the case study, it has been observed that very few people were there during the weekdays and moderately low density during the weekend on the open spaces according to the volume and scale of it. The place seemed designed for encouraging car whilst the parking are not enough close proximate. The multi directional wind flow often confuses the visitors to locate themselves more comfortable outdoor place. The attachment of the place with the people is not as rich as expected. However, the park has huge potential to bring it more closer to the community if the looseness of it can be minimized.

4. Community based design framework & benchmark

In this part, few possible framework and benchmark is being explained to show how we can design not really within a traditional method but also re-think the actual options keeping in mind mainly for our local community improvement. The future of our society is not just merely a technical matter of finding more eco-friendly energy solutions, but a question of holistic social sustainability and identifying principles for healthy communities (Lehmann, 2011). Researchers and organisations from different part of the world have discussed about green urbanism principle, qualitative urban design guideline, indicators and measures of design for neighbourhood and precincts are addressed below.

4.1 Principles of Green Urbanism

1. Climate and context
2. Renewable energy for zero CO_2 emissions
3. Zero-waste city
4. Water
5. Landscape, gardens and urban biodiversity
6. Sustainable transport and good public space—compact and poly-centric cities
7. Local and sustainable materials with less embodied energy
8. Density and retrofitting of existing districts
9. Green buildings and districts, using passive design principles
10. Liveability, healthy communities and mixed-use programs
11. Local food and short supply chains
12. Cultural heritages, identity and sense of place
13. Urban governance, leadership and best practice
14. Education, research and knowledge
15. Strategies for cities in developing countries (Lehmann, 2011)

4.2 Bioclimatic design guideline

The guideline is based on air movement in urban design sector helps the designer to derive some strategic ideas how to start their design. These ideas can be equally followed for community based urban bioclimatic design issues. The guidelines are illustrated below showing the figures:

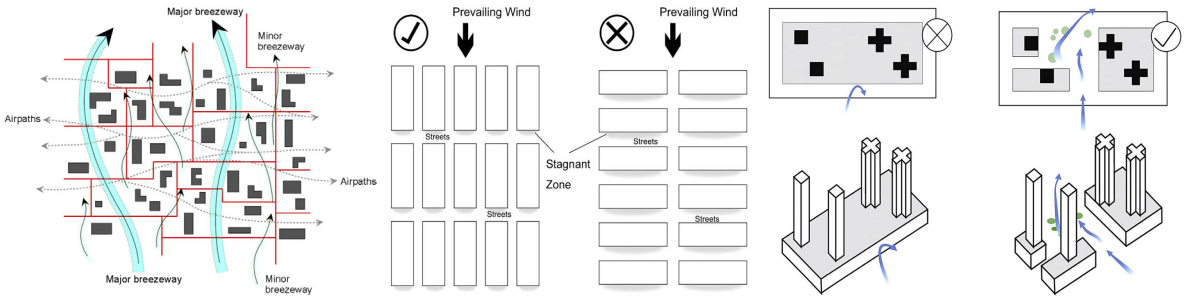


Figure 8: Breezeway/air path, Orientation of street grids, Non-building area (Ng, 2008)



Figure 8: Projecting obstructions (Ng, 2008)

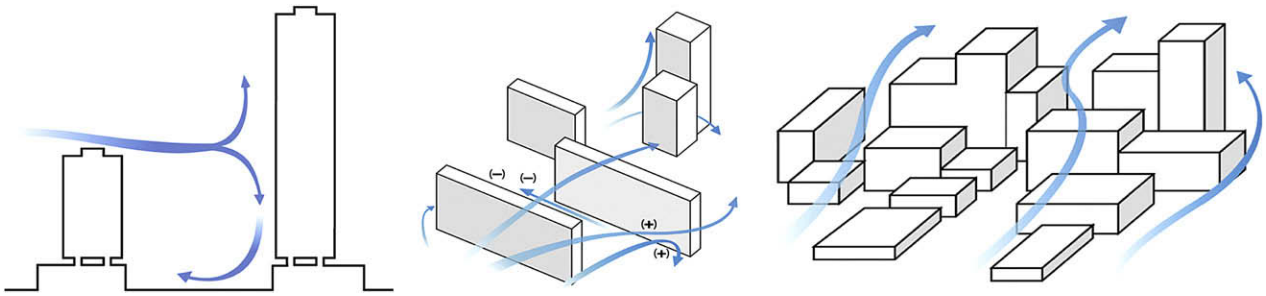


Figure 11 : Building heights (Ng, 2008)

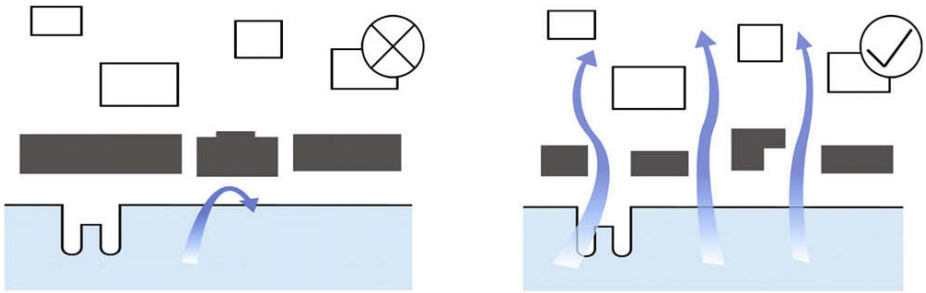


Figure 11: Waterfront sites (Ng, 2008)

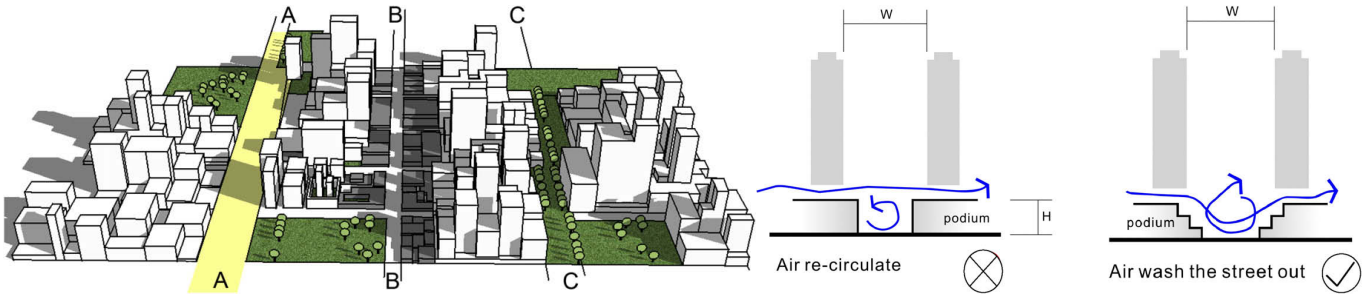


Figure 11: Linkage of open spaces, Scale of podium (Ng, 2008)

4.3 Design indicators for Sydney Olympic park

The indicators are written below which were specially maintained for designing the Sydney Olympic park.

1. Sustainability Master Planning Approach
2. Precinct Location and Siting Planning
3. Social Commitment
4. Energy Efficiency and Conservation
5. Water Conservation and Management
6. Solid & Other Waste Management
7. Resource Conservation (Materials)
8. Chemical Use
9. Wastewater Management
10. Stormwater Management
11. Economic Commitment (Hyde et al., 2007)

4.4 Comparison between the guidelines

Common agendas				
Nos.	**Type**	**Principles of Green Urbanism**	**Bioclimatic design guideline**	**Design indicators for Sydney Olympic park**
1	**Climate**	Climate and context	Breezeway/air path	Precinct Location and Siting Planning
2	**Sustainability**	Renewable energy for zero CO^2 emissions		Sustainability Master Planning Approach
		Sustainable transport and good public space—compact and poly-centric cities		
		Local and sustainable materials with less embodied energy		
		Green buildings and districts, using passive design principles		
3	**Open space**	Liveability, healthy communities and mixed-use programs	Linkage of open spaces	
4	**Bioclimatic**	Water	Waterfront sites	Water Conservation and Management
		Landscape, gardens and urban biodiversity		Chemical Use
5	**Management**		Projecting obstructions	Solid & Other Waste Management
				Resource Conservation (Materials)
				Wastewater Management
				Stormwater Management
6	**Community**	Cultural heritages, identity and sense of place		Social Commitment
		Education, research and knowledge		
7	**Policy**	Zero-waste city		Economic Commitment
		Local food and short supply chains		
		Urban governance, leadership and best practice		
		Strategies for cities in developing countries		
8	**Energy**			Energy Efficiency and Conservation
9	**Architecture**	Density and retrofitting of existing districts	Orientation of street grids	
			Non-building area	
			Building heights	

Table 2: Combination of different benchmarking

5. Finding factors which influence place attachment

Findings taken from the case studies stated above (part 3) and benchmarking from different sustainable bioclimatic design approaches (part 4) and also analysing the scenario in Dhaka, some factors are being mentioned here which might play role to influence place attachment to

a loose space in bioclimatic sustainable way. The factors are highly influenced by the climate, culture and social pattern of the particular case context. It is difficult to specify any specific parameter to influence the place attachment, yet some factors such as bioclimatic design, user's interest, social impact, commercial components etc. are important. Some basic factors identified:

5.1 Personalization of the loose space

It is very important to make the loose space personalize with the community it belongs. Otherwise, the effort to make it sustainable could be end up with usual grey as before. Figure 12 shows some kids are in search of their own portrait from the wall graffiti. This is an example taken from a community in Old Dhaka.



Figure 12: kids are trying to find their own portrait in the wall painting (Plabon, 2012)

5.2 Easy access

Often lack of accessibly makes a place loose in a community. The overall size of the neighbourhood should be suitable for walking so that each loose space is easily accessible by the community. Neighbourhoods range from 40-200 acres (16-81 hector); a quarter-mile radius (approx. 400 m) is a benchmark for creating neighbourhood unit that is manageable in size and feels walkable (Milosovicova, 2008). Here accessibility refers both physical and visual connectivity to the space in order to increase community participation. Figure 13 illustrates the idea.



Figure 13: Physical and visual connectivity (Studio)

5.3 Multipurpose use of open loose spaces

In order to make loose space more participatory in any community, it is very important to ensure maximum use of it. And this is possible when there will be a mixed use activity run by the neighbourhood by their own interest. The use pattern could be domestic or transitional. Although there is no comparative statistics are available, however Dhaka city is already facing a serious lack of open space. Some of the open space (such as parks) is being constantly taken by 'land grabbers' with the support of those in power (Hossain, 2006). Hence, the loose space could be a potential solution for filling up that gap. Various public activity and aesthetic values should be provided to interest people.

5.4 Safety of loose space

While designing loose space, safety for the user group takes one of the major considerations. Sometimes the loose spaces are found quite unsafe due to lack of sunlight, visual connection, accessibility, lack of any ownership pattern etc. especially in the Dhaka city context. Nearly 61% of the country's crime occurs in Dhaka City where less than 10% of country's total population live (Ahmed, Baque, & M.A., 1996). Also, the presence of antisocial elements in these places - particularly in parks and cinema halls - poses a serious threat to their proper use

by city residents (Siddiqui, Ahmed, Awal, & Ahmed, 2000). It is important to make it walkable under proper lighting (both natural and artificial) to make it safe for the community people.

5.5 Combining common interest of the respective community

It is important to involve and strengthen the community by drawing people together around common issues and concerns (Ebeneku-Anim et al., 2006). A typical loose space has got the probability of turn into a powerful centre which could provide common interest to each other reinforcing connections in the neighbourhood. Every community should assess its internal resources, this includes community members' knowledge and skills, existing relationships between different associations, capacity of local institutions, existing public and private infrastructure and the local economy; and the process is to be 'asset-based, internally-focused and relationship-driven' (Rans, 2005). The focus here is creating relationships, fostering trust and exciting individuals to consider the existing capital within their community (Cars, 2007).

5.6 Maintenance

To maintain the loose space the community should come up with their own solution and distribution of management with having a core control by government or private organisation keeping the main interest of neighbourhood. It is obvious that the processes of engagement may differ between communities since every community has its own unique structure; however, a few generalities may be considered. The entire maintenance process has to be continuous in before and after the design process to keep it safe from being loose again.

5.7 Biodiversity and bioclimatic design approach

Green spaces offer a wide range of possibilities to a wide range of humans, thus making urban green a desirable choice for offering a solution to essential needs of social sustainability (Häkkinen et al., 2012). Though it's not always necessary that every sustainable design needs to look green. A good design can be "green" without looking green (Holtzman, 2011) . In order to make the loose spaces more environmentally sustainable, bioclimatic solution could be one of the very good design approaches. Based on the bioclimatic design guidelines (section 4.2) the loose spaces can be design depending on the local conditions and micro climate of the site. More implementation of passive design should be prioritized here which includes maximum solar access, natural air path, and landscape, local material use by the community to make the project's life span longer and financially viable. This will also help to save energy and water, which will reduce the green house gases in the environment. Analysing the case of Sydney Olympic Park, where biodiversity has been very well maintained, it can be suggested that loose space design should follow the four basic strategies for biodiversity:

4. Expanding the area of protected habitat
5. Maximizing the quality of existing habitat
6. Minimizing the impact from surrounding land use
7. Promoting connectivity of natural habitat to counter the effect of isolation (Bennett, 1998, 2003).

6. Discussion

Based on the literature review, highlighted case studies and benchmarking strategies, it can be discussed here that place attachment of the urban loose spaces in any community is very

important to provide social and environmental sustainability. We can learn a lot about how cities work from the people who live in and use them, but it is all too rare that inhabitants are asked how they would like their cities to be (Bloom & Bromberg, 2004). Though the process varies according to the context and climate, however the basic strategies discussed in section 5 could be followed. Of course we cannot say that community attachment to the loose spaces is the only best solution to treat them sustainably, however it might be a good approach. This process may not attract everyone to participate but the hope is always there. Because, we should give the opportunity to the society if there is anyone interested to participate such activity is always welcome to do so. Designing the loose spaces in urban area might encourage community people to explore their neighbourhood in such a new way where they might not have the attachment before. The wholeness of it can give the city a new surprising look. Eventually the loose space can become as public space where people can go for recreation, even if it's not their proximate area. Hence, attaching the people with the method of sustainable design of the loose spaces can significantly improve the quality of the life.

7. Conclusion

It is not always wise to rely only on experts to design cities for us. There is enough evidence which shows, lack of place attachment is one of the main reasons to characterise a place as loose. The aim of the research was to find out the reason that makes a place loose and what could be the possible sustainable properties and process to make it participatory by the community through place attachment. It is true that there is no fixed answer; however, to achieve social sustainability, community design approach is often proved to be a successful effort because this is one of the fundamental pillars of sustainable development even in environmental arena. Focused on the social and environmental dimension of urban sustainability, the research has investigated how these urban loose spaces and almost ignored areas could play a significant positive role to improve urban social and environmental development where active and creative community involvement can give the whole process a different dimension. Awareness from all sectors, consciousness from very early education may help to shape the society better. We admit, it's always very difficult to face the huge shifting population load from rural to urban land and deal with the various day to day challenges in the case of Dhaka city. But it doesn't mean we stop thinking about it and wait for the experts to solve everything for us. We engage community in different level in the planning and can educate them to understand and give feedback to this complex situation in their comfortable way. Bloom said when we collectively assert our desire to build a park or tend a garden, when we work with others to make something larger than personal economic interests or private property; we challenge such unimaginative and oppressive structures. We create new social configurations and local places turned to our needs. We show what human beings are capable of when we work together (Bloom & Bromberg, 2004). More research in the field is required for any concrete solution answer.

8. Reference

Ahmed, N., Baque, & M.A. (1996). *Urban Bangladesh, geographical studies*: Urban Studies Programme, Dept. of Geography, University of Dhaka.

Authority, O. C.-o. (1995). *Homebush Bay Development Guidelines*

Bennett, A. F. (1998, 2003). Linkage in the landscape: The Role of Corridors and Connectivity in Wildlife Conservation.

Bloom, B., & Bromberg, A. (2004). Making Their Own Plans / Belltown Paradise (pp. 5, 23): White Walls, Inc.

Cars, G. (2007). Neighbourhood governance – capacity for social integration, Neighbourhood Govern, Final report HPSE-CT-2001-00080
Dempsey, N., Brown, C., & Bramley, G. (2012). The key to sustainable urban development in UK cities? The influence of density on social sustainability. *Progress in Planning 77 (2012) 89–141*.
Ebeneku-Anim, F., Jacobson, I., McRoberts, M., & Munyura, P. (2006). *Building Sustainable Urban Communities: Can a common participatory space offer a solution?* Master of Strategic Leadership towards Sustainability, Blekinge Institute of Technology, Karlskrona, Sweden.
Häkkinen, A., Kaasalainen, H., Laitinen, V., Nollet, C., Sagizbaeva, O., Sannemann, C., & Vuorinen, S. (2012). Attractive shared spaces for social and environmental interaction : The role of ecosystem services in social sustainability and
quality of life: Helsinki University Centre for Environmental: Urban Ecosystem Services.
Holtzman, J. (2011). Bioclimatic Approach and design philosphy Retrieved 7 November, 2012, from http://www.holtzmandesign.com/?page_id=80
Hossain, S. (2006). *Social characteristics of a megacity: a case of Dhaka City, Bangladesh* Paper presented at the TASA Conference 2006, University of Western Australia & Murdoch University.
Hyde, R., Moore, R., Kavanagh, L., Schianetz, K., Prasad, D., Blair, J., . . . Hair, A. (2007). PLANNING AND DESIGN STANDARD FOR IMPROVING SUSTAINABILITY OF NEIGHBOURHOODS AND PRECINCTS. In C. Cooper, T. D. Lacy & L. Jago (Eds.): National Library of Australia Cataloguing-in-Publication.
Islam, M. S. (2007). *Physical Density and Urban Sprawl: A Case of Dhaka City.* Master of Science thesis in Built Environment Analysis, Kungliga Tekniska Högskolan (KTH). Retrieved from http://www.infra.kth.se/bba/MASTER%20THESISES/SyfulFinal.pdf
Kayes, M. I. (2008). Example of "gray space" in Dhaka City, from http://dhaka.architectureforhumanity.org/projects/5707
. KIBERA PUBLIC SPACE PROJECT. (2006), from http://www.kounkuey.org/KPSP01Brochure.pdf
Lehmann, S. (2011). TRANSFORMING THE CITY FOR SUSTAINABILITY The Principles of Green Urbanism. *Journal of Green Building, Volume 6, Number 1*, 104-113.
Milosovicova, J. (2008). Social Conditions of Urban Design. *Sustainable Urbanism*.
Mostafavi, M. (2010). *Ecological urbanism*: Baden, Switzerland : Lars Müller.
Neeson, R. (2005). Designing Limits: Tourism + Public Space: NSW Architects Registration Board.
Ng, E. (2008). Policies and technical guidelines for urban planning of high-density cities – air ventilation assessment (AVA) of Hong Kong. *Building and Environment*, 1478-1488. doi: 10.1016/j.buildenv.2008.06.013
Painting, F. (2012). Praça Cantão: Favela Painting.
Pask, A. (2010). *Insurgent Public Space*. New York, USA: Taylor & Francis.
Plabon, L. (2012). School of Everything Else (SEE), from https://www.facebook.com/photo.php?fbid=404063206291518&set=o.125736350813178&type=1&theater
R.Bruce Hull, Mark Lam, & Vigo, G. (1994). Place identity: symbols of self in the urbanfabric. *Landscape and Urban Planning, 28*(2-3), 109-129.
Rans, S. A. (2005). Hidden Treasures: Building Community Connections by Engaging the Gifts of * People on welfare * People with disabilities * People with mental illness * Older adults * Young people. *ABCD Institute*.
. Remediation Fact Sheet. 2012, from http://www.sopa.nsw.gov.au/media/pdfs/publications/fact_sheets/remediation_fact_sheet
Siddiqui, K., Ahmed, J., Awal, A., & Ahmed, M. (2000). *Overcoming the Governance Crisis in Dhaka City*: University Press Limited.
Smith, C. E. (2011). *Design with the other 90% cities*. New York, USA: Cooper-Hewitt, National Design Museum.
Studio, I.
UEP. (2011). Making space for biodiversity in urban areas, 2012, from http://www.uep.ie/pdfs/guidelines_CH2.pdf
Weisburd, C., Zeitlin, M., & Diene, S. M. Sustainable Community Infrastructure: The Case for Biological Waste Treatment in Yoff, Senegal. *ARC- Sustainable Community Infrastructure* 43-59.

Short Bio

Tanjina Khan is an Architect and full time Lecturer in the department of Architecture, BRAC University, Bangladesh. After successfully completing her bachelor degree in Architecture from BRAC University where she received 'Vice Chancellor's GOLD Medal' for achieving the highest CGPA, she started her career at a well reputed architecture firm in Dhaka as an architect and urban designer. Then she decided to focus in teaching and joined North South University and eventually in BRAC University with an intension to research and teaching. Tanjina was awarded 'Endeavour Postgraduate Award' funded by Australian Government for her dual Masters degree from University of Sydney, Australia in 'Sustainable Design and Building Services'. In addition to teaching, Tanjina is a free lancer architect and an enthusiastic traveller and cultural person. She attended various conference and seminars and design projects.

Sustainable solution for development of rural areas in West Africa: outlook for the future. The case study of Matéri (Benin)

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Abstract

One of the most pressing problems that African countries are facing today is the rapid growth of the urban and rural populations, but the development patterns have been unsustainable and helped multiply negative factors.
Today there is a huge drive towards cities; consequently, the large African cities are expanding rapidly unchecked, resulting in land reduction for agriculture and greater risks for the preservation of the natural environment.
This problem has been made worse in urban contexts in particular by the implementation of planning strategies and western-style living standards that are frequently inappropriate, the adoption of living models that are alien to the culture of the site and traditions, and by dependence on imported construction materials and technology. In rural areas, on the other hand, the worsening agricultural production crisis and the ensuing poverty have led to phenomena of spontaneous urbanisation that has contributed to the deterioration of natural resources.
In this context a possible response to the problems related to the increased demographic pressure characterising the whole African continent could be: tackling issues related to the lack of rural development; stimulating a self-sufficient economy; proposing a life style that is more closely tied to the community, starting with the various uses of the land inherent to traditional African dispersion throughout the territory, without foregoing the introduction of the wealth and complexity of new materials and technologies that are suitable to the climatic, geographic and cultural situation.
The subject has been tackled by the Atelier of environmental sustainability in IUAV University in Venice, which took Matéri, a small rural centre to the north of Benin as a pilot project for sustainable development, providing living solutions in response to the indications in the town plan and together with the local community and institutions.

Keywords: sustainable urban development, new rural-urban model

Introduction

In Africa cities play a crucial role in the growth of national economies. The population of the big cities increased 10-12 times between 1960 and 2005 but this growth was not accompanied by correlated economic development. More generally, today the average annual growth rate of the African population is around 4% while in the big cities it reaches 7-8%. Cities in which it increases by 10% or more are no longer exceptions, in particular where the rural exodus is exacerbated by natural calamities or phenomena related to the unequal development of the territory.
By 2050 Africa will have become prevalently urban, thus inverting the traditionally rural weight of the continent.
This means that every year millions of people will be searching for new accommodation in the city suburbs, in an attempt to improve their own living conditions, on the margins of the "great mirage" of the modern city, although there are no real opportunities.
This kind of city in Africa was created and developed during the colonial period, with an urban structure that was planned on models that were not African, exposing the inhabitants to a life style that was alien to the local culture and modifying, often irreversibly, traditions and life styles.
The clearest expression of poverty at an urban level are slums and the informal quarters that characterise the landscapes of all African cities, assuming such dimensions that one is led to believe they are an actual consequence of urbanisation, the only way in which a city can be built, the *forma urbis* of Africa in the twenty-first century.
This phenomenon is associated with the lack of attention paid to small urban centres and rural areas, in terms of investment and support for family economies and a lack of policies to protect the land or controlled planning strategies.
Megalopolis and rural areas are therefore two interrelated situations: urban unrest has a structural effect on rural realities, engulfing the fertile land that should guarantee their livelihood, and this in turn effects urban life, with people, cultural, social and organisational structures.
The sustainable development of the urban agglomerates that are somewhere between the city and rural dimension, where the issue of living and the necessary infrastructures is interwoven with natural resource management, the role of family agriculture, the reciprocal relations between city and *brousse*, therefore becomes an important subject to be dealt with.
On the one hand it makes it possible to reduce the migratory drive towards big cities and the unchecked urbanisation that often ensues; on the other, it is possible to keep spontaneous, i.e. unplanned urbanisation under control in rural areas that might suffer from problems of territorial management (soil erosion during the rainy season, lack of water control, lack of sewage infrastructures).
Furthermore, it also makes it possible to develop new urban development strategies by experimenting new knowledge and planning methods, recording the transformations of the territory during its growth process and using these changes as an opportunity for reflection and research.
Rural development, as supported in Rural Poverty Report 2011 published by IFAD, is something more than just simple agricultural development as it encompasses a rural space where agriculture is at the centre of the socio-economic system, but where other activities with diversified functions and objectives are also present, all of which must be integrated and coordinated from the perspective of coherent and sustainable development. The construction of the inhabited space and the necessary infrastructures is surely amongst them.

Development in Rural contexts: between tradition and modernity

For some time now Africa has been a laboratory of ideas and forms, the object of great transformations and capable of significant potential that, owing to the vastness, density and pressure of its population, absorbs and contaminates any transformations concerning it, offering possible models for a coexistence between modernity and tradition.

With the premise as its starting point that tradition today can still be implemented and reinterpreted in a new manner, there is another path that could be followed, one that challenges the very idea of western planning, to be applied not only to the urban suburbs that are part of the cities, but also to small cities and rural centres; on the contrary, it is one that proposes new planning models that know how to take into account the culture of the site, protecting the testimony of cultural identity and thus also become an opportunity for territorial intervention and the re-invention of tradition. African rebirth does not mean copying the urban forms of pre-colonial cities or their architecture; it is clear that the problems of contemporary society are different and that life styles have changed; however, an understanding of these forms and their characteristics is necessary, as it offers material that can be reworked, reinterpreted, and adapted to the needs of those who are involved in its creation today.
It is not a case of promoting a traditionalist feeling but rather of preserving local abilities and knowledge , whilst reformulating the actual term sustainability.
It is important to understand the forms and characteristics of the traditional settlements and how these may be included when redesigning the territory from the perspective sustainable urban development. However, in this stage many things occur: new forms are added to older ones, recreating the geography of the African territory. This is why a new interpretation of beyond-modernity is necessary, placing importance on crossbreeding, remixes, hybridisation and the indigenous mixing that Africa can represent today, the result of which is a dialectic relationship between tradition and modernity.

A Study of the Housing and Settlement Patterns: Matéri (Benin)

A small rural centre to the north-west of Benin in the department of Atakora, 600 km north of the capital Cotonou, Matèri is an example of the rapid changes that could affect the rural areas of the country in the near future.
Together with the local administration, it was taken as an example to start a planning experiment by the Atelier of environmental sustainability in the IUAV University in Venice. The objective was the development of an urban-rural reference model for the construction of an identity for a contemporary African city, which could also be applied in other areas of the Benin territory.
This area is characterized by agricultural functions and activities based on a rural type of social, economic and cultural background.
It is divided into 6 arrondissement with a total of 55 villages. Today the municipality has around 100,000 inhabitants but a significant development of the population is foreseen over the next 15 years, with a forecast of 200,000 inhabitants in 2030.
From the satellite picture of the area (Figure 1) the following elements are recognizable: the urban agglomerate where the institutional buildings and the market are located; the agricultural areas *(savane à emprise agricole)* in the central part of the territory with the small villages; the wild-pastoral areas concentrated in the west; the naturalistic emergences of the Park of Pendjari in the north. The territory, covered by a savannah of shrubbery and trees, is crossed by many water courses, most of them seasonal
The main street that crosses the urban centre in the west-east direction converges into the axis connecting Matéri with the South and the Central part of Benin and - in the North - with Burkina Faso.
The main points of the Development Plan (*Plan de Developpement de la Commune*) adopted in 2010 by the local government are basically as follows (Figure 2):

- development and concentration of new settlements - in a strip of expansion around the present nucleus of houses - following a controlled plan of soil occupancy and providing them with the basic services: (drinking water, electricity, sanitation facilities);
- strengthening the urban settlement along the main itinerary with the addition of: aggregation places (urban youth centre, centres devoted to sport and young people associations) and new facilities (schools, sport places, agricultural warehouses, markets, laboratories for the

production/transformation of agricultural products, laboratories and centres for professional education and startups);
- concentrating the administrative buildings in the area located in the north of the existing residential nucleus;
- developing a commercial area in the south part of the settlement in order to grant continuity with the existing market;
- contributing to an improvement in the life style in the existing districts with their inclusion in a holistic project of sustainable development of the territory;
- development of new touristic structures respecting the presence of the natural Park of Pendjari - a UNESCO heritage site - and following the criteria of sustainable management in order to control the development of this precious part of the territory and of its natural resources.

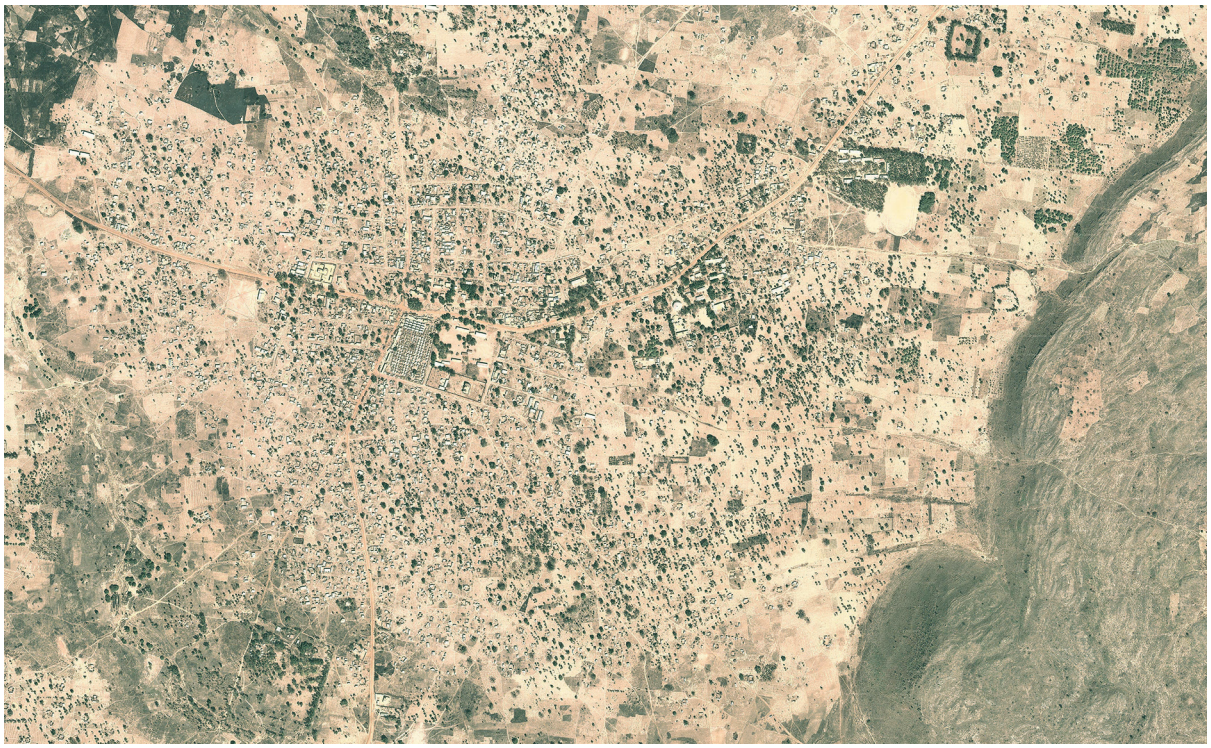


Figure 1: Satellite view of Matéri (reworked version from Google Maps - ©2014 Google)

The plan for Matéri

Starting with the general guidelines contained in the development plan, during the academic year the Atelier students experimented new settlement models able to assimilate the culture of the place in their configuration and to recover and consolidate the local know-how, enriched by technological innovations and the exploitation of the natural renewable resources, adopting strategies that are suited to the context and can be repeated in the local communities.
The extraordinary opportunity of renewable energy resources could lead to new territories and new potential.
The main objective was to contribute to the translation of the contents of the Matéri Development Plan whilst also giving an image of the places that were the object of this transformation in order to start a debate with the local community.
This resulted in a trip/training period in May 2014 when activities were organised to involve the community and local technicians with the two-fold objective of primarily discussing the projects selected and assessing, with the involvement of the population, any possible repercussions in both terms of feasibility and acceptance.

This interest in the study of new urban development models in a rural context not only involved the study of research themes with significant spatial implications, but also an assessment of how such interventions could act as the engine for sustainable territorial transformation, generating new centrality and standard of living.
Seen as urban explorations for the development of Matéri, the resulting projects offer an answer to the general topics hitherto evoked, proposing expansion strategies through the construction of autonomous residential districts from the existing central nucleus. These districts will increase in dimension and identity in the near future, whilst taking into account the context, and without setting aside the collective memory and immaterial dimension of the local myths and sacred spirits which still are integrative elements of African architecture.
It was therefore no coincidence that the project proposals were developed on the basis of consolidated paradigms and useful archetypes that had been acquired from contextual and historical studies, adding however, new 'ways' of living linked to the current changes were added to the consolidated settlement systems.
In African culture the house is never seen as a static concept; on the contrary, it is a dynamic process of mono-functional rooms, which grows and changes according to the changes in the relationships between the people and relatives in the family group (Figure 2): the home "is nothing other than the physical projection of the space of the social organisation of the family inhabiting it" (Labelle Prussin).

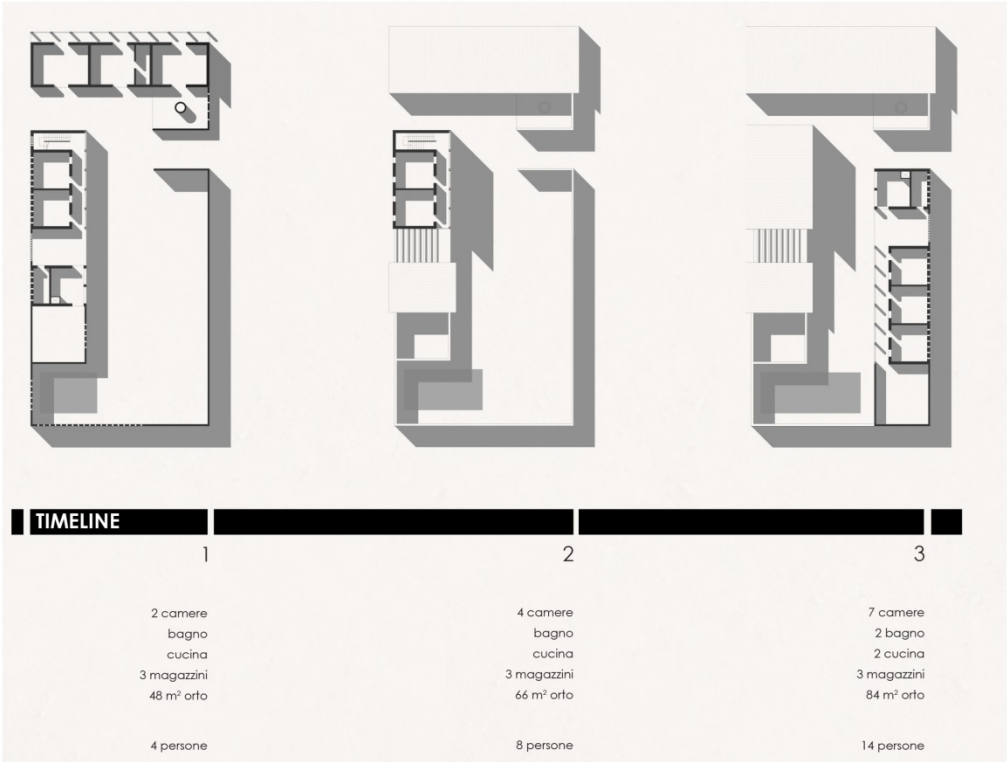


Figure 2: Multi-purpose house: plans and modification in use (project by Guidolin, P., Parolin, F., Sottana, C.)

The transformation of residential spaces implicates changes not only in the domestic environment but also in the urban living environment whose true dimension lies in the relationships with and through the living places, and in the expression of a social and territorial relationship.
Since the concepts of flexibility and adaptability are fundamental in the development of African living space, the projects not only propose flexible living typologies with different combinations, but also a 'modular' architecture that, being repeatable, is also sustainable and innovative.

The starting point for the construction of the room/accommodation was the ‘minimal unit’ and it was around this that the living units were developed, following a freedom of aggregation that is a component of the form of the new housing areas.
Bearing in mind that most of the people that will live in the expansions come from the surrounding rural areas, particular attention was paid to maintaining some characteristics of the typical African house in the aggregation spaces, such as the courtyard - an essential component for the environmental control and for the socio-cultural exchange (Figure 3).



Figure 3: House type: plans and longitudinal sections (project by M. Becevello, A. Calandriello, F. Zanibellato)

The projects tried to develop prototypes that responded to the socio-cultural needs and issues linked to the context (morphology, climate, natural energy resources and locally available materials). Equipment for public use, public buildings and new public spaces play an important role in the urban expansion strategies that were adopted as they help give the settlement a more specific character, generating new centrality (urban centre, new market areas linked to production, processing and sale of the agricultural products with the relative classrooms and laboratories for professional training and designing new, recognisable places.
In the strategies of urban expansion adopted, the public facilities and the collective buildings assume a very important role, each time giving a well defined character to the residential area: they are in fact the generating elements that create new recognizable places (Figure 4).



Figure 4: Seattlement growth: the collective building and the relationship to the new residential area (project by F. Baretta, C. Pinarel, M. Tiozzo)

It is possible to speak of a "settlement character" of the new facilities which result in a design and hierarchy of the open spaces, introducing new centralities such as the urban centre, the market areas connected to the production, processing and sale of the agricultural products with the relative classrooms and laboratories for professional training (agricultural centres), accommodation facilities in order to stimulate the development of tourism thanks to the presence of the Pendjari Park. The typology of the buildings is often the result of the hybridization of living places and collective spaces, since there is not much difference between domestic architecture and big complexes dedicated to sacred or civil uses in African culture. The proposed solutions for the urban centre (Figure 5, 6), seen as a place for meetings and education, provide a complex of buildings housing rooms for teaching, a library open to the city, educational workshops linked to the presence of vegetable gardens, places for the sale of products, and a canteen. The most important aspect is the relationship between the various parts of the buildings, since the shape of the complex, as suggested by the study of the traditional houses of Tatasomba, is secondary.

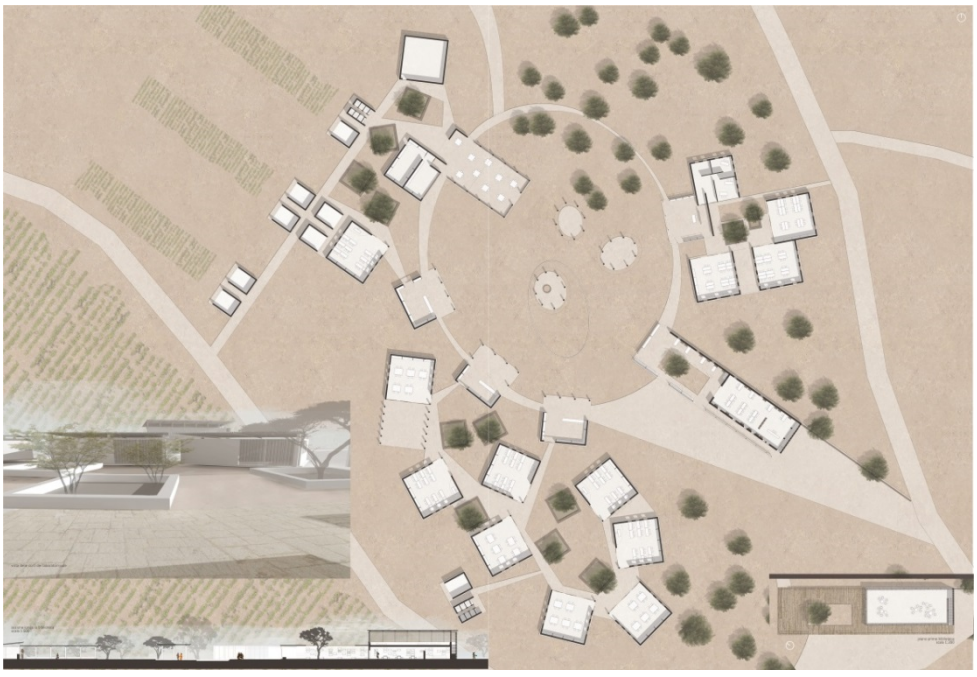


Figure 5: Urban centre: general site plan (project by G. Marchetto, G. Morrone)

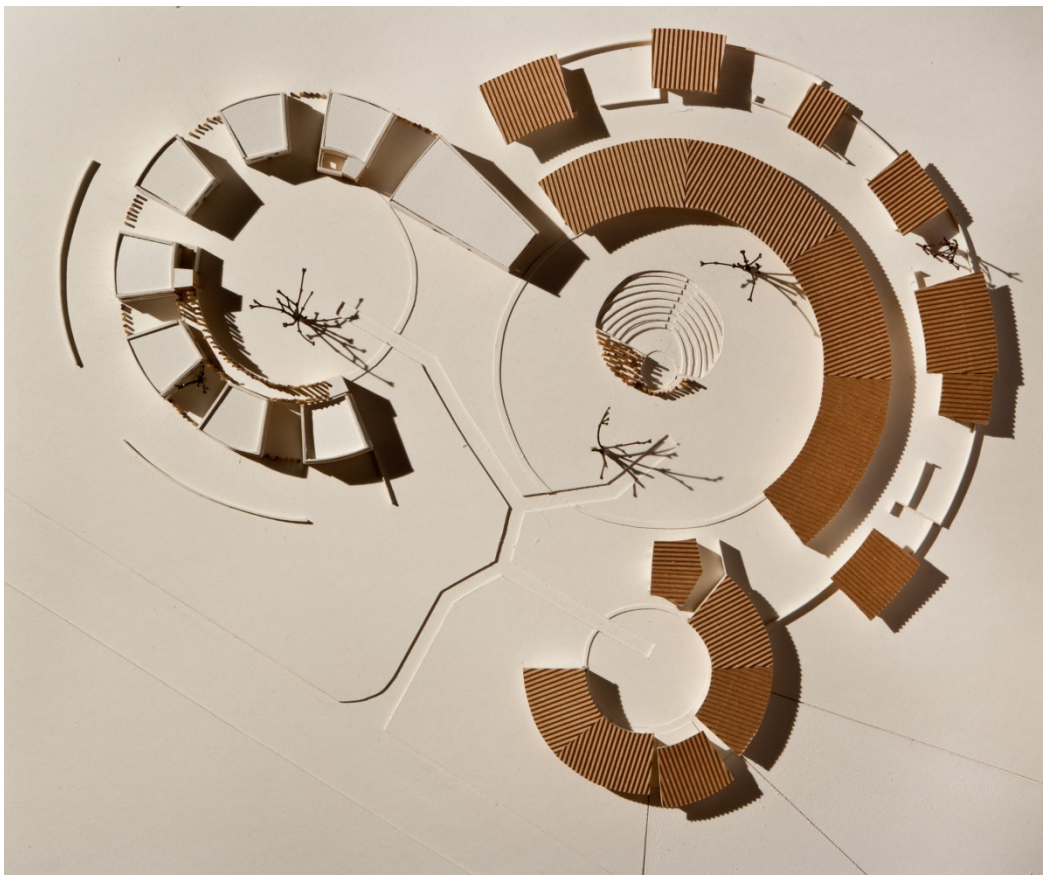


Figure 6: Urban centre: model of general site plan (project by G. Bolzanella, M. Polato)

In the projects for the agricultural cooperation centres (Figure 7) the scale has to be urban: if the housing unit is the module of the settlement system, with its dimensions the field regulates the planning of the ground on a territorial scale; if the courtyard in the urban nucleus is the fulcrum for family life, in the public space of the agricultural centre it becomes the meeting place where study spaces (training laboratories, classroom), and work spaces (greenhouses, craftsmen workshops, small craftsmen workshops for the transformation of products such as milk, sales points).
The space dedicated to the production, the processing and the storage of raw materials will be placed in an area near the field directly in contact with the market for the selling of agricultural products.

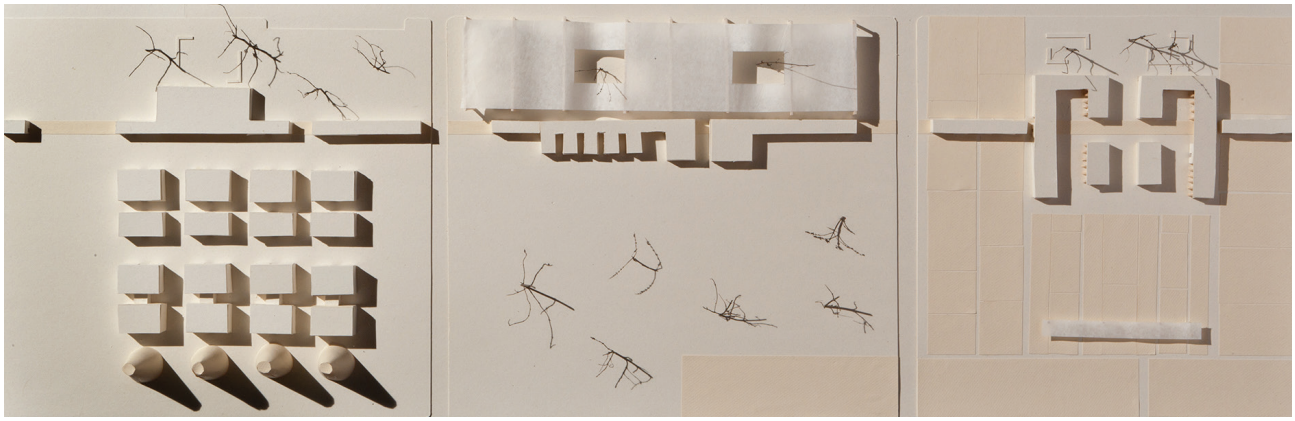


Figure 7: Farm centre: model of general site plan (project by L. Dilorenzo, S. Tonetto)

The objective is creating an agricultural plan that corresponds to African resources and requirements.
The main strategy behind all these projects is the stimulation of an eco-sustainable agriculture and preservation of the rural characteristics - still very frequent in Matéri - integrating them with the emerging urban characters.
The purpose of the integration of different forms of social-economics and spatial organization has two goals: on the one hand, to support the modernization of the urban structure, and on the other hand, through the creation of local micro-chains and the education of the new generations, to trigger a mechanism able to generate profit and guarantee the subsistence of the population.

Conclusion

It is obvious that in many countries in Sub-Saharan Africa a development in the urban systems is underway that is affecting not only the large cities but also an increasing numbers of small and average-sized rural centres.
From its very beginnings, the Matèri Administration's objective has been evident in its town plan: making Matèri as modern as possible, concentrating in particular on expansion and improving the infrastructures of the existing nuclei and the addition of new collective activities, in accordance with a particular plan of the settlement area.
The proposals that the Atelier put forward strived to give a concrete response to these needs, suggesting not only planning strategies (new ways of land use, possible living models in which modernity and the traditional co-exist), but also by proposing concrete sustainable projects based on strategies that are suitable to the context with the materials they use and renewable energy sources, the feasibility of which was recognised by the local Administration during meetings *in loco*.
Interest in the research of new models of urban development in a rural context has been, in addition to the exploration of the research topics with strong spatial implications, the verification of ways in which such interventions could become the engines of a sustainable transformation of the territory, generators of new centralities and of the quality of living.
The research is supported by broader paradigms within which the relationship between urban-rural, density-dispersion and tradition-innovation are located.

References

Arecchi, A., Abitare in Africa: architetture, villaggi e città nell'Africa subsahariana dal passato al presente. Mimesis Liutprand, Milano, 1998.
Arecchi, A., La casa africana. CLESAV Citta Studi, Milano, 1991.
Baker, J., Small town Africa, Studies in Rural-Urban Interaction. The Scandinavian Institute of African Studies, Uppsala, 1990.
Danby, M., in Kaj Blegrad Anderson, African Traditional Architecture: A Study of the Housing and Settlement Patterns of Rural Kenya. Oxford University Press, New York, 1977.
Fassassi, M. A., L'architecture en Afrique noire. Cosmoarchitecture. L'Harmattan, Paris, 1978.
Piot, C., Remotely Global: Village Modernities in West Africa. The University of Chicago Press, Chicago and London, 1999.
Labelle Prussin, An Introduction to Indigenous African Architecture, in The Journal of the Society of Architectural Historians, vol. 33, issue 3, 1974.
Preston Blier, S., The anatomy of architecture. Ontology and metaphor in Batammaliba architectural expression. The University of Chicago Press, Chicago and London, 1987.
International Fund for Agricultural Development (IFAD), Rural Poverty Report 2011. IFAD, Roma, 2011.
Republique du Bénin, Department du l'Atacora, Commune de Matéri, 2010. Plan de developpement de la Commune de Matéri. PDC. Matéri.

Republique du Bénin, Department du l'Atacora, Commune de Matéri, Schema directeur d'amenagement de la Commune de Matéri. SDAC. Commune de Matéri, 2010.
Sinou, A., Poinsot J., Sternadel J., 1989. Les villes d'Afrique noire: politiques et operations d'urbanisme et d'habitat entre 1650 et 1960. Orstom/ACA, Ministère de la Coopération et du développement, La Documentation Française, coll. Analyse de documents, Paris, 1989.
Sinou, A., Poinsot, J., Sternadel, J., Les villes d'Afrique noire: politiques et operations d'urbanisme et d'habitat entre 1650 et 1960. Orstom/ACA, Paris, 1989.
United Nations Human Settlements Programme (UN-Habitat), The State of African Cities 2014, Re-imagining sustainable urban transitions. UN-Habitat, Kenya, 2014.
https://maps.google.it/, October 2014

Teacher Support Materials (TSM) for the Design and Conduct of Science Investigatory Projects (SIP)

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Abstract

The study designed, developed and validated Teacher Support Materials (TSM) for the design and conduct of Science Investigatory Projects (SIP) in Schools Division of Bukidnon. Research and Development (R&D) design was used which follows four stages: (1) design stage, (2) writing stage, (3) validation stage, and (4) revision stage. The Task Analysis Chart (TAC) guided the planning and preparation of the content topics in the teacher support material and sample lessons. The teacher support materials were validated by the panel of experts using the criteria for evaluation specifically for the content and content accuracy, clarity, and appropriateness. The findings of the study revealed that the provisions in the criteria were satisfied very adequately for content and content accuracy, clarity, and appropriateness of the material. As rated by teacher-users, the material was very much acceptable, applicable, and useful. The feedback given by the panel of experts together with the thesis committee members and teacher-users became the bases for refining and finalizing the material. The use of TSM guides the science teachers in their quest in improving science education by religiously conducting Investigatory Project in the sciences that would enhance inquiry skills and values for lifelong learning among students.

Keywords and phrases: Development and validation of Teacher Support Materials (TSM), Science Investigatory Projects (SIP), Research and Development (R&D)

Introduction

Instructional materials are widely used in schools to deliver effective teaching and better learning process among the students. Teachers in the field ensure to provide the most effective learning tools for all students. Teacher support materials for teaching instruction could help a lot to enhance not only the skills and knowledge of the students but also to support teachers deliver effective science teaching and learning. Science teachers prefer to make their own teaching materials that would really suit to the levels of their learners and address the problems encountered by teachers in science education. Instructional materials mostly made by teachers are specific, practical, and relevant to the learners.

The support materials are designed for students who are in need of an intensive learning care of the teachers. These materials are carefully planned and developed in order to promote better and successful learning outcomes among the students. These are the product

of teachers' being creative and innovative in their own field of specialization to attain optimum learning to their students.

Instructional materials enhance quality learning interaction in the classroom environment particularly in writing research and Science Investigatory Projects (DepEd Memo. No. 99 & 359, s. 2010). As prescribed by the DepEd Memorandum, science teachers are required to design and develop teaching materials that would facilitate effective science teaching most especially in writing research and making investigatory projects as one of the DepEd thrusts. The Bureau of Secondary Education-Science Education Institute (BSE-SEI) stressed that designing and conducting investigatory projects in science classes help to promote better achievement of students in science, and hasten the production of best student-researchers who can even compete up to the international level. Investigatory projects in the field of sciences develop the young minds to become creative, imaginative, and resourceful.

Science Investigatory Project (SIP) is a planned undertaking in a particular field of science like Biology, Chemistry, Physics, Mathematics or Technology involving a problem and calling for creative and critical thought and action which apply scientific principles or ideas. As claimed by Maminta (2002) interest in and appreciation of science can be stimulated through undertaking Science Investigatory Project (SIP).

With that view and consideration, the Department of Education (DepEd) through the Bureau of Secondary Education (BSE) aims to promote Science & Technology consciousness among the youth through the exhibition of Science Investigatory or Research Projects. Ultimately, it seeks to identify the best and the most creative among the science-inclined & technology conscious students who can ably represent the country in various international science competition. Entries are grouped into (2) major divisions: Fair 1 – Biological Science & Fair 2 – Physical Science.

In the Division of Bukidnon, secondary level, it was found out that only few from all districts produced a national representative for the national level competition in school year 2008-2012. National representatives were first place winners in the different fair categories and fair divisions at the regional level Science and Technology Fair. It is noted that no one from the districts in the Division of Bukidnon made it to the National level in school year 2010-2011. Hence, even if the thrust had been fully implemented through Science Fairs that feature Science Investigatory Projects (SIP) presentation, it has been observed that only few schools participated in the said competition.

Results of the baseline survey conducted to all science teachers in Pangantucan and Kalilangan districts revealed that teachers have neither favorable nor unfavorable attitude in designing and conducting Science Investigatory Project. They lack the skills, competence, trainings, and seminar-workshops to teach the conduct of Science Investigatory Projects (SIP). In addition, there were no specific teaching guides or manuals, and instructional materials that would help the teachers in designing and conducting Science Investigatory Project in teaching science and for the students to become motivated in making research investigations.

For this reason, the researcher realized the need to develop teacher support materials that would guide the science teachers and motivate high school students to make a series of investigations and come up with excellent investigative reports. This teacher support materials contained sample lessons adopting teaching approaches integrating inquiry skills and values in science, and different parts of conducting research investigations as prescribed by DepEd Memorandum No.190, s.2011. Moreover, the sample lessons are for different year levels in favor for both biological and physical science teacher-users.

The development of teacher support materials for the design and conduct of Science Investigatory Project (SIP) is anchored on the instructional design theories of Merrill (1937)

& Glaser (1976), and the concepts of Research and Development (R&D) model (Alberto, 2002).

Merrill (1937) stressed that instructional design is a set of systematic procedures for the development of instructional materials. These materials aid the teachers in making lessons clear, simple, illustrative and varied. These include variety of modes in presentation such as enrichment, reinforcement, support materials and many others. Instructional materials could be written, manipulative or visual form. The teacher support materials such as workbooks, manuals, modules, guides, and resource books are written forms of teaching materials.

As emphasized by Glaser (1976), the fundamental purpose of a design science of instruction is improving the quality of instruction, and this can be done through two basic activities: instructional development and instructional evaluation. Both of these activities can be conceptualized as having three major phases: (1) design is the blueprint for an instructional developer or evaluator, (2) production, which is the actual making of an instructional or evaluation program, and (3) validation, which is the testing of how good that instrument.

Pursuant to DepEd Memo. No.99, s.2010, science educators should develop instructional materials to enhance quality learning interaction in the classroom. Teachers should enhance their skills in managing change in the classroom instruction enable to meet the everyday challenge to facilitate lifelong learning among the students. It is supported with DepEd Memorandum No. 359, s.2010 which emphasized on the development of teaching materials that would guide the in-service teachers in science teaching most especially in the aspect of writing research and science investigatory projects.

Research and Development (R&D) model of Alberto (2002) was used in the development of teacher support materials for the design and conduct of science investigatory projects. It contains the following stages: (1) design stage, which is preparation of Task Analysis Chart (TAC) of teacher support materials and sample lessons, (2) writing stage, the actual making of the parts of teacher support materials, (3) validation stage, which is evaluation of teacher support materials by the panel of experts and teacher-users, and (4) revision stage, the revision of materials based from the comments and feedback from the experts and teacher-users.

The Figure 1 shows the conceptual model of the study. It consists of two boxes. The left box reveals the instructional design theories and R & D model as the bases for the development of teacher support materials. It was anchored on the theories of Merrill (1937) and Glaser (1976). The R & D model of Alberto (2002) follows four stages of development such as design stage, writing stage, validation stage, and revision stage. On the other hand, the right box shows the development and validation of teacher support materials which integrate inquiry skills and values in science. This focused on the teaching approaches such as inquiry approach, project-based learning, practical work approach, cooperative learning, and discovery approach. The sample lessons and parts of science investigatory projects as prescribed by DepEd Memo.No.190, s. 2011 were also included in this box.

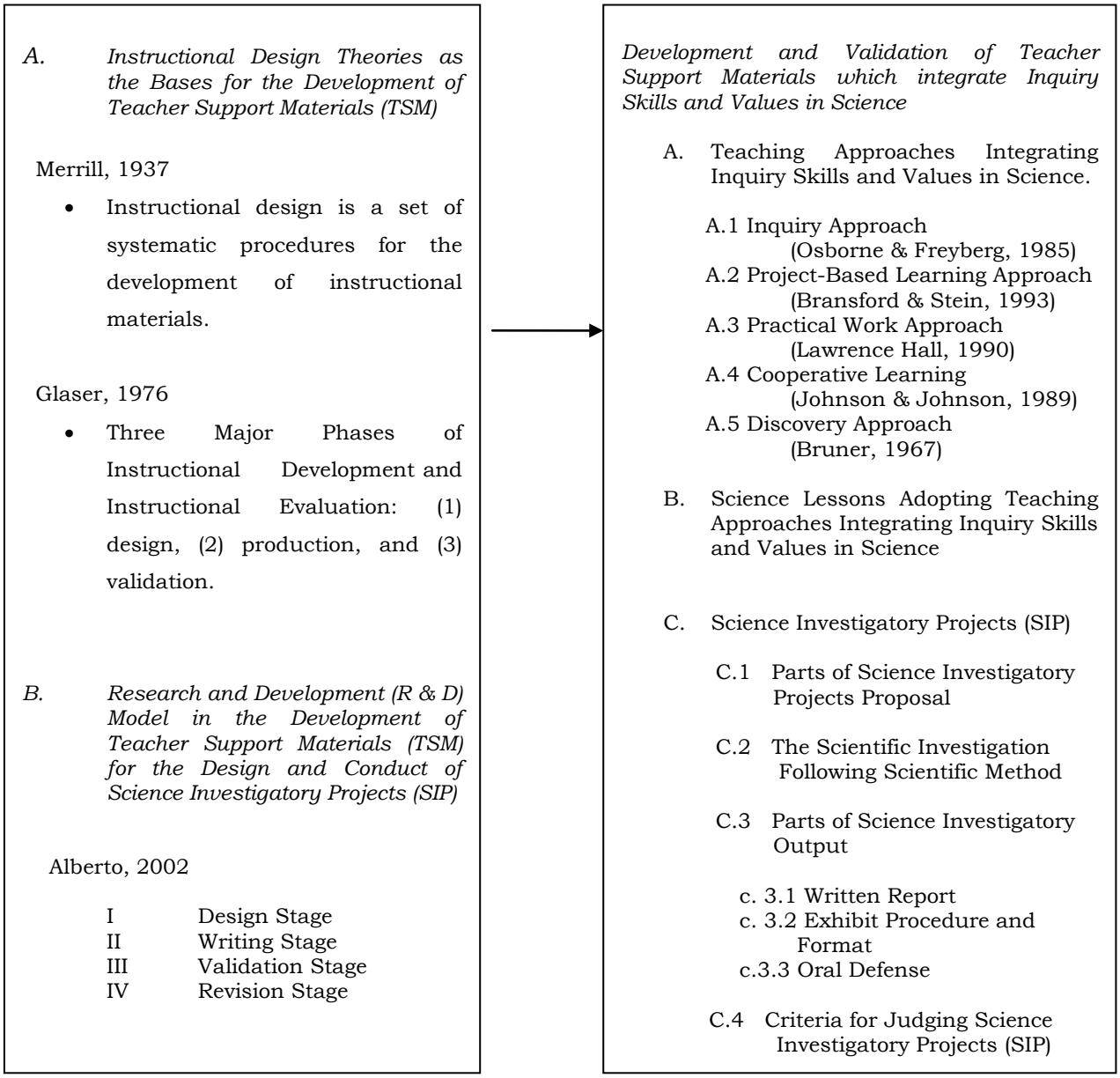


Figure 1. The Conceptual Model in Developing Teacher Support Materials (TSM) for the Design and Conduct of Science Investigatory Projects (SIP).

Statement of the Problem

The study intends to find answers to the following questions: (1) How can Teacher Support Materials (TSM) for the design and conduct of Science Investigatory Project (SIP) be designed?, (2) How can Teacher Support Materials (TSM) for the design and conduct of Science Investigatory Projects (SIP) be developed?, and (3) How can the Teacher Support Materials (TSM) be evaluated from the feedback of experts and teacher-users and to be revised in the final form?

The main objective was to design, develop and validate Teacher Support Materials (TSM) for the Design and Conduct Science Investigatory Projects (SIP) for the Schools Division of Bukidnon for School Year 2011-2012.

With this study, the writer aimed to:

1. design Teacher Support Materials (TSM) for the design and conduct of the Science Investigatory Projects (SIP).
2. develop Teacher Support Materials (TSM) for the design and conduct of the Science Investigatory Projects (SIP) integrating teaching approaches with sample lessons which integrate inquiry skills and values in science.
3. evaluate Teacher Support Materials (TSM) for the design and conduct of Science Investigatory Projects (SIP) from the feedback of experts and teacher-users and to be revised in the final form.

Research Methodology

The study was conducted during the school year 2011-2012 to the biological and physical science teachers in the Schools Division of Bukidnon. Research and Development (R&D) model of Alberto (2002) was used in developing and validating the teacher support materials for the design and conduct of Science Investigatory Projects (SIP). The different stages were as follows: (1) design stage, that includes Task Analysis Chart (TAC) preparation of Teacher Support Materials (TSM) and Task Analysis Chart (TAC) preparation of sample lessons, (2) writing stage, which includes writing the parts of Teacher Support Materials (TSM), (3) validation stage includes evaluation of teacher support materials by the panel of experts and teacher-users, and (4) revision stage, which highlights on the revision of teacher support materials based on the comments , suggestions, and feedback from the panel of experts and teacher-users.

The responses from the evaluation given by the panel of experts and teacher-users were utilized in making decisions as to whether revisions would be made on the teacher support materials for the design and conduct of science investigatory projects. The interpretation scale for responses of the experts and teacher-users was adopted from Sabacahan (2002).

The quantitative and qualitative responses of the panel of experts and teacher-users were tabulated, analyzed and interpreted. The mean and standard deviation were computed statistically using the Minitab software to determine the content and content accuracy, clarity, appropriateness, acceptability, applicability, and usefulness of the teacher support materials for the design and conduct of science investigatory projects. An interpretation scale was used to interpret the responses as adequate or not adequate provision of the particular features.

Results and Discussion

This section presents the results of the design, writing, validation and revision stages of the developed teacher support materials for the design and conduct of Science Investigatory Project (SIP). The presentation of results is done by parts. The part 1 reveals the design of the Teacher Support Materials (TSM), part 2 highlights the actual making on the content parts of the material, part 3 shows the results made by the panel of experts and teacher-users, and part 4 stresses the revisions made based from the comments, suggestions, and recommendations of the panel of experts, teacher-users and thesis committee members.

The Design of Teacher Support Materials

Results of the baseline survey conducted to all science teachers in Pangantucan and Kalilangan districts revealed that secondary school teachers have neither favorable nor

unfavorable attitude in conducting Science Investigatory Project. They lack the skills, competence, trainings, and seminar –workshops to teach the conduct of Science Investigatory Projects (SIP). In addition, there were no specific teaching guides or manuals, and instructional materials that would help the teachers in designing and conducting Science Investigatory Project in teaching science and for the students to become motivated in making research investigations.

With these reasons, the researcher designed, developed, and validated teacher support materials that guide the science teachers and motivate high school students to make a series of investigations and come up with excellent investigative reports. Research and Development (R&D) model of Alberto (2002) was used in developing and validating the teacher support materials for the design and conduct of Science Investigatory Projects (SIP). The R&D model followed four stages of development such as, design stage, writing stage, validation stage, and revision stage.

The design stage included Task Analysis Chart (TAC) preparation of Teacher Support Materials (TSM) and sample lessons, writing the outline of the materials, and identifying the parts of the teacher support materials. The Task Analysis Chart (TAC) was used as guide in the development of the teacher support materials and sample of investigative lessons in designing and conducting science investigatory projects. The contents of the material were carefully designed based on the current needs of science teachers and students in making research investigations and producing excellent research output in science subjects. The materials addressed the problems of teachers in designing and conducting investigatory projects in science classes due to lack of teaching guides and strategies. The developed material was considered to be simple, practical, and relevant to the users.

The concepts in developing the teacher support materials for the design and conduct of Science Investigatory Projects (SIP) were based from instructional design theories, R&D models, and other related studies. In addition, the readings taken from different sources of information like DepEd Memorandum, DepEd Order, DepEd Annual Reports Magazine, DepEd Online Articles and many others contributed a lot in building up the concepts of the present study.

The researcher reviewed different science activities from Science and Technology textbooks, science modules, science manuals, science oriented internet sites, and other references enable to develop very good sample of investigative lessons adopting different teaching approaches that enhance investigative task that is fun, enjoyable, simple, practical, and very interactive to develop lifelong skills and values among the students.

The writing of the outline and identifying the parts of the material were based from the developed Task Analysis Chart (TAC), as shown in appendix A. The material contained introduction which stressed the importance and significance of the constructed teacher support materials to address problems encountered by science teachers in designing and conducting investigatory projects. The instructions on how to use the material were clearly stated. In packette 1, there were five teaching approaches with sample of investigative lessons integrating inquiry skills and values in science, and packette 2 stressed the preparations in designing and conducting Science Investigatory Projects (SIP).

Moreover, the sample lessons contained the kind of teaching approach, instruction for the users, objectives, learning activities, evaluation, and agreement that emphasized investigatory projects. All these highlighted the relevance of the material in acquiring and applying the basic principles, concepts, skills, and values in Science and Technology.

Development of the Teacher Support Materials (TSM)

The nature, feature, merits and procedures of the different teaching approaches were highlighted in the actual making of teacher support materials. In addition, the sample of

investigative lessons presented the title which gives the learner an instant grasp of the lesson and the time frame. The time frame emphasized the length of the lesson for every activity that the students performed.

The objectives of the lesson were specific, measurable, achievable, realistic, and time-based (SMART). Lessons would be attained most especially if there was maximum involvement and interaction of the students in the given hands-on, minds- on, and hearts-on tasks. The subject matter contained the topic references and possible materials that would be used in the activities. Next were the learning tasks that elaborate the series of activities designed for high school students. The discussion of the lesson, inquiry skills and values to be developed, generalization, valuing /application, assessment and agreement (investigatory research -an extension work) were also included in writing the material.

The content topics and lessons were properly selected and developed so that it would be more investigative in nature on the part of the high school students and for them to become motivated in making science investigatory projects. Interesting lessons were developed in order to maximize the use of inquiry skills, local and community resources, and the formation of values among high school students. The format of the lessons was based on the kind of teaching approaches used in teaching Science Investigatory Projects (SIP).

The teacher support material in the study included relevant content topics which were divided into two packettes, namely: packette 1, the teaching approaches with sample of investigative lessons in developing inquiry skills and integrating values in science; and packette 2, which includes preparation in the making of Science Investigatory Projects (SIP) as prescribed by the DepEd Memorandum No. 190, s. 2011. The parts of the Science Investigatory Projects (SIP) consist three phases. Phase1 (title proposal) includes problem, title, rationale, materials, procedure, implications, time table, budget, and proponents. On the other hand, phase 2 emphasizes the actual investigation following scientific method; while, phase 3 highlights the final output which categorizes into three, namely, the written report, exhibit procedure, oral defense, and criteria for judging.

The sample of investigative lessons adopting teaching approaches integrating inquiry skills and values in science was based from the instructional objectives and competencies of the Philippine Secondary Schools Learning Competencies (PSSLC) as prescribed by the Department of Education, Philippines. In, addition, it served as guide in writing the instructional objectives, concepts, and activities that guide the science teachers and motivate high schools students to make Science Investigatory Projects (SIP). The TAC of this study highlights the parts, content descriptions, investigative topics, concepts, objectives, values and inquiry skills to be developed, students' activities, time allotment and related references.

The topics of every sample lessons were based from the learning competencies known as Philippine Secondary Schools Learning Competencies (PSSLC) prescribed by the Department of Education. The chosen topics were investigative in nature and were taken from integrated science, biology, chemistry, and physics subjects so that biological and physical science teachers could use and later on develop lessons on their own adopting teaching approaches that integrate inquiry skills and values in science.

Sample of investigative lessons were as follows: Lesson 1- Simulating How Scientists Work: Identifying Variables (Integrated Science) , Lesson 2-Acids and Bases in Matter (Chemistry) , Lesson 3 –Preparation of Colloids (Chemistry), Lesson 4 - House Wiring and Electric Circuit (Physics) , and Lesson 5- Community Interaction : Terrarium Making (biology).

Validation of the Teacher Support Materials by Experts and Teacher-users

Evaluation by the Panel of Experts

The developed teacher support materials for the design and conduct of science investigatory projects were scrutinized by the panel of experts of Bukidnon State University, Malaybalay City, Bukidnon. The materials were validated based on its content and content accuracy, clarity, and appropriateness. The rating of the experts was the bases in revising and finalizing the whole content of the teacher support materials. Table 1-4 presented reveals the corresponding rating of the experts.

Table 1 presents the summary of means and standard deviations of the assessment of experts on the features of teacher support materials for the design and conduct of science investigatory projects. The data in Table 1 shows that the panel of experts strongly agreed that the features of teacher support materials, such as content and content accuracy, clarity, and appropriateness are satisfied very adequately. Thus, the researcher made no major revisions for the teacher support materials. The scores of the experts are closer to the mean, therefore, there is homogeneity of scores among the panel of experts.

Table 1
The Assessment of Experts on the Features of the Teacher Support Materials (TSM) for the Design and Conduct of Science Investigatory Projects (SIP)

Features	$\bar{x}$	s.d.	Interpretations
Content and Content Accuracy	3.62	0.50	provision is satisfied very adequately
Clarity	3.83	0.38	provision is satisfied very adequately
Appropriateness	3.57	0.51	provision is satisfied very adequately
Overall	3.68	0.47	provisions are satisfied very adequately

Legend: $\bar{x}$ = Mean
s.d. = Standard Deviation

The data suggests that the developed teacher support materials enhance the design and conduct of science investigatory projects. This would address the problems encountered by teachers in designing and conducting Science Investigatory Projects (SIP) due to lack of skills, competence, trainings, and most of all unavailability of teaching guides or manuals as revealed in the survey conducted by the author in 2010 which confirmed the findings of Maminta (2002).

The development of teacher support materials is supported by DepEd Memo. No.99 s.2010, which stressed that science educators should develop instructional materials to enhance quality learning interaction in the classroom. Teachers should enhance their skills in managing change in the classroom instruction most especially in the aspect of writing research and science investigatory projects as stated in DepEd Memorandum No. 359 s. 2010. It is in lined with DepEd Advisory No.403 & DepEd

Memo. No. 190, s. 2011, which highlighted the annual competition of Instructional Materials (IMs) teachers' category, and Science Investigatory Projects (SIP) students and teachers' category.

The annual national science quest and science and technology fair are programmed science activities of the Bureau of Secondary Education-Science Education Institute (BSE-SEI) of the Department of Education, which aimed to achieve the following objectives, such as, undertake science activities that enhance creativity, understanding and exchange novel ideas, provide an effective medium in the development of science and technology, instill in the minds of participants an atmosphere of sound competition, camaraderie and sportsmanship, and lastly give recognition to researchers. The awards received by the winners serve as their incentive for the quest to continue improving their talents and skills in the fields of Science and Technology.

Moreover, the R&D models of Alberto (2002) and Simbulan (2001) enlightened the writer on the development of teacher support materials for the design and conduct of investigatory projects, which contain sample of investigative lessons adopting teaching approaches integrating inquiry skills and values in science. Based on the insights gained from several studies conducted, there were three most important stages to consider in preparing teaching materials. These are development, validation, and application stages.

In Table 2, most of the panel of experts strongly agreed that content and content accuracy were very adequately provided in the developed teacher support materials. The scores of the experts are homogeneously distributed, thus, there is closer dispersion of the

Table 2
The Assessment of Experts on the Content and Content Accuracy of Teacher Support Materials (TSM)

Feature	$\bar{x}$	s.d.	Interpretations
A. Content and Content Accuracy			
1. Present subject matter content accurately	3.67	0.58	provision is satisfied very adequately
2. Utilize factual information in text	3.67	0.58	provision is satisfied very adequately
3. Present topics and information applicable to real life situation	3.67	0.58	provision is satisfied very adequately
4. Guide the teachers in the development of students 'Inquiry skills and values in science	3.67	0.58	provision is satisfied very adequately
5. Enable the teachers to use prior knowledge on the content of the material	3.33	0.58	provision is satisfied very adequately

6.	Help the teachers to integrate Science Investigatory Project (SIP) in their science classes	3.67	0.58	provision is satisfied very adequately
7.	Help the teachers think and make decisions on how to facilitate the conduct of SIP	3.67	0.58	provision is satisfied very adequately
	Overall	3.62	0.50	provisions are satisfied very adequately

Legend: $\bar{x}$ = Mean
s.d. = Standard Deviation

scores. The cluster mean shows that the provisions for content and content accuracy were satisfied very adequately.

This means that the content topics in the teacher support materials are presented accurately with respect to: a) presentation of subject matter, b) utilization of factual information, c) presentation of topics and information in practical lives, d) development of inquiry skills and values of students in science, e) utilization of teachers' prior knowledge with regard to the content of the material, and f) design and conduct of science investigatory projects.

The above findings support the study of Sabacahan (2002) in her Guided Discovery Laboratory Lessons that improved the higher order thinking skills among high school students. Manila (2005) on the development of lessons in physics using conceptual approach met the criteria of the evaluation and the materials are reliable in terms of content. The developed Conceptual Physics Lessons are perceived by the students as not difficult.

The teacher support materials enhanced the inquiry skills and values of students in science because it focused hands –on, minds - on and hearts – on activities. Similar to the Research and & Development (R&D) study of Visto (2000). This was on the development and validation of a workbook on selected mechanics problems in physics using explicit method of problem solving through modular approach of teaching revealed that the developed workbook met the criteria. The high school students were motivated to answer mechanics problems in Science and Technology IV using explicit method of problem solving.

The responses given by the panel of experts reveal that the clarity of materials was satisfied very adequately. It denotes that they strongly agreed to the features found in the teacher support materials in terms of clarity as supported in the cluster mean. However, two out of three experts agreed in item number 2 to have activities that are attainable within its time frame. Among the eight items evaluated, this one got the lowest mean which indicates that the writer should made improvements to enhance further the feature of the material.

As shown in Table 3, the developed teacher support materials are clear with respect to: a) organization and sequencing of learning activities, b) target time frame, c) development of questions, c) use of standard-sized print, d) using clear and simple language directions, e) consistency of activities with educational theories and principles, f) writing of text which is suitable to the users' comprehension level.

The responses of experts on clarity of the constructed materials suggested that the material was highly acceptable tool for learning

Table 3

Mean and Standard Deviation of the Assessment of Experts on the Clarity of Teacher Support Materials (TSM)

Feature	$\bar{x}$	s.d.	Interpretations
B. Clarity			
1. Provide learning activities that are well organized and well-sequenced	3.67	0.58	provision is satisfied very adequately
2. Have activities that are attainable within its time frame	3.33	0.58	provision is satisfied very adequately
3. Pose questions that are well-developed	4.00	0.00	provision is satisfied very adequately
4. Use clear and standard –sized print	3.67	0.58	provision is satisfied very adequately
5. Provide directions that are complete and written in clear and simple language	4.00	0.00	provision is satisfied very adequately
6. Provide directions that are clear and easy to follow	4.00	0.00	provision is satisfied very adequately
7. Provide activities that are consistent with educational theories and principles	4.00	0.00	provision is satisfied very adequately
8. Provide text which is suitable to the users' comprehension level	4.00	0.00	provision is satisfied very adequately
Overall	3.83	0.38	provisions are satisfied very adequately

Legend: $\bar{x}$ = Mean
s.d. = Standard Deviation

It attains with the concept of Simbulan (2001) which stressed that the development of material using R&D design includes writing of objectives, text, activities, and exercises, organizing of contents with clarity and proper sequencing using appropriate illustrations, and drawings. The writer should always consider the guides in writing the text and exercises. This is dynamic and evolving process, as it is evaluated, it constantly evolves –editing of the materials and evaluation of contents as to its suitability and effectiveness.

The findings support Alberto (1998) who claimed that Research and Development (R& D) is beneficial for teachers who wish to produce effective

teaching materials enable to facilitate best learning experience among students. Most often, these materials are intended to supplement or enhance the usual support materials in teaching, which include workbooks, modules, films, and others. Development, validation and application are the three most important methods in the preparation of materials.

The panel of experts strongly agreed that the appropriateness of the teacher support materials was very adequately provided. The scores of the evaluators were closer to the mean, therefore, there is homogeneity among the scores. This implies that with this material, the science teachers are guided in

Table 4
Mean and Standard Deviation of the Assessment of Experts on the Appropriateness of Teacher Support Materials (TSM)

Feature	$\bar{x}$	s.d.	Interpretations
C. Appropriateness			
1. Are well designed and suited for teachers' learning in making Science Investigatory Projects (SIP)	3.67	0.58	provision is satisfied very adequately
2. Can motivate teachers to guide students to learn about Science Investigatory Projects (SIP)	3.33	0.58	provision is satisfied very adequately
3. State directions at an appropriate level of difficulty	3.67	0.58	provision is satisfied very adequately
4. Promote active involvement and interaction	3.67	0.58	provision is satisfied very adequately
5. Help in enhancing conceptual understanding about Science Investigatory Projects (SIP)	3.67	0.58	provision is satisfied very adequately
6. Help in developing /enhancing teachers' skills in teaching science	3.33	0.58	provision is satisfied very adequately
7. Lead the teachers to integrate Science Investigatory Projects (SIP) in science classes	3.67	0.58	provision is satisfied very adequately
Overall	3.57	0.51	provisions are satisfied very adequately

Legend: $\bar{x}$ = Mean
s.d. = Standard Deviation

designing and conducting investigatory projects in their science classes.

Based on the responses of experts, the support materials aid the science teachers to design and conduct Science Investigatory Projects (SIP) as one of DepEd thrusts, which aimed to uplift the quality of science education in the country through facilitating students' to develop their inquiry skills and values in science for lifelong learning.

DepEd Memo. No.1 s. 2010, No. 224 s. 2008, and No. 299 & 309, s. 2001, emphasized intensive training and seminar workshops for all science teachers on the conduct of Science Investigatory Projects (SIP) in science curriculum. It stressed that the relevance of science teaching- learning processes and approaches would be further improved through integrating scientific technological research in Basic Science Education. DECS (1995), SEI (1992), Manual on Investigatory Projects for Science Club (1993), and Science Program in BEC (2002) stressed the penetration of Science Investigatory Projects (SIP) in science curriculum.

It is in Science Investigatory Projects (SIP) wherein Filipino learner gains a functional understanding of scientific concepts and principles linked with real-life situations, and acquire scientific skills, attitudes, and values necessary to analyze and solve day-to-day problems. Teachers facilitate students' investigations using a variety of media and resources available in school and community. The teaching learning process is interactive where learners, the teachers, instructional materials and information technology interact with one another.

As revealed by Cabaluna (2000), teachers often practiced and implemented science investigation. They often exercised their creativity, resourcefulness, and research skills but occasionally practiced exhibit and oral presentation. Pupils were average in performing science investigation, and using t-test and correlation, it was found out to be significant between pupil performance and teacher readiness.

Maminta (2002) pointed out administrators occasionally performed their roles in curriculum development, instructional improvement, pupil services, financial, and facility management and community relations in the conduct of investigatory projects of grade six pupils. However, pupils were occasionally able to do project planning, research processing, writing the report and presenting the project. As claimed by Paloma (1995), the principle of learning by doing guided the child to explore and discover especially in his environment through firsthand experience utilizing the intellectual skills of observation, description, comparison, measuring, classification, making inference and experimentation.

The common problems encountered by teachers in the conduct of investigatory projects were as follows: (1) lack of skills, competence, and training on the part of the teachers, (2) inadequate laboratory equipment and facilities, (3) lack of funds to support the conduct of the investigatory projects, (4) no available computer to be used for research, (5) difficulty in net surfing, and (6) difficulty in teaching investigatory projects due to unavailability of learning guides and manuals. Also, science teachers encountered difficulties in the following competencies: (1) Applying national and creative thinking process in searching for the solutions to problems, (2) demonstrate a functional understanding of the basic concepts, principles, and relationships applicable to a scientific study , and (3) manifest self-reliance, independence, patience and persistence in one's Science Investigatory Projects (SIP).

Evaluation by the Teacher-users

The researcher was able to distribute the instrument to the selected teacher-users in evaluating the teacher support material. The teacher-users assessment tool was administered to determine the acceptability, applicability, and usefulness of the teacher support material for the design and conduct of Science Investigatory Projects (SIP). The biological and physical science teachers were used as the try-out group. Teacher-users answered independently on every feature of the assessment. The data in Table 5 present the responses of the teacher-users.

Table 5
The Assessment of Teacher-users on the Features of Teacher Support Materials (TSM) for the Design and Conduct of Science Investigatory Projects (SIP)

Features	$\bar{x}$	s.d.	Description
On the material's acceptability	3.83	0.38	Very Much
On the material's applicability	3.78	0.42	Very Much
On the material's usefulness	3.70	0.46	Very Much
Overall	3.76	0.43	Very Much

Legend: $\bar{x}$ = Mean
s.d. = Standard Deviation

The Table 5 shows that the scores of the teachers-users were homogenously distributed; therefore, there was cluster of the scores around the mean. The data suggest positive responses of science teachers to the teacher support material for the design and conduct of science investigatory projects, which contained sample of investigative lessons adopting teaching approaches integrating inquiry skills and values in science. Teacher-users found the materials very much acceptable, applicable, and useful most especially in promoting and uplifting the quality of science education through implementing one of the most important DepEd thrusts, that is the religious and constant conduct of Science Investigatory Projects (SIP) in all science classes both elementary and secondary schools in the Philippines as stipulated in the DepEd Memoranda.

As asserted by Carin & Sund (1985), the science educators must shift from a traditional way of teaching to a more innovative way, such that they must not only teach factual knowledge but should also work towards the development of the students' inquiry skills. Hence, the principle of learning by doing guided the child to explore and discover especially in his environment through firsthand experience utilizing the intellectual skills of observation, description, comparison, measuring, classification, making inference and experimentation (Paloma, 1995),.

McConnel (2000) claimed that the opportunities for students to carry out scientific/technological research would be through investigatory projects to explore the mysteries and marvels of the world. Teachers should play the roles as facilitators and guide to scaffold student's problem-solving abilities in a social constructivist learning environment. As stated by Lawson (1995), the major objectives of effective science teaching are to help students to develop creative and critical thinking skills, construct understanding of the major conceptual thoughts, and develop the self-confidence to pose questions and problems to seek answers and solutions.

In Table 6, most of the biological and physical science teacher-users rated the material as very much acceptable. There were high ratings in items 1 and 4. The materials were interesting and teachers would appreciate teaching and conducting Science Investigatory Projects (SIP) through the use of the constructed and validated teacher support materials. The science teachers found the materials very much acceptable. It shows that teachers favored mostly in the development of the material which prepare students to develop inquiry skills and values in science that are very much needed not only for their investigatory projects but for solving real life problems as well.

Table 6
The Assessment of Teacher-users on the Acceptability of Teacher Support Materials (TSM)

Feature	$\bar{x}$	s.d.	Description
A. On the material's acceptability			
1. I find the teacher support materials interesting.	3.85	0.37	Very Much
2. I am motivated to teach and integrate SIP in Science Classes with the help of teacher support materials.	3.75	0.44	Very Much
3. I am willing to teach Science Investigatory Project using the teacher support materials.	3.75	0.44	Very Much
4. I appreciate teaching and integrating SIP through the use of the teacher support materials.	3.95	0.22	Very Much
Overall	3.83	0.38	Very Much

Legend: $\bar{x}$ = Mean
s.d. = Standard Deviation

The study of Felisilda (2010) revealed that the teachers often used variety of teaching approaches in teaching investigatory projects. These teaching approaches used by teachers to motivate and encourage pupils to conduct investigatory projects. NAP (1996) & BEC (2002) suggested inquiry approach in teaching for students' gain better understanding of the world , while the NSES (2009) mandated that science teachers should develop an inquiry-based program enable students to engage real life situations that promote best learning experience.

Similar studies of Allen (1997), Belgira (2000), and Alcontin (2003) on the effects of inquiry laboratory activities and designing laboratory activities to develop inquiry skills of students. The study showed inquiry approach in science teaching uplift the inquiry skills of the high school students. The concepts of Johnson and Johnson (1988), and Kagan (1994) focused on the great impact of cooperative learning in science education that promotes best academic performance among students.

Mayer (2003) and Gallenstein (2004) emphasized that using the discovery approach of teaching in the learning process helped to motivate students in making investigatory projects in science classes. As supported in the study of Khan (2002), discovery approach in science teaching led to the development of inquiry skills among high school students, which is similarly the same concept to the present study in designing and conducting investigations integrating different approaches to facilitate best learning experience of students.

The science teachers found the material very much applicable in designing and conducting Science Investigatory Projects (SIP) in teaching science. The teachers

agreed that the feature of materials were applicable and attainable, could be applied in real life situations, and could facilitate meaningful learning experiences among students. Conducting Science Investigatory Projects (SIP) as an agreement in the lesson is a great challenge to the students. Thus, the teacher support materials encouraged and motivated the science teachers to change from traditional "dispenser of knowledge" to that of a "facilitator of learning".

Table 7
The Assessment of Teacher-users on the Applicability of Teacher Support Materials (TSM)

Feature	$\bar{x}$	s.d.	Description
B. On the material's applicability			
1. The teacher support materials are attainable.	3.65	0.49	Very Much
2. The learning activities in the teacher support materials can facilitate meaningful learning	3.85	0.37	Very Much
3. The teacher support materials can be applied to real life situations.	3.85	0.37	Very Much
Overall	3.78	0.42	Very Much

Legend: $\bar{x}$ = Mean
s.d. = Standard Deviation

National Educators Academy of the Philippines (2010), Millar (2004), UP-NISMED (1998), Ostlund (1998), Lawrence Hall of Science (1990), and Jakeways (1986) emphasized the relevance of practical work approach in science teaching to develop hands-on, minds-on and hearts on activities in the learning process to attain best learning experience of students. The clarity of objectives in practical work approach should be considered to attain better academic performance of students as emphasized by Millar and Abrahams (2009).

The studies on practical work approach of Loreno (2001) and Rabago (2003) stressed that this approach could provide the learners interest and brings out the best of their potentials. It could be used as supplementary to the traditional lecture-discussion method of teaching research investigations in teaching science. Moreover, the study of Thomas (2000) found some evidence that project based approach in teaching enhances the quality of student learning compared with other instructional methods. He also cited evidence that project-based learning is effective for teaching processes such as problem solving and decision making, but much of this research lacked comparisons with other methods.

In addition, National Academy of Sciences (2004), Falik (2002), and David (2008) highlighted the fact that project-based approach of teaching created constructivist learning environment in which students' construct their own knowledge as they continue to encounter real-world problems.

The usefulness of the teacher support materials for the design and conduct of science investigatory project in science classes is reflected in category c items 1 to 5. It is noted that teachers agreed that the materials were useful. It shows that the teacher support materials enhanced the development of students' inquiry skills or science process skills and thinking skills among students. The developed material encouraged teachers in the field to develop their own investigative lessons integrating inquiry skills and values in science that lead to the development of Science Investigatory Project (SIP).

The ratings as shown in Table 8 indicate that the contents in the teacher support materials such as the five teaching approaches , sample of investigative lessons , and the description on the different parts in making investigatory projects were very much useful for the science teacher-users. With this, there were only slight revisions made on the different parts of the material particularly on the sample of investigative lessons adopting teaching approaches which integrate inquiry skills and values of students. The complete parts with descriptions in making investigatory projects could be a big help especially for beginner

Table 8
The Assessment of Teacher-users on the Usefulness of Teacher Support Materials (TSM)

Feature	$\bar{x}$	s.d.	Description
C. On the material's usefulness			
1. The teacher support materials can enhance the development of students' inquiry skills or science process skills and critical thinking skills.	4.00	0.00	Very Much
2. The teacher support materials can bring out students' prior knowledge in making of SIP	3.80	0.41	Very Much
3. The learning activities in the teacher support materials encourage active participation among students in making Science Investigatory Project(SIP).	3.55	0.51	Very Much
4. The activities in the sample lessons of the teacher support materials can be carried out by students with little teacher's supervision.	3.40	0.50	Very Much
5. I am challenged to develop my own investigative lessons integrating inquiry skills and values in science that lead to the development of Science Investigatory Project (SIP).	3.75	0.44	Very Much
Overall	3.70	0.46	Very Much

Legend: $\bar{x}$ = Mean
s.d. = Standard Deviation

teachers in conducting science investigatory projects in their science classes.

In general, the features of the teacher support materials were very much useful specifically in designing and conducting science investigatory projects in science classes. The contents of the teacher support material could bring out teachers' and students' prior knowledge in making science investigatory projects. It gives proper direction for teachers in making investigative lessons that would develop inquiry skills and values of students especially in the learning process.

Revisions on the Teacher Support Materials (TSM)

The qualitative comments and suggestions from the panel of experts and teacher-users were given consideration most especially in revising and finalizing the contents of the material. There were some phrases in the texts edited, added, replaced and restated. Other thesis committee members added significant statements. The original and revised texts of the teacher support materials are as follows:

Draft 1. Qualitative comments and revisions on the Teacher Support materials.

Title of the material

Original text: Intervention Materials for Integrating Science Investigatory Projects (SIP) in Science Classes.
Revised text : Teacher Support Materials (TSM) for the Design and Conduct of Science Investigatory Projects (SIP)

The experts and thesis committee members agreed that the instructional material made by the writer was the Teacher Support Materials (TSM) for the Design and Conduct of Science Investigatory Projects (SIP). The material was appropriate to be called teacher support materials rather than intervention materials based on the nature and content of the constructed materials.

Teaching approach

Original text: Involvement in learning implies possessing skills and attitudes that permit you to seek resolutions to questions and issues while you construct new knowledge.
Revised text: Involvement in learning implies possessing inquiry skills and values that permit students to seek solutions to questions and issues in science and technology.

Revision of statements was made in the Teacher Support Materials for the Design and Conduct of Science Investigatory Projects so that it would be more accurate, directive, and easy to understand by the teacher- users.

Original text:	Variables are the factors that are studied in an investigation. 1. The independent variable is the one that is manipulated or changed. 2. The dependent variable is that which responds to the change. Other variables are held constant. 3. Only one variable should be manipulated or changed at any one time. 4. The responding variable should be measured.
Revised text:	Variables are factors studied in an investigation. • Independent variable is the manipulated or changed variable. Only one variable should be manipulated or changed at any one time. • Dependent variable responds to the change. • Other variables are held constant. • Responding variable should be measured.

concepts particularly in the sample of investigative lessons, and synthesizing the concept statements into a clear and simple language that would be suitable to the comprehension level of the users.

Other Comments and suggestions from the panel of experts, teacher-users, and thesis committee members

1. Author's name is too scattered. There is no need to put high school science teacher and Division of Bukidnon. Indicate the year of development.
2. The illustrations were too crowded. It loses the essence of the cover.
3. Follow the correct technical format like contents, not table of contents because there was no table. The contents were too crowded. Pagination could be moved further to the right. The spacing could be improved.
4. The material should have a foreword to indicate what is this material about, for whom is this addressed, what are its contents, who will use it, how was the materials organized, and why the lessons are for different year levels.
5. Some of the contents in the rationale are for the foreword. Separate the rationale from the foreword.
6. References would be very essential which discussions are taken from sources. Cite references in the end of every materials / strategy discussed.
7. Use American Psychological Association (APA) format in writing the references.
8. Include more graphics and pictures to make it more attractive.
9. Use Times New Roman font 12 for the print size, there is a need to improve presentations especially when illustrations are to be inserted. Avoid crowding of word-text. It would not appear friendly for users.
10. Materials on descriptions / discussions of the strategies could be improved to make this motivating for teachers. Some would not like to read "heavy reading" to study their text, instead they would rather want to read the essentials in bullet form with brief discussions.

Teachers being the molders of the youth and building the builders of the nation should be creative, innovative and resourceful in order to meet the demands of quality science education in the country today.

Findings, Conclusions and Recommendations

Findings

Major findings of this study are summarized as follows:

1. The Task Analysis Chart (TAC) was used in designing Teacher Support Materials (TSM) for the design and conduct of Science Investigatory Projects (SIP).
2. The Research and Development (R & D) model of Alberto (2002) was adopted in the development of Teacher Support Materials (TSM) for the design and conduct of Science Investigatory Projects (SIP).
3. The Teacher Support Materials (TSM) provided very adequately for content and content accuracy, clarity, and appropriateness, as evaluated by the experts.
4. The teacher-users evaluated that the teacher support material was very much acceptable, applicable, and useful.
5. The feedback given by the panel of experts together with the thesis committee members and teacher-users were the bases for refining and finalizing the teacher support materials.

Conclusions

The conclusions were drawn based on the findings of the study:

1. The Task Analysis Chart (TAC) and R & D model of Alberto (2002) were very much useful in the design and development of Teacher Support Materials (TSM) for the design and conduct of Science Investigatory Projects (SIP).
2. The teacher support materials were acceptable, applicable, and useful for the design and conduct of Science Investigatory Projects (SIP) in science classes.
3. The constant use of teacher support material could guide the science teachers in their quest in improving science education by religiously designing and conducting Science Investigatory Project (SIP) in teaching high school sciences that would enhance inquiry skills and values for life long and best learning among the high school students.

Recommendations

Based on the conclusions, the following are recommended:

1. The secondary school science teachers could use the developed and validated teacher support materials for the design and conduct of Science Investigatory Projects (SIP) to facilitate best learning experience in conducting research investigations.
2. Science supervisors and school administrators could recommend the use of this teacher support material most especially to science teachers who encountered difficulties in teaching research investigatory projects to their students.
4. Science teachers could develop investigative lessons adopting different teaching approaches that enhance inquiry skills and values in science.
5. There could be further study to test the effectiveness of this Teacher Support Materials (TSM) in the conduct of Science Investigatory Projects (SIP).

References

Alberto, V.P. (2002). Nothing sensational! A compendium of monographs on teaching activities, lessons, and assessment forms in science. Bukidnon State College, Malaybalay City, Bukidnon.

Alberto, V.P.(2002). Self-Instructional modules in General Zoology for college freshmen. Bukidnon State College, Malaybalay City.

Alberto, V.P. (1998). Improving teaching competencies: A handbook for preservice and inservice science teachers. Bukidnon State College, Malaybalay, Bukidnon.

Alberto, V.P (1997). Evaluation criteria for teacher-made instructional materials. Unpublished, Bukidnon State College, Malaybalay, Bukidnon.

Alberto, V.P. (1986). Development and validation of self-instructional modules for prospective science teachers. Doctoral Dissertation, De la Salle University, Manila.

Basic Education Curriculum 2002 Manual

Carin, A. A., & Sund, R. B. (1980). Teaching science through discovery, 4th ed., Columbus, Ohio, Charles E. Merill Publishing Company.

DepEd Advisory No. 403, s. 2011. 9th National Science Quest

DepEd Memorandum No. 48, s. 2011. Values integration in all subjects both elementary and secondary schools.

DepEd Memorandum No. 190, s. 2011. Science and Technology Fair for 2011-2012

DepEd Memorandum No. 359, s. 2010. 8th National Science Quest

DepEd Memorandum No. 99, s. 2010. 5th National Science Educators Convention

Deped Memorandum . No. 56, s.2007. Integration of values in all science subjects in schools .

Glaser, R. (1976). Components of a psychology of instruction: Toward a science of design. Review of Educational Research, 46, 1-24

Gunstone, D. (1990). Better links: Teaching strategies in the science classroom. Science Teachers Association of Victoria. Clunies Ross House , 191 Royal Parade , Parkville Vic 3052: STAV Publishing Pty Ltd.

Johnson, D.W. and Johnson, R.T. (1991). Learning together and alone. Englewood Cliffs: N.J., Prentice Hall

Johnson, D.W., Johnson, R.T., & Holubec, E. J. (2000). Cooperative learning in the classroom. Alexandria, Virginia: Association for Supervision and Curriculum Development.

Maminta, L.G. (2002). An evaluation of the conduct of science investigatory projects of grade VI pupils. . Unpublished master's thesis, Bukidnon State University, City of Malaybalay.

McConnel, D.A. (2000). Promoting education through sustainable development via-student centered learning programme. Retrieved November 11, 2011, from http://www.recsam.edu.my/rndpdf/.

Merrill, M.D. (1937). Instructional design theory. Englewood Cliffs, New Jersey 07632: Educational technology publications, Inc.
Merrill, M.D. (1971). Three levels of instructional design (IR&D working paper No.15). Provo, UT : Brigham Young University.
Merril, M.D. (1983). Component display theory. In C.M. Reigeluth (Ed.), Instructional design theories and models. Hillsdale,NJ: Lawrence Erlbaum Associates.
Merrill, M.D. (1987). A lesson-based on component display theory. In C.M. Reigeluth (Ed.), Instructional design theories in Action.Hillsdale, NJ:Lawrence Erlbaum Associates.
Potane, J. (2010). The Attitude of teachers in integrating science investigatory projects in teaching science. District-based action research, Kimanait National High School, Division of Bukidnon.
Sabacahan, G.M.(2002) Guided discovery laboratory lessons for facilitating the development of higher order thinking skills. Unpublished master's thesis, Bukidnon State College, Malaybalay City.
Science Education Institute (1992)
Simbulan, S.G. (2001). Instructional Materials. Bukidnon State College, Malaybalay City.
UP-ISMED (1998). University of the Philippines-Institute for Science and Mathematics Education Development.

The Effects of Global Climate Change on Agricultural Foreign Trade of Turkey

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Abstract
Global warming and climate change will continue to be at the center of policy debates in the world. Since agriculture is very vulnerable to climate change, various climate change scenarios are projected for the impact of climate change on the agricultural sector. However, there are conflicting hypotheses regarding the relation between climate change and agricultural production, and agricultural trade as well, in the literature. In this study, the major determinants of agricultural trade capability of Turkey. Food security issues may be main obstacle in front of Turkey when climate change seriously occurs. Consequently agricultural foreign trade might suffer from global warming when food security is a major problem for a country. Current study exhibits possible costs of climate change in Turkey in the condition of food security.

Key words: climate change, externality, Turkey, foreign trade

Introduction

Global warming and the consequent growing climate change is the biggest negative externality issue created by mankind. Global income shared by all countries in the world are largely shared by 8-10 countries whereas the negative effects of climate change and its results are shared in an equitable manner. Increasing commodity production through increasing competitive economic system has triggered global warming. Least developed countries in the field of foreign trade, have been in trouble as in all areas. Each sector will be equally affected by climate change.

Each sector will not be equally affected by climate change. Agricultural sector depends on natural conditions and produce essential goods for humans. Consequently, this sector would be considerably affected by climate changing conditions. If existing problems related with nutrition in the world are considered, then the sector should be taken more seriously.

Turkey is a major agricultural country, with about 41 billion dollars of agricultural production value. However, the self-sufficiency issues in agriculture, excessive international competition and fluctuations on foreign exschange rate when combined with the effects of climate change has potential to endanger the revenues that will be earned in this sector.

In this study, it is investigated the case of Turkey which needs to be successful on topics of food security, combating with climate change and foreign trade of agricultural productions.

Material and Method

The material of the research consists of statistical database of International Food and Agriculture Organization (FAO) and Turkey Statistical Institute (TSI). The statistical time series were estimated after collecting of the raw data. Apart from statisticals, their working reports of these institutions are also employed in analysis. Apart from these, compiling

studies, scientific papers, statistical analysis, research reports, web pages have been used for scientific inferences.
Statistics on the selected product covers the period of 1961-2014. Figures of per capita agricultural production are an important explanatory variable for many factors such as self-sufficiency, population pressure, and export of production surplus. Especially, the cereals constitute about 75% of the total crop production. Wheat has considerable share in the cereals. Irrigation water is also important position for maize, thus the maize was included the analysis for this reason. Sunflower crops were included in the analysis in terms of providing information about the processing industry. There is still a supply deficit in vegetable oils. Consequently, there have been self-sufficiency issue in this product. The paddy production is not sufficient to increase the per capita amounts. Those selected four crops have characteristic that will provide better understanding the big picture.
The statistical time series approach has been used as a research method because agricultural production is under the effects of nature, and natural circumstances have lagged behind effects on production decisions. In other words, these can affect the current time period t and also t+1 and
t+2 next periods. In statistics, these kinds of effects are time lags and called "distributed lag." Distributed lag models require complex methods that have been used frequently in recent years. Algebraically, we can state that a dependent variable, y_t, can be explained by a policy variable, xt. In this case the lagged values of the policy variable ($x_{t-1}, x_{t-2}, x_{t-3}, \ldots x_{t-n}$) can affect the dependent variable. In some cases the dependent variable is affected by lags that develop independently. In this case, the dependent variable will depend on lagged values such as ($y_{t-1}, y_{t-2}, y_{t-3}, \ldots y_{t-n}$). Some time series models can explain these kinds of events. autoregressive integrated moving average model (ARIMA) is preferred for this research.

Time series models can explain these kinds of events. Autoregressive integrated moving average model (ARIMA) is preferred for this research. In the AR process, a random variable is dependent on its or the error term's past values [10]. In its most basic form, it is expressed as shown below.

$$y_t = \alpha + \beta_1 y_{t-1} + e_t \quad t = 1, 2, \ldots, T \qquad (1)$$

In this model, α constant term parameter is the parameter that will be estimated and valued in β [-1; 1] interval and has e zero average and error term with constant variance.

In the **MA(q)** process, y_t is equal to the sum of a constant term and the moving average of the current and past error terms. In general form the function can be written as follows.

$$y_t = \alpha + e_t + \beta_1 e_{t-1} + \beta_2 e_{t-2} + \ldots + \beta_q e_{t-q} \qquad (2)$$

Here e_t shows the error terms that have a zero-mean and constant variance. $\mu, \beta_1, \ldots, \beta_n$ are the unknown constants that will define the correlation.
The ARIMA process is composed of the integration of the two models mentioned above. For example, an ARIMA (1, 2) model with one sequentially dependent lag and two lags with moving averages can be written as:

$$y_t = \alpha + \beta_1 y_{t-1} + e_t + \gamma_1 e_{t-1} + \gamma_2 e_{t-2} \qquad (3)$$

There are software packages that estimate these kinds of models and make it possible to make predictions. In this research STATISTICA software was used. The above mentioned AR, MA, and ARIMA processes hypothesize an important subject. This hypothesis is "stationary." These processes assumes the series that are examined are steady. However, most

economical data are known to not be steady [12] In a steady time series, the mean, variance, and partial sequential functions do not change with time.

Non-stationary time series can be transformed into steady data. In order to do this, the differences in the series from one or more degrees can be calculated. It is an important indicator to understand a series with a non-stationary sequential dependency function. Some statistical tests are suggested for this. This paper consider Ljung-Box Q test statistic. Q stationary test, which complies with x^2 distribution, is utilized to determine if the error terms are independent of each other [11]. Many statistical software calculate necessary Q value. Generally the 25 lags are appropriate, but in the lower order models, a 15-20 lag length is considered [13], [14], [15]. In this research, the lag length used is 12-15, depending on the data. Correlogram analysis was employed in understanding if the series are steady.

Results and Discussion

Table: Forecasts of selected crops in Turkey (1961-2030)

Years	Wheat	Maize	Sunflower Oil	Rice
1961	288,76	35,10	0,888	5,371
1971	326,66	30,55	4,461	5,236
1980	371,34	29,84	4,663	5,529
1990	295,58	35,52	8,039	3,909
1995	298,88	30,01	4,870	2,164
2000	316,18	34,22	6,274	3,379
2005	294,72	41,65	6,871	4,538
2010	252,62	55,36	9,859	6,516
2015*	**223,97**	**55,18**	**8,81**	**5,267**
2016	**224,50**	**61,38**	**9,40**	**5,417**
2017	**227,13**	**60,78**	**10,20**	**5,367**
2018	**223,83**	**67,72**	**9,85**	**5,561**
2019	**219,68**	**67,12**	**9,86**	**5,542**
2020	**216,56**	**67,77**	**11,36**	**5,599**
2021	**218,92**	**69,53**	**12,03**	**5,559**
2022	**217,80**	**72,06**	**12,90**	**5,646**
2023	**212,17**	**70,40**	**13,03**	**5,448**
2024	**212,36**	**73,32**	**13,42**	**5,580**
2025	**210,49**	**71,73**	**14,09**	**5,469**
2026	**210,26**	**73,97**	**14,80**	**5,612**
2027	**210,59**	**72,79**	**14,91**	**5,497**
2028	**208,95**	**74,91**	**15,81**	**5,598**
2029	**206,65**	**72,95**	**16,95**	**5,495**
2030	**206,24**	**75,06**	**16,83**	**5,573**

*Bold figures are forecasts that includes the years of 2015-2030

According to future forecasts of the selected crops of Turkey, production of wheat is doubled. The increase in total production volume may be incomplete in providing information about food security. In fact, it is observed a decrease on per capita rates. For instance, the figure 252 kg/year at 2010 would be expected to be 206 kg/year. The decline rate is 18 percent in per capita production.

More promising case exists in maize production. There has been a 3-fold increase in production since 1961. Per capita production of maize increased 57 percent between 1961-2010. Yet, it would be 36 percent between the years of 2010 and 2030.

The estimated per capita growth would be 71 percent level between the years of 2010-2030. with the development of sunflower processing industry, the increasing capacity of sector and technological progress.

The difficulty of paddy rice production in Turkey and lack of production areas and consequently that world price is lower than Turkey hampers the increase of per capita figures in this field. Problems experienced in the year of 1990 and 2000 decreased the harvest and per capita rice amount fallen down to 2.1 kg/year. According to the predictions, Turkey may tests 14 percent decreases between the years of 2010 and 2030.

An increase case occurs in the two of the selected four major products (corn and sunflower oil) and decrease is observed in the wheat and rice cases. Per capita production decreases can be influenced by many factors such as rapid population growth. However, it should be noted that rapid population growth is also shown as a major cause of global climate change. Another reason is the international competitiveness on agricultural products. Especially interests of developed countries in trade may aggravate the effects of climate change. If it is analysed following graphic declared by FAO, we can understand that an important role of developing countries in international trade of the agricultural products have disappeared in the early 1980s. Those countries that are major exporters of agricultural products have become an importer of agricultural products.

It is inferred from the study that Turkey has some difficulties on certain agricultural products due to climate change. Staying below the level of self-sufficiency may play a role in reducing the export of certain agricultural goods. The selection of seed varieties to adapt to climate change, the acceleration of the industrialization process in agriculture, can be successful policies against climate change. Yet, it is not forget that the climate change is not responsible for decreasing agricultural export.

References

FAO, 2013. http://faostat.fao.org/site/717/default.aspx#ancorgenel

Stern, N., 2006. Stern Review: The Economics of Climate Change. s.403-449.

Fankhauser, S., 1995. Valuing climate change. The economics of tk greenhouse, Earthscan, London.

Greene, W., 2003. Econometric Analysis.Prentice Hall, USA.

Gürlük, S., 2006. The estimation of ecosystem services value in the region of Misi Ruraş Development Project: Results from a contingent valuation survey. *Forest Policy and Economics,* Vol.9(3), 209-218.

Gürlük, S., Turan, Ö, 2009. Dünya gıda krizi, nedenleri ve etkileri, Uludağ Üniversitesi *Ziraat Fakültesi Dergisi,* 22(1): 63-74.

Gürlük, S., Ward, F., 2009. Integrated basin management: Water and food policy options for Turkey. *Ecological Economics,* 68(10): 2666-2678.

Haines, A., Parry, M., 1993. Climate change and human health. *Journal of the Royal Society of Medicine,* 86: 707 -711.

Hohmeyer, O., Gartner, M., 1992. The Costs of Climate Change. Report to the Commission of the European Communities, Fraunhofer Institut fur Systemtechnik und Innovations-Forschung, Karlsruhe, Germany.

IPCC, *2007.* Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. Van der Linden and C. E. Hanson, eds., Cambridge, UK.

Şimsek, D., 2011. Dünya'da ve Türkiye'de Tarım ve Gıda Ürünlerinde Arz ve Talep Yönlü Değişmeler ve Etkileri. Yüksek Lisans Tezi, UÜ Fen Bilimleri Enstitüsü, Tarım Ekonomisi Anabilim Dalı, Bursa.

TUİK, 2013. Hane Halkı İşgücü Araştırması. Bölgesel Sonuçlar 2004-2013 İşgücü ve Yaşam Koşulları Daire Başkanlığı. İş gücü İstatistikleri Grubu. Ankara.

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The Influence of Gentrification on the Power Demand in the Unit of District

-Focusing on Garosu-gil of Sinsa-dong, Gangnam-gu Seoul-

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Abstract

The gentrification was initially described by Ruth Glass as the phenomenon in which the composition and nature of the whole area are changed as the middle-class families move into laborers' residence. Regarding the cases like Chicago and New York, the commercial use ratio gets decreased as the commercial districts become more residential.

In case of Korea, however, the commercial use ratio gets increased as the residential districts become more commercialized. Since the gentrification phenomenon in Korea has a short cycle, the use within districts is rapidly changing. The alteration of the use within districts has an influence on the energy demand. In order to cope with changes in the energy demand within districts showing the gentrification in Korea, it is necessary to quantify changes in the energy demand before/after the gentrification. This study calculated the power demand of each business type before/after the gentrification, by tracking store types and changes in area within the district showing the gentrification in Korea. Based on this, the influence of the gentrification on the power demand in the district was analyzed. Owing to the gentrification, the total area of buildings was increased. It is considered to be caused by extension and remodeling of buildings. The area in 2015(74,028㎡) was increased by 2,714㎡(3.81%) compared to the one in 2010(71,313㎡). The power demand of business type was increased by 1,991Mwh/yr(12.34%) from 16,723Mwh/yr in 2010 to 18,787Mwh/yr in 2015.

Keywords :

Gentrification, Power Demand, Effect of Commercialized on Energy, Energy security

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1.1 Backgrounds & Objectives of the Study

The gentrification was initially described by Ruth Glass as “the phenomenon in which the composition and nature of the whole area are changed as the middle-class families move into laborers' residence". In case of the gentrification in foreign countries, generally, the commercial use ratio gets decreased as the commercial districts become more residential. [1] However, the gentrification in Korea shows the aspect different from the foreign cases. In case of Korea, the gentrification occurs in the residential district, so that commercial buildings are increased in many cases. Because of it, there are even cases in which residental areas become commercialized.

Since commercial districts have the power consumption patterns different from the residential districts, it is necessary to analyze the influence of the gentrification on the power consumption in districts in the aspect of energy security. Thus, this study suggested the quantified data more than a certain amount that could consider the variation in the power demand.

1.2 Range & Methods of the Study

This study was conducted for Garosu-gil located in Sinsa-dong, Seoul, the representative case of the gentrification in Korea. The gentrification was rapidly proceeded in the relevant district from 2010 to 2015. The changes in store types and the area variation of 64 buildings within the relevant district before/after the gentrification were surveyed. The changes in business type and the area variation of the business within buildings were collected by using the building register of land use information and the facade documentary photos. Based on the energy consumption unit per area and the collected data, the power demand was analyzed.

2. The Gentrification in Korea

2.1 The Gentrification

The gentrification in Korea shows the aspect different from the overseas gentrification. In overseas cases, generally, the weight of commercial space within districts is decreased as the commercial districts become residential.

In case of Korea, on the contrary, it is general to see that the weight of commercial space within districts is increased as the residential districts become commercialized. The representative cases of preceding researches in Korea are like Table. 1.[2]

Table1. Research cases of Korean Gentrification Phenomenon

Researcher	Research Title	Subject[Main Variable]	Conclusion & Implication
Kim, Keol et al1 (1998)	Issues & research trend of gentrification	Prospect of research trend based on explanation and definition of gentrification	Expanded to researches on the use of census data, gender & class, and unbalanced development
Jung, Hyeon Joo (2005)	Theories and issues of gentrification: Contextual analysis through comparative study	Comparative study on cases and consideration of theories in the aspect of supply and demand	Differentiation of gentrification in unique socioeconomic context of each region rather than theoretical generalization
Oh, Dong Hun (2005)	Seeking for policy directions for realizable material vitalization through comparative study on gentrification cases	Comparison of condition and process of regions between voluntary and involuntary gentrification	Successful in the aspect of vitalization of downtown residence/Maintained by new Yuppies
Kim, Keol (2006)	Changes in neighborhood in the process of gentrification and housing redevelopment in Seoul	Gentrification is a phenomenon meaning the improvement or restoration of declined real estate by middle-class people or commercial developers	Similar to the West in post-industrial thesis and zone difference thesis/Different in the aspect of urban policies
Jung, Ji Hee (2008)	Value-rising commercialization of Samcheongdong-gil based on the position of culture & art facilities	Influence of commercialization through the formation of shopping district, and factors & characteristics of location	Gentrification caused by value-rising commercialization of downtown residence
Lee, Hee Yeon (2009)	Housing movement patterns and movement decision factors of gentrification in Seoul	Analysis on housing movement patterns and housing movement decision factors [personal characteristics, local characteristic variable]	The personal and local characteristics have influence on gentrifiers' housing selection.
Kim, Bong Won 외2 (2010)	Analysis on the characteristics of commercialization of gentrification in Samcheongdong-gil	Analysis on causes, main agents of changes, change period and change factors of gentrification	Gentrification is caused by the increase of rent and ground rent.
Lee, Ji Hyeon (2011)	Empirical analysis on gentrification in Seoul	Analysis on the characteristics of householding, movement factors, strengths & weaknesses of downtown	Through downtown redevelopment, the inflow of middle-class people is increased while showing high satisfaction with residential environment.

		residence, and lifestyle	

The initial research in Korea was started from 1995. Before 2005, the theories and issues were analyzed through foreign cases. With the start by Kim et al[3]in 2006, researches on gentrification have been proceeded in Korea. Recently, the necessities of researches are gradually increasing due to the increase of residents' involuntary movement, loss of innate characteristics of districts, and reduction of gentrification period.

2.2 Main Cases of Korea

The gentrification in Korea was observed first time in Insa-dong, Seoul of the 1990s.

In 1990, it took 20 years in case of Insa-dong and Hongik Univ. in Korea. In the early 2000s, it took 6 years in Samcheong-dong of Jongro-gu, and also took 2-3 years in Seochon in 2010. The period is gradually decreasing due to the development of SNS. [4]

The Table. 2. below is the areas, characteristics and periods of the gentrification in Seoul, Korea.

Area	Period	Before Changes	After Changes
Insa-dong	1990	Traditional handicrafts, traditional teahouse	Franchise(cosmetics, restaurant)
Around Hongik Univ.	2002	Theater, retail store, individual cafe	Major brand franchise(restaurant)
Samcheongdong-gil	2002	The street was formed by traditional food, gallery, and employees related to culture/art.	Franchise(restaurant, cosmetics)
Seochon	2010	Hanok(Korean-style house) village/The street is formed by the local characteristics and employees related to culture/art.	Franchise(restaurant)
Garosu-gil	2010	Designer's clothing store, individual cafe, gallery	Major brand clothing, franchise, cosmetics store
Itaewon Gyeongridan-gil	2010	The street is formed by employees related to culture/art.	Franchise(restaurant)

3. Changes in the Power Demand Patterns Before/After the Gentrification

3.1 Analysis Outline

The subject area is Garosu-gil in Seoul, the representative case of gentrification in Korea.

The spatial range of the relevant area is the alley(about 680m) from J-tower to Apgujeong-dong Hyundai High School located in Gangnam-gu, Seoul.

This study was for 64 buildings located in the 'straight-lined main street' facade within Garosu-gil.

Based on the building register and landscape data, the number of store, and the use & area of stores within the relevant buildings from 2010 to 2015 were surveyed.

In case of the unidentified store use, the use of the previous year was applied. The unidentified area of business type was calculated by dividing the number of store identified into area.



3.2 Analysis

In order to classify the business types of stores in buildings, it was encoded based on Korea Standard Industrial Classification[5] provided by National Statistical Office. Table. 3. shows the increase of total area of each use in buildings. The total area in the district was increased from 71,314㎡ in 2010, to 73,082㎡(2.48%) in 2012, and 74,028㎡(3.81%) in 2015. Regarding the weight of business type, the weight of business facility management & business support service was the highest in 2010, and business facility management & business support service in 2012, and wholesale & retail business in 2015.The area of the use in buildings of each year was 13,293㎡. Except for the specialty, science & technical service, and wholesale & retail business increased by 1,281㎡, the area of every business type was decreased. The accommodation & restaurant occupied the biggest area in 2010 while it was decreased from 15,073㎡ to 13,522㎡. 1,550.55㎡(11.46%).

Table3. Changes of Building Uses

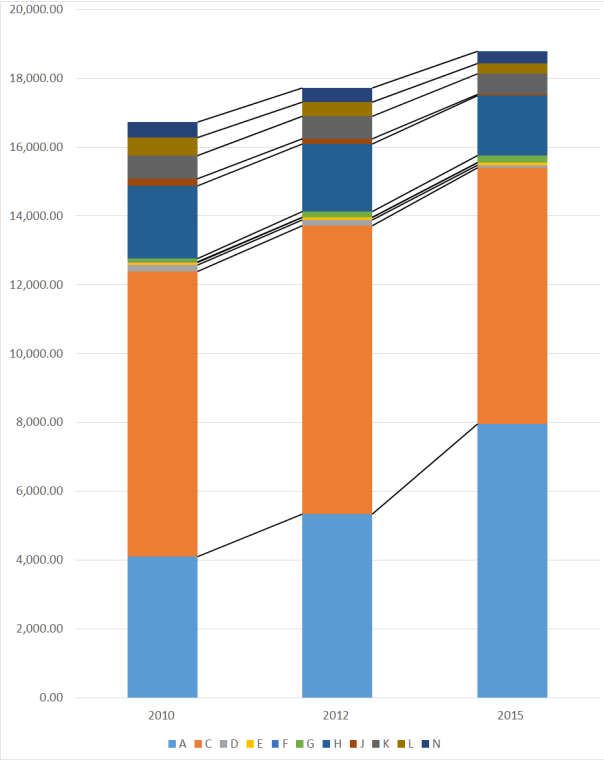
Code	Classification of Business Type	Area of Each Year(㎡)		
		2010	2012	2015
A	Wholesale & retail business	14,111.99	18,372.58	27,405.42
C	Accommodation & restaurant	15,072.84	15,226.70	13,522.29
D	Publication, visual entertainment, broadcasting communication, and information service	1,149.45	1,114.09	494.60
E	Finance & insurance	345.29	345.29	345.29
F	Real estate & leasing service	276.29	128.29	0
G	Specialty, science & technical service	1,072.60	1,831.95	2,353.42
H	Business facility management & business support service	24,430.37	22,562.24	20,045.80
J	Educational service	2,640.53	2,064.61	602.62
K	Health service & social welfare service	5,818.27	5,616.45	5,259.47
L	Art sports & leisure-relevant service	2,804.28	2,241.09	1,525.87

Table4. Power Consumption Unit

Classification of Business Type	Power Consumption Unit(kWh/㎡·yr)
Wholesale & retail business	290.48
Accommodation & restaurant	550.09
Publication, visual entertainment, broadcasting communication, and information service	163.72
Finance & insurance	191.35
Real estate & leasing service	76.55
Specialty, science & technical service	88.57
Business facility management & business support service	86.81
Educational service	76.74
Health service & social welfare service	114.68
Art sports & leisure-relevant service	190.10
Housing	141.86

Classification of Business Type	Year		
	2010	2012	2015
Wholesale & retail business	4,099.25	5,336.87	7,960.73
Accommodation & restaurant	8,291.42	8,376.05	7,438.48
Publication, visual entertainment, broadcasting communication, and information service	188.19	182.40	80.98
Finance & insurance	66.07	66.07	66.07
Real estate & leasing service	21.15	9.82	0
Specialty, science & technical service	95.00	162.26	208.44
Business facility management & business support service	2,120.80	1,958.63	1,740.18
Educational service	202.63	158.44	46.25
Health service & social welfare service	667.24	644.09	603.16
Art sports & leisure-relevant service	533.09	426.03	290.07
Housing	438.21	411.68	350.85

Table5. Estimated Power Consumption



In order to calculate the power demand of the relevant district, the energy unit calculated based on the data measured for commercial buildings was used.[6] In case of the omitted residential building unit, the power consumption unit for housing of statistical data from a similar institution was used. [7] The results calculated by substituting the power consumption unit to the area of business types in buildings are shown in Table. 5. From 2010 to 2012, the accommodation & restaurant business type occupied the most part of power consumption while wholesale & retail business(7,960.73Mwh/yr) occupied the most power consumption in 2015. The power demand of each year was increased from 16,797Mwh/yr in 2010, to 17,801Myh/yr(5.98%) in 2012, and 18,787Mwh/yr(11.81%) in 2015.

In case of the power demand of business type in each year, the total area of every business type was decreased except for wholesale & retail business and specialty, science & technical service.

In case of the increased business types such as wholesale & retail business and science & technical service, the area was increased by 13,293.43㎡, and 1,280.82㎡ respectively.

The power demand in accordance with the increase of area was increased by 3,861.476Mwh/yr and 113.4422Mwh/yr respectively.

In case of accommodation & restaurant, it occupied the most part of the power demand of business type in 2010(8,291.42Mwh/yr) and 2012(8,376.05Mwh/yr). However, it was decreased to

7,438.47Mwh/yr in 2015, so that its power consumption became the second place after wholesale & retail business. Due to the gentrification, the variation in area of business type was shown, and then the variation in power demand was followed by.

4. Conclusion & Discussion

This study calculated the power demand in accordance with the gentrification for Garosu-gil of Sinsa-dong, the representative case of the gentrification in Korea. Owing to the gentrification, the total area of buildings was increased. It is considered to be caused by extension and remodeling of buildings. The area in 2015(74,028㎡) was increased by 2,714㎡(3.81%) compared to the one in 2010(71,313㎡). The power demand of business type was increased by 1,991Mwh/yr(12.34%) from 16,723Mwh/yr in 2010 to 18,787Mwh/yr in 2015.The wholesale & retail business, and specialty, science & technical service were the only business types showing the increased area.

Besides them, the area of other business types was decreased. The wholesale & retail business, and specialty, science & technical service were the only business types showing the increased power demand of each business type. The power demand of the wholesale & retail business, and specialty, science & technical service was increased by 3,861.476Mwh/yr and 113.4422Mwh/yr respectively compared to 2010. Owing to the gentrification, the area of each business type in the district was varied. The varied area of each business type has an influence on the power demand in the district. It is considered to be used as a basic data for predicting the power demand in districts showing the gentrification in the future.

Reference

[1] Janet Smith. 2015. Gentrification and Neighborhood Change

[2] Choi, Byoung Hyun. 2013. Genrtrification Effect of Redeveloped Inner City Apartment Housing in Seoul

[3] Sin Hyeon Joon. 2015. Culture + Seoul.2015. May. Diagnosis of gentrification process and seeking for alternatives

[4] Kim, Kirl. 2007. The Causes and Factors Generating Gentrification in Seoul

[5] National Statistical Office. 2007. Korean Standard Industrial Classification

[6] kang,yeon-hee. 2011. A Study on Prediction of Electricity Consumption considering Business Characteristics in Commercial Buildings –Focused on Daegu City-

[7] Korea Energy Management Corporation. 2002.

[8] Kim, Bong-Won et al 2. 2010. Analysis on commercialization characteristics of the gentrification of Samcheongdong-gil

[9] Lee, Chan. 2008. A Study on the role of Gallery in the Gentrification of Sam-Chung Dong Street.

[10] Oh, Dong-Hoon. 2004. Searching for Direction of Practicable Urban Revitalization Policy by Gentrification Case Study –focused on historic preservation area-

[11] Kim, ji-Eun. 2011. Mobilizing Property-Based Interests: Politics of Policy-driven Gentrification in seoul, Korea

[12] Cho, Myoung Rae. 2013. The gentrification and urban life. The understanding of gentrification

[13] Jin, Chang Joong. Analyzing the transition process and characteristics of the commercialization of residential areas, in relation to culture-led gentrification: case study in Hongik University area

[14] Lee, Seon-Young. 2008. Neighborhood Change as a Gentrification Process in Yongsan Redevelopment District

[15] Shin, Jung Yeop. 2014. Critical Review of Gentrification in Urban Spatial Structure and Exploration of the Future Research Direction

The Relationships between Weather Variables and Transmission Line Reliability

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Abstract:
The electricity transfers to the customer due to transmission lines. Lightning is one of the major causes affecting the reliability of transmission system. Different topography factors including ground resistance causes large number of transmission system outage. This paper present a method based on regression models to study and analysis outages due to lightning on 115 kV Lamphun 2 – Lampang 2 transmission line in the Northern of Thailand base on the historical of Electricity Generation Authority of Thailand transmission line outage data and the Thai Meteorological Department's weather data from 2009 to 2013. The results will allow making the decisions to obtain the best operation and maintenance plan to reduce impacts of lightning on the reliability by install transmission line arrester. Before installation of TLA we need to estimate the effect of the arrester application as well as the proper location for installation. In order to determine the installation area, fault location and lightning density are investigated.

Index Terms— Distribution system, weather effects, regression, lightning outages.

I. INTRODUCTION

Distribution Systems are the most critically section of power system with respect to interruption of service to customers. Weather, Lightning, Trees, animals, foreign objects and human error are the causes of transmission lines outages. Electricity organization in

Thailand has been concerned about reliability of distribution system for many years for decreasing the forced interruptions with proper design, technology and maintenance of the system. However, it is difficult to avoid interruptions completely. Electricity organization in Thailand use System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI) as indices to estimate reliability of the distribution system. To compute these indices requires a complete data of all outages. Including date, time, duration, protection operation, cause of outages also weather during outage.

Location of transmission line has a significant in type of outages. For example, a transmission line in mountain region always has damaged due to lightning, a transmission line nearby seashore has damaged due to corrosion. In most cases, environmental factors such as weather, animals, vegetation are the large part of the causes of outages for transmission system in Thailand. In this paper take weather variables into consideration relationships between weather and 115 kV transmission line outages causing by lightning

II. TRANSMISSION LINE OUTAGE EVALUATION FOR THAILAND

This paper collect outage data for all transmission lines in Thailand operating voltage are 115 kV, 230 kV and 500 kV from 2009 to 2013 with total length of 32,400 circuit-kilometer. A large number of outage is presented as unknown cause. The second majority of transmission lines outage is lightning outage were reported in Fig.I.

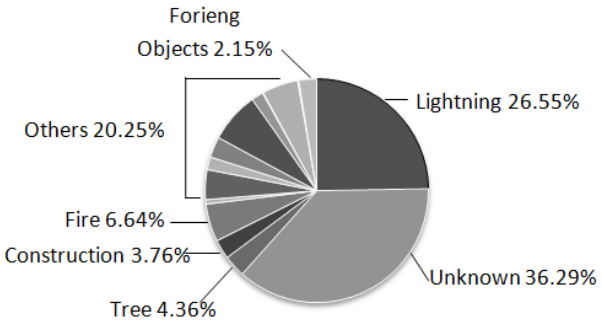


Fig. I: Outage causes of Transmission Lines in Thailand

Table I shows number of Thailand's transmission line outages and their causes recorded. In addition, unknown and lightning were recorded as the main causes of these outages. Other factors, tree, construction, fire, animal including pollution is caused of 37.16% of all outages.

Table I. Transmission Line Outages in Thailand from 2004 to 2013

Cause of Outage	Number of Outages	Percentage
Unknown	2,295	36.29%
Lightning	1,679	26.55%
Tree	276	4.36%
Construction	238	3.76%
Fire	420	6.64%
Animal	49	0.77%
Pollution	338	5.34%
Transmission Equipment	123	1.94%
Relay	120	1.90%
Substation	329	5.20%
Foreign Object	136	2.15%
Human Error	12	0.19%
System	173	2.74%
Flood	15	0.24%
Other	111	1.76%
Vandal	10	0.16%
Total	6,324	100.00%

Table II shows the ranking of the first ten rank transmission line that tripped by lightning. The line 115 kV LN2 – LP2 (115 kV Lamphun 2 – Lampang 2) is deliver the electricity from Lampang province to Lanphun province in the northern of Thailand, which located across mountain and agricultural area. The 115 kV LN2 – LP2 has the most of tripped causing by lightning as show in Fig.II.

Table II. Ranking of 115 kV Transmission Line Outage Causing by Lightning from 2009 to 2013

Transmission Line	Number of Outages				
	2009	2010	2011	2012	2013
115 kV LN2 - LP2	2	1	3	3	6
115 kV BLG - YL2	8	2	4	0	0
115 kV TP - RN	8	6	0	0	0
115 kV CT - KLA	4	4	5	0	0
115 kV CT - TR	3	1	5	2	2
115 kV RY3 - SH1	2	4	3	4	0
115 kV SO1 - TH	2	4	2	2	2
115 kV NPO1 - UD2	0	8	4	0	0
115 kV AT1 - TL	4	1	1	1	4
115 kV SRD - UB1	1	3	4	2	0

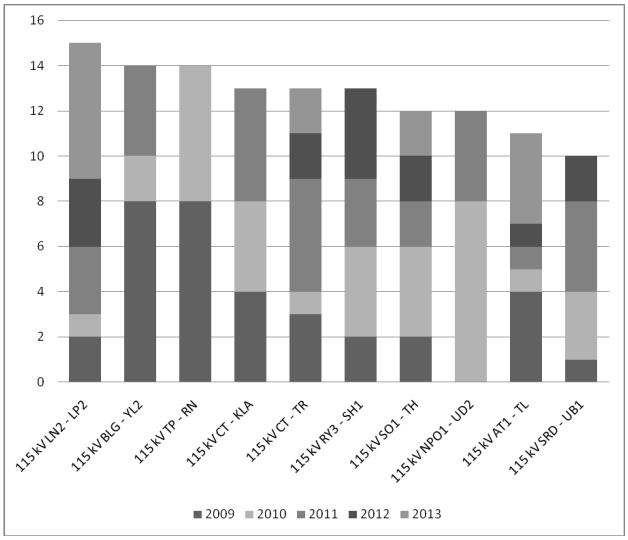


Fig. II Number of 115 kV Transmission Line Outages causing by Lightning 2009 to 2013

III. OUTAGE AND WEATHER DATA

The typical outage management in electricity organization record necessary information related to circuit outages including service area, circuit number, cause, weather, outage duration, tripped equipments, date and time, etc. Weather is importance causes and always included by every utility departments. The weather during outages is a set of weather conditions based on local weather characteristics. The most reliable weather information can always be obtained from local weather stations, which record weather data including date, temperature, rain falls, thunderstorms and wind on daily basis.

Wind and lightning are the most important weather phenomena[3]. Weather data in this paper provided by weather station in Lamphun and Lampang province; contain detailed wind max speed data, temperature, relative humidity, rains and, thunderstorm days. The lightning data including date, time and peak current of the lightning stroke that collected from lightning location system in Thailand. The processing of raw data was need to extract useful information from the raw outages data, such as, weather data and the lightning stroke data for integrate these information into a single data set on the daily basis. Both outage data and weather data were recorded on daily basis then processed according to the date.

IV. LINEAR REGRESSION MODELS

Linear regression model has been use to find relationship between wind max speed and the number of thunderstorm days nearby 115 kV Lamphun 2 – Lampang 2 transmission line area. In this paper is extended to map multivariate relationship. Moreover, the independent variable for wind speed and indicator variable showing lightning or no lightning have been transformed and aggregate as discussed below.

Data on a daily basis are quite scattered because of randomness and not suitable to regress directly. A month was counted as one period, which gave a total 60 data entries and the outages were counted as total number in one period.

Predictor	Coef	SE Coef	T	P
Constant	-15.190	6.786	-2.24	0.029
$\mathbf{X_1}$	0.6232	0.1799	3.46	0.001
$\mathbf{x_2}$	-0.00759	0.04986	-0.15	0.880
$\mathbf{x_3}$	0.022844	0.004731	4.83	0.000
$\mathbf{x_4}$	0.1846	0.1702	1.08	0.283

The normalization process contained probabilities of the corresponding events in periods. The four input variables representing these probabilities and the output variable is given by Y

(number of thunderstorm days). The interaction between wind and lightning was observed from the data. Therefore, four input variables are:

x_1 = temperature (°C)
x_2 = relative humidity (%)
x_3 = rainfall (mm.)
x_4 = max wind speed (km/h)

V. RESULTS

Results of applying for the linear regression model for the regression equation is below

$$Y = -15.2 + 0.623\,x_1 - 0.0076\,x_2 + 0.0228\,x_3 + 0.185\,x_4$$

Table III Summary of Regression Models for Weather data and Lightning

S = 2.24035 R-Sq = 71.0%
R-Sq(adj) = 68.9%

Table IV Analysis of Variance

Source	DF	SS	MS	F	P
Regression	4	676.13	169.03	33.68	0.00
Residual Error	55	276.05	5.02		
Total	59	952.18			

The residual plots for output Y (Thunderstorm days) is show in Fig. III with the linear regression model as show above. Table III and Table IV are showed the results from regression model test.

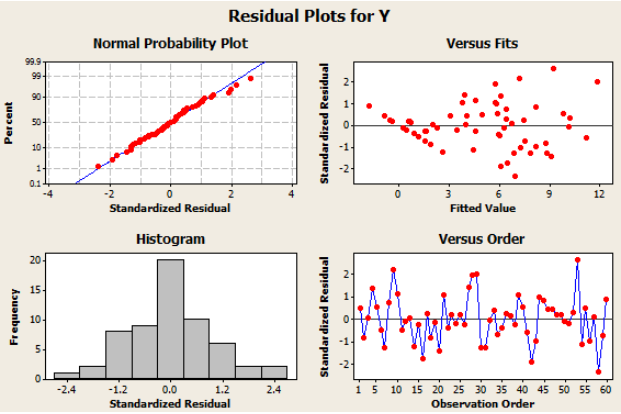


Fig. III Residual Plots for Thunderstorm days

VI. CONCLUSIONS

Analysis of outages in the electricity organization on transmission system in Thailand was presented in this paper. The main conclusion can be explained from this study is that the environmental factors are responsible for the most of transmission line outages. Also, a large number of outages was reported to be the lightning (do not examine the unknown cause).

The linear regression model has been use to find relationship between wind max speed and the number of thunderstorm days nearby 115 kV Lamphun 2 – Lampang 2 transmission line area . The regression model in this paper was investigated to determine the effects of weather factors and lightning on outages. The results show in the model with linear relationship for

four input variables. The scatter plots of this model show good correlation. This method is presented to predict weather related transmission line failure for 115 kV Lamphun 2 – Lampang 2. There are some limitations to this method. First, it was assumed that the wind direction is not effect. Secondly, randomness exists in the occurrence of failures. Even with all factors having the same number of failure for each day. The last one, the number of outage in five years 2009 to 2013 in too small data for predict the output.

VII. REFERENCES

[1] J. McDaniel, C Williams, and A. Vestal, "Lightning and reliability – a comparison of three utilities," presented at Rural Electric Power Conference, 2003.

[2] M. Darveniza, C. Arnold, B. Holcombe, and P. Rainbird, "The Relationships Between Weather Variables and Reliability Indices for a Distribution System in South-East Queensland," CIRED International Conference on Electricity Distribution), Vienna, Austria, 2007

[3] A. Pahwa, M. Hopskins, and T. C. Gaunt, "Evaluation of Outages in Overhead Distribution Systems of South Africa and of Manhattan, Kansas, USA," Proceedings of International Conference on Power Systems Operation and Planning. Cape Town, South Africa, Jan. 2007.

[4] S. Kankanala and A. Pahwa, "Regression Models for Outages Due to Wind and Lightning on Overhead Distribution Feeders," presented at Power and Energy Society General Meeting, IEEE, San Diego, CA, Jul. 2011.

VIII. BIOGRAPHIES

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The research of the amount of planting carbon reduction for the residential landscape - The case of Kaohsiung city residential

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Abstract

Over half of the global population lives in cities, and urban energy usage is up to 75%, thus, cities became the largest source of carbon emissions. As environments are destroyed, reduced carbon emissions become an essential part of twenty-first century urban planning. A topic worthy of exploration is how Taiwan can follow the example of foreign experience in the implementation of low-carbon cities, where the traditional style of urban transformation for new low-carbon cities meet the objectives of the sustainable development of a city,. In this study, the Greenery Index EEWH is used as the research tool. This study discusses the status of the residential greenery landscape of Kaohsiung City, as well as the gap between the standards of greenery index requirements, in order to understand how the scope can be improved. The Greenery Index is created through the Greenery calculations of the CO^2 sequestration effect of plants for the assessment of green design in building environments of open spaces, balconies, roofs, and walls. This study intends to encourage afforestation, produce oxygen, absorb carbon dioxide, clean the air, mitigate the phenomenon of urban high temperature climate, improve the ecological environment, and beautify the environment. The theoretical basis of this study was the EEWH greenery index, and the research method was to investigate greenery, fieldwork and recording, and literature review. The main purpose of this study was to explore the landscape of residential carbon reduction for comparison with other cases. The use of relevant literature summarized the assessment methods and factors to calculate the amount of carbon reduction through the greenery index, discussed the Case environment, size, and other factors in order to reduce the amount of carbon difference, and summarized the analysis results for the reference of subsequent residential landscape design.

Keywords: Greenery index, Kaohsiung, Landscape design, EEWH, Residential.

I. Introduction

Global warming is caused by greenhouse gas emissions, which contribute to climate change, extreme weather, and damage the human ecosystem, thus, humans are awakening to the importance of social low-carbon development. Since 2009, countries began to implement the Green New Deal, which emphasizes “clean low-carbon energy”, “low-carbon industrial economy”, “the construction of a low-carbon society”, and carbon reduction, in order to achieve carbon reduction targets. Lin (1994) pointed out that the “urban heat island effect” in cities is due to the presence of the large number of high regenerator facilities, buildings, and pavement, which are compressed to city green areas, resulting in increased city heat generation. In recent years, the annual summer temperatures of global cities continue to rise, including Taiwan, which is an extremely unusual. Studies have shown that climate warming will lead to biological reduction, increased extreme weather events, water scarcity, and infectious diseases, as well as crop failures and rising sea levels. The Atrium design concept began in high-rise residential development, and after years of development, gradually reached the mature state. However, in the 1960s and 1970s, people began to repel reinforced concrete buildings, and returned to the pursuit of natural environments. Designers attempted to create natural environments in many ways, and added natural gardens to modern buildings.

II. Purpose of Research

In September of 1999, Taiwan began building a green “EEWH” evaluation and mark system, which is the mark after the US LEED system, and the second embodiment of the system worldwide. The EEWH evaluation system originally had seven indices, including a “Greenery index”, a “soil water content index”, “Water Resources”, a “Daily Energy conserving index”, “Carbon dioxide mitigation”, “waste reduction”, and “Sewage and Trash”. In 2003, another revision added the “Biodiversity index” and the “indoor environment”, to form a “green building nine evaluation index system (EEWH).” In response to these issues, the study will explore the base amount of Kaohsiung’s Atrium residential plantings for carbon reduction, which uses the Greenery index of EEWH, and conduct comparative analysis of the regional differences. The main purpose is, as follows:

1. Through analysis, establish the amount of carbon reduction of residential buildings Atrium landscape.
2. According to the Greenery index, explore the relationship between the residential Atrium building landscape and the environment.
3. Explore the relationship between the residential Atrium building landscape plantings and dwellings.

III. Research Method and Procedures

The research methods included discussion, site investigation, and literature review on greenery.

The theoretical basis of this study was the EEWH“ greenery” index and relevant literature, in order to analyze and research the calculation method of planting in the “greenery” index to the CO^2 sequestration amount.

The assessment standard of the greenery index is the amount of plant photosynthesis, that is, the plants' CO^2 sequestration amount for 40 years, as shown in Table 1, is used as the conversion standard for greenery benefits. These data are analyzed by the Graduate Institute of Architecture, National Cheng Kung University, according to the experimental values of the leaves' photosynthesis in the warm climate of foreign countries, combined with the measured values of sunlight, climate conditions, tree forms, and leaf area, in order to obtain the CO^2 sequestration effect accumulated for 40 years.

The largest function of such assessment lies in providing the relative conversion mechanism of the environmental benefits for different plants, which excludes the obstacle of the landscape policy of the past, where various plants had only standard separation and afforestation, while ignoring the afforestation of the shrubs, runners, grasses, and flowers or multiple layers.

Table 1 Various Plants' CO2 Sequestration Amount Gi (kg/㎡) Per Unit Area

<table>
<tr><th colspan="2" rowspan="2">Plant types</th><th rowspan="2">CO^2 sequestration amount Gi(kg/㎡)</th><th colspan="2">Covering depth</th></tr>
<tr><th>Roof, balcony, terrace</th><th>Others</th></tr>
<tr><td>Ecological multi-layer</td><td>Dense plant hybrid zone of large and small trees, shrubs, grasses and flowers (the space between every two trees is below 3.5m.)</td><td>1,200</td><td>1.0m or above</td><td rowspan="4">1.0m or above</td></tr>
<tr><td rowspan="3">Trees</td><td>Large broad-leaved trees</td><td>900</td><td rowspan="3">0.7m or above</td></tr>
<tr><td>Small broad-leaved trees, coniferous trees, leaf-thinning trees</td><td>600</td></tr>
<tr><td>Palms</td><td>400</td></tr>
<tr><td colspan="2">Shrubs (at least over two shrubs per m2)</td><td>300</td><td rowspan="2">0.4m or above</td><td rowspan="2">0.5m or above</td></tr>
<tr><td colspan="2">Perennial runners</td><td>100</td></tr>
<tr><td colspan="2">Grass and flower parterres, natural grass land, aquatic plants, lawns</td><td>20</td><td>0.1m or above</td><td>0.3m or above</td></tr>
</table>

The systemic RS2 score of the “greenery index” is assessed by the weight of plants' CO^2 sequestration amount, which is also obtained by the conversion of the index design value of TCO^2 and the fiducial value of TCO^2c in Table 2 (CO^2 sequestration amount β per unit green area), according to the formula [the systemic score $RS2=6.81x((TCO^2-TCO^2c)/TCO2c)+1.5$, and $0.0 \leqq RS2 \leqq 9.0$]. The index design value TCO^2 includes plants' CO^2 total sequestration amount, and is

aggregated by the standard CO^2 sequestration amount of various plants' CO^2 sequestration amount Gi(kg/ ㎡) per unit area, as shown in Table 1, of all the plants in the base, and according to the formula [the index design value $TCO^2=(\Sigma(GixAi))x\alpha$].

IV. Research Scope and Comprehensive Analysis

Targeting the high-quality residential buildings in Kaohsiung, this study conducted investigation and analysis on the atrium landscape environment, and calculated the greenery index assessment in each case. The main scope is defined, as follows:

1. The research scope is Kaohsiung downtown (the original Kaohsiung City).
2. The research target is the residential hotspot in Kaohsiung City - Gallery special administrative area. In addition, one case each from northern Kaohsiung and southern Kaohsiung are used for comparison.

Table 2 Regional distribution table of the research target (ranking according to the quantity in the regions)

No.	Project name	Year	Construction company	Construction site
1	Art Museum Garden B	2007	DinYue Construction Co.	Gushan District
2	Green Art Villa	2007	DinYue Construction Co.	Gushan District
3	Wave Embankment	2008	Cheng Yang Construction Co.	Gushan District
4	Art Show	2008	Fu Hua Construction Co.	Gushan District
5	Northern Beauty Shore	2009	Cheng Yang Construction Co.	Gushan District
6	Municipal President	2009	Beijing Construction Co.	Gushan District
7	Mori Art Museum	2013	Cheng Yang Construction Co.	Gushan District
8	Dragon and Maka	2014	Long Teng Construction Co.	Gushan District
9	Qinghai Section	2014	Private project	Gushan District
10	Shoushan	2009	Fu Mao Construction Co.	Qianzhen District
11	Benye Shijia	2014	Ben Ye Construction Co.	Qianzhen District
12	Mingfa Aiqun	2014	Ming Fa Construction Co.	Qianzhen District
13	Shijia Section	2014	Private project	Qianzhen District
14	Caritas Star	2010	DinYue Construction Co.	Zuoying District
15	Left Yingfushan	2014	Private project	Zuoying District
16	New Fusiduan	2014	Private project	Zuoying District
17	Dingzhan	2011	Fu Mao Construction Co.	Lingya District
18	Shanghong Dingxin	2014	Shang Hong Construction Co.	Fongshan District
19	Chengde	2014	Private project	Renwu District
20	Fall in Love with Domed	2015	Tai Wei Construction Co.	Sanmin District
21	Mingfa Xinjing	2015	Ming Fa Construction Co.	Xiaogang District

V. Conclusion

This study explored the relationship between the amount of carbon reduction of high-quality residential Atrium landscapes and its case, as well as the assessment methods and factors, by summarizing relevant literature. The carbon reduction amount was calculated through ecological index groups in the EEWH environmental evaluation system (EWWH) – meaning the use of the greenery index to explore the difference between building factors of the case environment and size, and its carbon reduction. Analysis results were summarized and concluded as reference for subsequent residential landscape atrium design. The formation of an atrium must go through a careful construction planning process, and then the atrium design most suitable for the building is planned. Finally, the overall design is implemented. However, while designing an atrium, only through comprehensive understanding of the space characteristics and usage behavior can sustainable products be used, which conform to the market needs. The reviewers' ideas regarding the assessment index of the atrium landscape will produce the effect on the formation of an atrium environment in a pure building, thus, forming the relation of cyclic mutual interdependence. The results indicated that, with the same area of the base, each build case may have the different greenery designs and produce different carbon reduction amounts due to the differences in building areas, green areas, building height, number of users, etc. In terms of design time, the most important purpose of the physical atrium environment is to allow daylight into the building atrium, and thus, increase the chance of atrium growth and indoor lighting. According to the research results, daylight is helpful to the health and improvement of productivity and economics, thus, the introduction of natural lighting is an item which must be valued during designing and planning. Its research contribution and value are atrium physical environment, atrium design factors, construction technology factors, material factors, and atrium use environment, management, and maintenance factors. When people buy houses and own the property, their rights to be informed are guaranteed in house purchasing. In addition, the assessment factors in this research can be considered as reference for people in selecting houses.

TCO^2: assessment value of CO^2total sequestration amount of base afforestation(kg)
TCO^2c: fiducial value of CO^2 total sequestration amount of EEWH afforestation (kg)
Gi: CO^2 sequestration amount per unit area of a certain plant (kg/m2)
Ai: planting area of a certain plant (㎡); the planting area of the trees is calculated based on the crown projected area;
The planting area of the shrubs, parterres, and the grass land is calculated based on the actual planting plane area; the planting area of the runners is calculated based on the actual stereoscopic cling area; others' planting area is calculated based on the actual dense planting plane area.
A': the smallest area of green land (㎡), which cannot be lower than 15% of the total base area, that is, if $A' < 0.5 \times Ao$, then $A' = 0.15 \times Ao$.
α: ecological greenery favored coefficient, but α must be greater than or equal to 0.

The favored coefficient is aimed at ecological afforestation, such as planned originally plantings and bird-attractive and butterfly-attractive plants. Regarding the least special ecological afforestation, α=1.0; thus, the design diagram and calculation table of overall planting must be put forward.

Table 3 Assessment Results of Case Carbon Reduction Ratio

No.	Case name	Area of base (M^2)	Construction area (M^2)	The smallest area of green land A'(M^2)	Green design value TCO_2(Kg)	The green fiducial value TCO2C(Kg)	Carbon reduction per unit (Kg/M2)	Carbon reduction ratio in the base (%)
1	Art Museum Garden B	3,572.04	1,386.09	874	474,390	262,314	132.81	3.72%
2	Green Art Villa	1,670.61	673.41	399	350,963	119,664	210.08	12.58%
3	Wave Embankment	847.00	340.00	203	433,893	60,840	512.27	60.48%
4	Art Show	3,139.78	1,884.00	502	223,340	150,694	71.13	2.27%
5	Northern Beauty Shore	3,226.60	1,316.65	764	564,243	229,194	174.87	5.42%
6	Municipal President	3,874.80	1,807.07	827	355,961	248,128	91.87	2.37%
7	Shoushan	3,479.00	1,873.00	642	428,464	192,720	123.16	3.54%
8	Caritas Star	1,697.64	678.20	408	201,272	122,333	118.56	6.98%
9	Dingzhan	1,101.00	762.00	136	76,972	40,680	69.91	6.35%
10	Mori Art Museum	1,890.87	921.86	388	191,302	116,281	101.17	5.35%
11	Benye Shijia	2,849.10	705.97	857	493,698.8	257,175.6	172.28	6.05%
12	Shanghong Dingxin	1,573.22	716.21	343	212,025.8	102,900	133.77	8.52%
13	Chengde	1,928.75	737.83	476	236,849.2	142,910.4	122.80	6.37%
14	Mingfa Aiqun	1,878	1,070.45	323	142,157	96,906	74.70	3.98%
15	Dragon and Maka	2,316.98	747.09	628	346,492.2	188,386.8	149.54	6.45%
16	Left Yingfushan	1,552.83	532.82	408	191,652.8	122,401.2	122.42	7.88%
17	Qinghai Section	3,808.17	1,484.90	929	421,022	278,792.4	110.56	2.90%
18	New Fusiduan	1,659.58	693.20	387	193,493	115,965.6	116.59	7.03%
19	Shijia Section	6,902	2,609.61	1,717	946,354	515,086.8	136.11	1.97%
20	Mingfa Xinjing	1,485	785.6	280	136,638.4	83,928	91.01	18.85
21	Fall in Love with Domed	1,496.8	896.61	240	198,188.8	72,022.8	131.41	16.03

Physical environment

1. In the aspect of planning:
   Influencing factors of physical environment include atrium configuration pattern and size. In addition, the issues brought by the external factors should be noticed.

2. In the aspect of planting:
   Planting quantity and location have an effect on physical environment, and its emphasis should be strengthened. Thus, plants are not only beautiful, they also have the additional functions.

Landscape environment

1. Footpath pavement is given higher emphasis as it has an effect on safety in use and walking feeling. Therefore, planning must consider construction quality to make it safer. Thus, people can walk on it at any time, which improves satisfaction with the residential atrium.
2. Atrium planting and greenery fail to satisfy residents. Therefore, it is suggested that adjustment and division should be made in the proportion of atrium afforestation. Apart from intensifying visual pleasure, atrium planting and greenery also have the adjustment function for physical environment.

In a sustainable developing city, the value of ecological environment is often ignored, which leads to increased environmental burden. Afforestation and water retention can improve the microclimate and reduce the greenhouse heat island effect.

The plant distribution in a high-quality residential atrium is explored, and the differences are analyzed, in order that suggestions are made for improved planning to slow the environment of global warming.

References

1. Lin, H.D., Urban and Rural Ecology, Chan's Arch Publishing, Taipei, 1999.
2. Albert J. Rutledge, Li, S.H.(trans), 1995, "Behavioral Observation and Park Design", Garden City Publishing, Taipei.
3. Norman K. Booth, Hou, J.H. and Li, S.H. (trans), 1997, "Landscape Assessment Factors" , Garden City Publishing, Taipei.
4. Michael Laurie, Lin J.J. and Chiu, L.R.(trans), 1998, "Introduction to Landscape Architecture" , Garden City Publishing, Taipei.
5. John L.Motloch, Lu, Y.N. and Lin, J.H. (trans), 1999, "Introduction to Landscape Design", Liu Ho Publishing, Taipei.

What Are the Citizens' Priorities over Sustainable Development Goals in Thailand? : Evidence from a Questionnaire Survey

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Abstract

The new Millennium Development Goals (MDGs) are to be announced at United Nations' General Assembly in September 2015. The new goals are expected to include Sustainable Development Goals (SDGs) in order to cover broader sustainability issues suitable for both the developed and developing countries. While the negotiations on the selections of the goals are underway among policymakers, however, the research efforts to understand what the citizen in different parts of the world really seek in their life are limited to a few prominent initiatives such as My World 2015.

Based on an analysis of a survey study (n=517), this study attempts to highlight citizens' needs and interests in Thailand among key MDGs and SDGs-related issues under discussions at the international level. The study is designed to compare the priorities among citizens over 15 years old in Thailand upon twenty-five social areas such as the environment, employment, health and safety as well as more specific issues in one particular area of sustainability. In addition, the study compares the results of the survey in Thailand with the results of a survey previously

conducted in Japan in order to highlight common as well as uncommon issues between these two countries.

The results of the study suggest that there are common interests among citizens in Thailand and Japan with respect to the MDGs and SDGs-related issues. This may be indicative that Thai citizens started to show interests in the issues that were not originally identified by MDGs with the improved economic and social conditions in the country in recent years. The results of the study may suggest, therefore, that additional process and mechanisms are necessary to integrate local needs and interests beyond the one-size-fits-all approach.

Further research includes a field-based face-to-face interview study in Thailand. The combination of the quantitative presentation of the survey and the field-based interview study will help us to gain a better grasp on the citizens' priorities over MDGs and SDGs-related issues in Thailand.

Key words: Millennium Development Goals, Sustainable Development Goals, questionnaire survey, Thailand

1. Introduction

International negotiations toward setting the Post-2015 Development Goals (Post-MDGs: Millennium Development Goals) are under way. Rio+20 resulted in ongoing debates about establishing of Sustainable Development Goals (SDGs). This change of the term from MDGs to SDGs implies that the new goals include global aspects of global and local environment, addressing the significance of future perspectives for all the regions on the planet. As even state of the art knowledge created by science and academic research can barely see the whole picture of such development (Kates et al., 2001) and as sustainability often involves values judgment, participation of general public in the goal-setting process is of critical importance (Schneider & Rist 2014; Wiek et al., 2011). Nevertheless, research initiatives to understand priorities of the general public among various goals are limited to a few studies such as

MY World 2015 survey (www.myworld2015.org/) conducted by the UN. In addition, the target countries were limited to the developing countries in the original version of the MDGs, while there are lively debates about participation of the developed countries in the post-MDGs (Brito, 2012; Glaser, 2012; Horner, 2012; Sachs, 2012).

2. Background

2.1. From the MDGs to the post-MDGs

The MDGs were adopted in 2000 at the Millennium Summit under the strong leadership of Kofi Annan, who was the Secretary-General of the UN at the time. Eight goals and twenty-one targets were set with the central goal of "eradicate[ing] extreme hunger and poverty." The date for achieving these goals and targets was set by 2015. As the deadline is getting closer, international negotiation toward establishing of the post-2015 MDGs is proceeding. On the other hand Rio+20 (the United Nations Conference on Sustainable Development) proposed to establish SDGs with stronger focus on environmental issues. At present, international debates toward the establishment of the post-2015 development goals are under way to integrate SDGs into post-2015.

2.2. Criticism toward the MDGs

There is a general understanding that the MDGs set in 2000 are highly valued for reduction of poverty and hunger. However, there are some critical reflections on them as well. Firstly, although the goals are regarded as simply worded and easy to understand (Aryeetey et al., 2012; Attaran, 2005; Elliott, 2005; Fukuda-Parr & Greenstein, 2010; Higgins, 2013; Hulme & Fukuda-Parr, 2009; Langford, 2010; Toulmin & Gueye, 2003), there is criticism that setting goals in "one size fits all" format does not take into account the specific characteristics and circumstances of each country and region (Gauri, 2012; Gough & McGregor, 2004; Grown, 2005; Handoussa, 2009; Heeks, 2005; Miranda & Patel, 2005; Vandemoortele, 2012). There are opinions that along with setting the

universal goals, it is necessary to provide explanation of these goals considering local and regional contexts (Fukuda-Parr, Yamin, & Greenstein, 2014; Glaser, 2012; Gore, 2004; Grown, 2005; Melamed & Bergh, 2014; Nayyar, 2011; Nhema, 2010; Vandemoortele, 2005). In this regards, it is considered that general public priorities for MDGs have connection with the income, living environment, age and other specific attributes of the individuals. There is also strong opinion that it is necessary to set targets reflecting these specific attributes side by side with the universal goals (Kanie et al., 2014; Nayyar, 2011; Nhema, 2010; Slay, Danilova-Cross, & Altangerel, 2013).

Another issue relating to the MDGs is that, as stated above, as the central goal was "eradicating extreme hunger and poverty", the main focus was placed upon the developing countries. There are active debates that post-MDGs should focus more on developed countries as well (Evans & Steven, 2012; Jeremic & Sachs, 2014; Kanie et al., 2014; Lingan, Cornforth, & Pollard, 2012; Manning, Harland, & Haddad, 2013).

2.3. MY World 2015 survey

MY World 2015 is primarily an online (www.myworld2015.org/) survey that examines the concerns among the general public about the post-2015 development agenda. The survey offers individuals to vote for the issues that are the most important for them among suggested 16 variants. According to the website, more than 7 million people have already participated in the survey as of February 2015. Among 16 suggested issues, the highest priority is given to "good education" and "better healthcare" and the lowest to the "action on climate change" as well as "phone and the internet access". While international negotiations toward the establishing of the post-2015 development agenda are proceeding, research initiatives to understand concerns and interests among general public is limited to the MY World 2015 survey.

3. Research design

This study uses a questionnaire survey (n=517) to question the general public about individual concerns and interests among twenty-five (25) MDGs/SDGs-related issues in Thailand. The survey was conducted through the internet in February 2015. The levels of the concerns and interests in a certain goal or issue are connected to specific attributes of an individual (sex, education level, income, marital status, number of children, living conditions, and level of happiness) in order to understand how individual attributes or circumstances are associated with the levels of the concerns and interests in a specific MDGs/SDGs goal or issue.

The goals and issues used in the questionnaire survey are selected from 1) MDGs, 2) Reports of the Open Working Group established for preparing a proposal on the SDGs, 3) The Report of High-Level Panel submitted to the UN Secretary-General in the process of developing of the post-MDGs, 4) Sustainable Development Solutions Network (SDSN) Report on the post-2015, and 5) topics included in the Better Life Index Survey by OECD. In particular, the survey adopts some of the goals and issues addressed in the Better Life Index Survey in order to incorporate concerns among citizens in the developed countries as well.

4. Results

4.1 Understanding issues with higher priorities among twenty-five (25) MDGs and SDGs-related issues

In order to understand MDGs and SDGs-related issues with higher priorities among citizens, this research addresses a question to respondents: “What are the issues that require improvement in your life? List in sequence the five most important problems.” For this question, respondents have 25 options to answer. Table 1 shows the results.

INSERT TABLE 1 HERE

As seen in Table 1, the issue in the highest ranking is “continuing economic growth” (33.85%). Relating to this, another one with a high ranking is “promoting good jobs” (30.17%). This may suggest that the improvement of economic conditions is still an important factor in the quality of life in Thailand as other countries.

Another result to observe is that the second and third highest ones are “reducing graft and corruption by public officials” (31.91%) and “constructing a society where people can live safely with minimum crime and violence” (30.17%). On the other hand, the lowest rated issues include ensuring access to safe drinking water (13.93%) and reducing child mortality rates (11.03%). This trend may indicate that some of the issues originally highlighted by MDGs are not relevant for some parts of society in Thailand any longer, as the country has greatly improved economic and social conditions over the years.

The issues with higher priorities among people in Thailand are better recognized in a comparison with the results of Japan. Table 2 illustrates the issues in the highest rankings in Thailand and Japan:

INSERT TABLE 2 HERE

There are sharp differences between the two countries with respect to the issues in the highest ranking. In the case of Japan, one of the highest rated include “promoting the introduction of sustainable energy” (29.5%) followed by “constructing society that protects people from disaster” (28.0%). This trend for the higher level of concerns toward energy and disaster issues may be related to the earthquake disaster that took place in Japan in 2011. On the other hand, the issues associated with graft and corruption are not on the ranking in Japan, while it is on the second highest ranking in Thailand. In general, corruption is recognized as an important social issue among developing countries and The results indicate that Thailand is not an exception in this regard.

4.2. Understanding issues with higher priorities related with three separate categories

This section presents the public perception over the goals and issues related with three separate categories including 1) poverty, 2) health and 3) environment in Section 4. The questionnaire questions individuals about their first, second, and their priority of issues by addressing a question: "what are the most important poverty (or health, environmental) issues for you? List in sequence the three most important issues." While this paper addresses goals and issues related with the three separate categories, the survey itself addressed other goals and issues related to, for example, education and food. However, this paper focuses upon the three categories to examine whether and to what extent the original MDGs issues are primary concerns among citizens in Thailand.

4.2.1. Poverty

The first goal of the MDGs, "to eradicate extreme hunger and poverty" is the goal that expresses the spirit of the MDGs with a reflection on the negative influence of development and economic activity upon the living conditions of people. This spirit is being observed in the discussions for SDGs. At present, the first and the second goals of the SDGs request to end poverty in all its forms and hunger everywhere on the planet and to achieve food security and improved nutrition respectively.

The results of the survey indicate that the poverty issues addressed by MDGs and SDGs may not be of the highest priority in Thailand any longer. As shown in Figure 1, among seven issues listed about the poverty issues, "eliminating starvation" is ranked the fourth (42.8%) and "greatly improving the lives of people living in slums" is placed the fifth (34.7%).

INSERT FIGURE 1 HERE

With this respect, in fact, there is a similar trend between Thailand and Japan. In both countries, the main concerns among the poverty-related issues are given to “providing necessary social security” (58.0% in Thailand and 58.3% in Japan) and “ensuring income above a certain level” (58.3% in Thailand and 57.1% in Japan). As such, each of them gains more than 50%. In line with the results of the survey shown in Table 1 indicate, this results may also indicate that the poverty issue originally identified by MDGs are no longer relevant for some parts of society in Thailand a with the improved economic and social conditions in the country in recent years.

4.2.2. Health

Compared to the coverage of the MDGs on health related goals such as “reduce child mortality” (Goal 4), “improve maternal health” (Goal 5) and “Combat HIV/AIDS, malaria and other diseases” (Goal 6), the number of suggested options in our survey is relatively large. Figure 2 shows the results of the survey about citizen’s priority over health issues in Thailand:

INSERT FIGURE 2 HERE

According to the results of the survey, the concerns of the Thai citizens for the health issues addressed by the MDGs are extremely low. The results show that only 6.0% of the people answered important for “reducing the mortality rate of children under 5 years of age” and only 4.2% answered important for “reducing the mortality rate of expectant and nursing mothers.” Only 9.7% chose the option “preventing the spread of HIV and AIDs and ensure a chance for a medical treatment.”

On the other hand, the votes are given to “exercising appropriately” (33.3%) and “reducing psychological stress” (31.9%). This is the same trend observed in Japan. The results may suggest that the characteristics of the lifestyle have changed over time in Thailand, as developed countries have experienced in the past.

4.2.3. Environment

As for the results of the survey conducted in Japan, “air pollution” ranks the first (43.5%) and “global warming” ranks the second (43.5%). “Forest degradation” (24.2%), “water pollution” (23.5%) and “ozone layer depletion” (22.0%) follow. While the influence of air pollution and global warming is relatively insignificant in Japan, both issues gather high concerns in the general public. On the contrary, the issues that are directly linked to people’s everyday life such as noise pollution, waste problem, soil contamination, land subsidence, the heat island phenomenon and violation of the right to sunlight do not receive major votes in Japan. Figure 3 shows the results of the survey in Thailand:

INSERT FIGURE 3 HERE

The results indicate that there are higher interests among Thai citizens in global warming or climate change (44.5%), forest degradation (39.8%), and air pollution (37.3%). This trend is similar with Japan. On the other hand, the result is contrary to the results of the MY World 2015, which mainly receive answers from respondents in developing countries. As described in Section 2.3, in the case of the MY World 2015 survey, the “action on climate change” gains the lowest concern among the respondents. The results of the survey in Thailand that, while the environmental issues that may directly affect their life do not receive much attention, climate change receive major votes may suggest that the country may have improved the local environmental conditions with better economic and social conditions over recent years. One thing to

note, however, is that there are higher interests in waste management issues (24.2%) in comparison to Japan (21.9%). This may indicate that waste management is still recognized as an important challenge to handle among Thai citizens.

5. Discussion

This paper demonstrated citizens' needs and interests in Thailand among key MDGs and SDGs-related issues under discussions at the international level. In addition, the study compared the results of the survey in Thailand with the results of a survey previously conducted in Japan in order to highlight common as well as uncommon issues between these two countries.

Overall, there are common interests among citizens in Thailand and Japan with respect to MDGs and SDGs-related issues. As stated above, this may be indicative that Thai citizens started to show interests in the issues there were not originally identified by MDGs with the improved economic and social conditions in the country in recent years. If this is the case, the results of the study may suggest that additional process and mechanisms are necessary to integrate local needs and interests beyond the one-size-fits-all approach. As such, in the post-2015 period, local and regional goals setting may be required to meet specific local conditions, while the monitoring efforts to ensure consistency between global and local goals may also need to introduced in the new period.

Further research is needed to understand why and how the issues of higher priorities among Thai citizen are being different from the issues originally addressed under MDGs. Beyond the improved economic and social conditions, there may be additional conditions leading to the changing patterns of interests in Thailand. There need to be further analysis necessary to understand differences in the interests in MDGs and SDGs-related issues among different segments of society as well, depending upon the living conditions and the income level, for example. This part of the study may include a field-based face-to-face interview

study in the country. The combination of the quantitative presentation of the survey and the field-based interview study may help us to gain a better grasp on the citizens' priorities over MDGs and SDGs-related issues in Thailand.

Note

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References

Aryeetey, E., Esty, D., Feulner, E., Geiger, T., Kaufmann, D., Kraemer, A. R., ... Suzman, M. (2012). Getting to Zero: Finishing the Job the MDGs Started. Retrieved from http://johnmcarthur.com/wp-content/uploads/2012/03/Getting-to-Zero-Final-Draft-PDF.pdf

Attaran, A. (2005). An immeasurable crisis? A criticism of the millennium development goals and why they cannot be measured. *PLoS Medicine*, *2*(10), 955–961. doi:10.1371/journal.pmed.0020318

Brito, L. (2012). Science for Sustainable Development. *Science*, *336*, 1396–1398.

Elliott, D. (2005). *Employment , Income and the MDGs - Critical Linkages and Guiding Actions. Briefing Paper.* (pp. 1–8).

Evans, A. & Steven, D. (2012). Sustainable Development Goals – a useful outcome from Rio + 20? New York: Center on International Cooperation.

Fukuda-Parr, S. & Greenstein, J. P. (2010). *How Should MDG Implementation Be Measured: Faster Progress or Meeting Targets?*

(No. No. 63). *SSRN Electronic Journal* (pp. 1–24). doi:10.2139/ssrn.2211599

Fukuda-Parr, S., Yamin, A. E. & Greenstein, J. (2014). The Power of Numbers: A Critical Review of Millennium Development Goal Targets for Human Development and Human Rights. *Journal of Human Development and Capabilities*, *15*(2-3), 105–117. doi:10.1080/19452829.2013.864622

Gauri, V. (2012). *MDGs That Nudge. The Millennium Development Goals, Popular Mobilization, and the Post-2015 Development Framework* (No. No 6282) (pp. 1–20).

Glaser, G. (2012). Base sustainable development goals on science. *Nature*, *67*, 35.

Gore, C. (2004). MDGs and PRSPs: Are Poor Countries Enmeshed in a Global-Local Double Bind? *Global Social Policy*, *4*(3), 277–283. doi:10.1177/146801810400400302

Gough, I. & McGregor, J. A. (2004). Global Social Policy Forum: Human Well-Being: Communicating between the Universal and the Local: Guest Editors' Introduction. *Global Social Policy*, *4*(3), 275–276. doi:10.1177/1468018104047483

Grown, C. (2005). Answering the Skeptics: Achieving gender equality and the Millennium Development Goals1. *Development*, *48*(3), 82–86. doi:10.1057/palgrave.development.1100170

Handoussa, H. (2009). Lessons from the MDGs in Africa. *Journal Compilation. African Development BAnk*, 213–223.

Heeks, R. (2005). ICTs and the MDGs: On the Wrong Track? *Information and Development*, *3*(3).

Higgins, K. (2013). *Reflecting on the MDGs and Making Sense of the Post-2015 Development Agenda* (pp. 1–40).

Horner, C. C. (2012). An Assessment of the June 2012 Rio+20 UN Conference on Sustainable Development. *Engage*, *13*(1), 59–63.

Hulme, D. & Fukuda-Parr, S. (2009). *International Norm Dynamics and "the End of Poverty": Understanding the Millennium Development Goals (MDGs)* (No. No 96) (pp. 1–39).

Jeremic, V. & Sachs, J. D. (2014). The United Nations in the Age of Sustainable Development. *The Economic and Social Review*, *45*(2), 161–188.

Kanie, N., Abe, N., Iguchi, M., Yang, J., Kabiri, N., Kitamura, Y., ... Hayakawa, Y. (2014). Integration and Diffusion in Sustainable Development Goals: Learning from the Past, Looking into the Future. *Sustainability*, *6*(4), 1761–1775. doi:10.3390/su6041761

Kates, R. et al. (2001) Sustainability Science, *Science*, Vol. 292 no. 5517 pp. 641-64.

Langford, M. (2010). A Poverty of Rights: Six Ways to Fix the MDGs. *IDS Bulletin*, *41*(1), 83–91. doi:10.1111/j.1759-5436.2010.00108.x

Lingan, J., Cornforth, J. & Pollard, R. (2012). *Sustainable Development Goals: Building The Foundations For An Inclusive Process* (pp. 1–13).

Manning, R., Harland, S. C. & Haddad, L. (2013). Whose Goals Count? Lessons for Setting the Next Development Goals. *IDS Bulletin*, *44*(5-6), 1–9. doi:10.1111/1759-5436.12049

Melamed, C. & Bergh, G. (2014). *Sustainable Development Goals and Targets: Options for differentiating between countries* (pp. 1–10). London.

Miranda, J. J. & Patel, V. (2005). Achieving the Millennium Development Goals: does mental health play a role? *PLoS Medicine*, *2*(10), 962–965. doi:10.1371/journal.pmed.0020291

Nayyar, D. (2011). *The MDGs beyond 2015* (No. No 38) (pp. 1–25).

Nhema, A. G. (2010). An MDG-plus Agenda for Africa. *IDS Bulletin*, *41*(1), 127–128. doi:10.1111/j.1759-5436.2010.00114.x

Sachs, J. D. (2012). From Millennium Development Goals to Sustainable development Goals. Lancet, 379, 2206–11. doi:10.1016/S0140-6736(12)60685-0

Schneider, F. & Rist, S. (2014). Envisioning sustainable water futures in a transdisciplinary learning process: combining normative, explorative, and participatory scenario approaches, *Sustainability Science*, Vol.9, pp. 463-481

Slay, B., Danilova-Cross, E. & Altangerel, T. (2013). *Reflection on the MDGs, and the post-2015 Agenda, from Europe and Central Asia* (No. No 7) (pp. 1–15). New York.

Toulmin, C. & Gueye, B. (2003). How will West African countries meet the MDGs? In *The Millennium Development Goals and Local Processe* (pp. 107–134).

Vandemoortele, J. (2005). Ambition is Golden: Meeting the MDGs. *Development*, *48*(1), 5–11. doi:10.1057/palgrave.development.1100100

Vandemoortele, J. (2012). *Advancing the UN development agenda post-2015 : some practical suggestions* (pp. 1–22). Bruges.

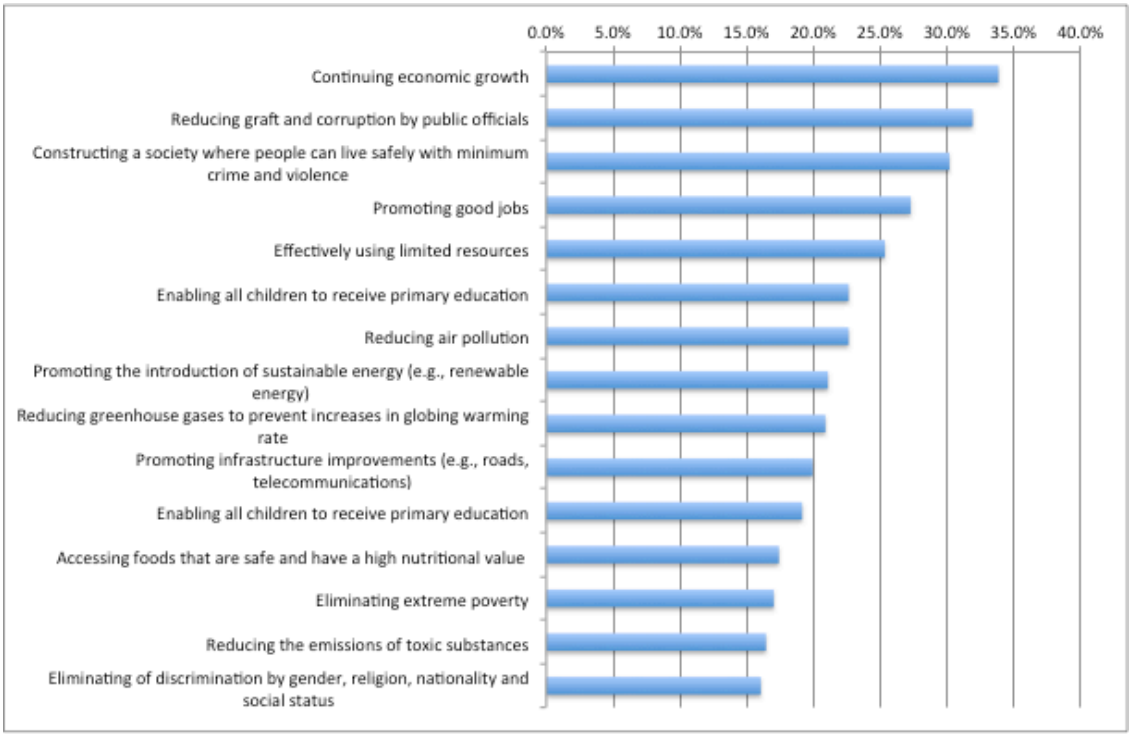
Wiek, A., Withycombe, L., Redman, CL. (2011) Key competencies in sustainability: a reference framework for academic program development, *Sustainability Science*, Vol.6 (pp. 203-218).

Table 1 Distribution of public concerns over the issues that need improvement in current life in Thailand (n=517)

	Number of replies		Percentage of cases
	N	Percentage	
Continuing economic growth	175	6.77%	33.85%
Reducing graft and corruption by public officials	165	6.38%	31.91%
Constructing a society where people can live safely with minimum crime and violence	156	6.03%	30.17%
Promoting good jobs	141	5.45%	27.27%
Effectively using limited resources	131	5.07%	25.34%
Enabling all children to receive primary education	117	4.53%	22.63%
Reducing air pollution	117	4.53%	22.63%
Promoting the introduction of sustainable energy (e.g., renewable energy)	109	4.22%	21.08%
Reducing greenhouse gases to prevent increases in globing warming rate	108	4.18%	20.89%
Promoting infrastructure improvements (e.g., roads, telecommunications)	103	3.98%	19.92%
Enabling all children to receive primary education	99	3.83%	19.15%
Accessing foods that are safe and have a high nutritional value	90	3.48%	17.41%
Eliminating extreme poverty	88	3.40%	17.02%
Reducing the emissions of toxic substances	85	3.29%	16.44%
Eliminating of discrimination by gender, religion, nationality and social status	83	3.21%	16.05%
Increasing agricultural productivity in a sustainable manner	82	3.17%	15.86%
Practicing sustainable farming and fishing	78	3.02%	15.09%
Eliminating gender discrimination and building a society with equality	73	2.82%	14.12%
Ensuring access to safe drinking water	72	2.79%	13.93%
Ensuring good sanitary conditions at home, school and work	72	2.79%	13.93%
Preventing the spread of HIV and AIDS and reducing it	71	2.75%	13.73%
Constructing society that protects people from disaster	69	2.67%	13.35%
Conserving biodiversity	59	2.28%	11.41%
Reducing child mortality rates	57	2.21%	11.03%
Promoting aid to poor countries	41	1.59%	7.93%
Nothing in particular of above	144	5.57%	27.85%
Total	2585	100.00%	

Table 2 The issues in the highest rankings in Thailand and Japan (n=517)

Thailand (n=517)



Japan (n=1,855)

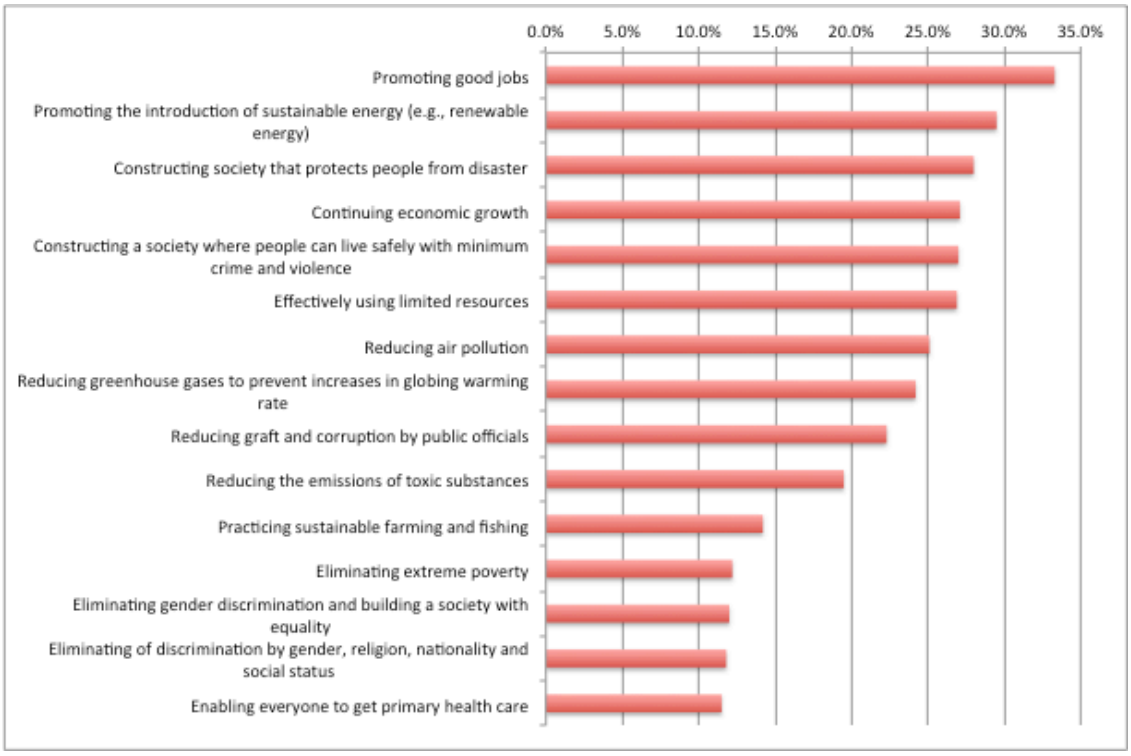


Figure 1 Distribution of public concerns over the poverty related issues (n=517)

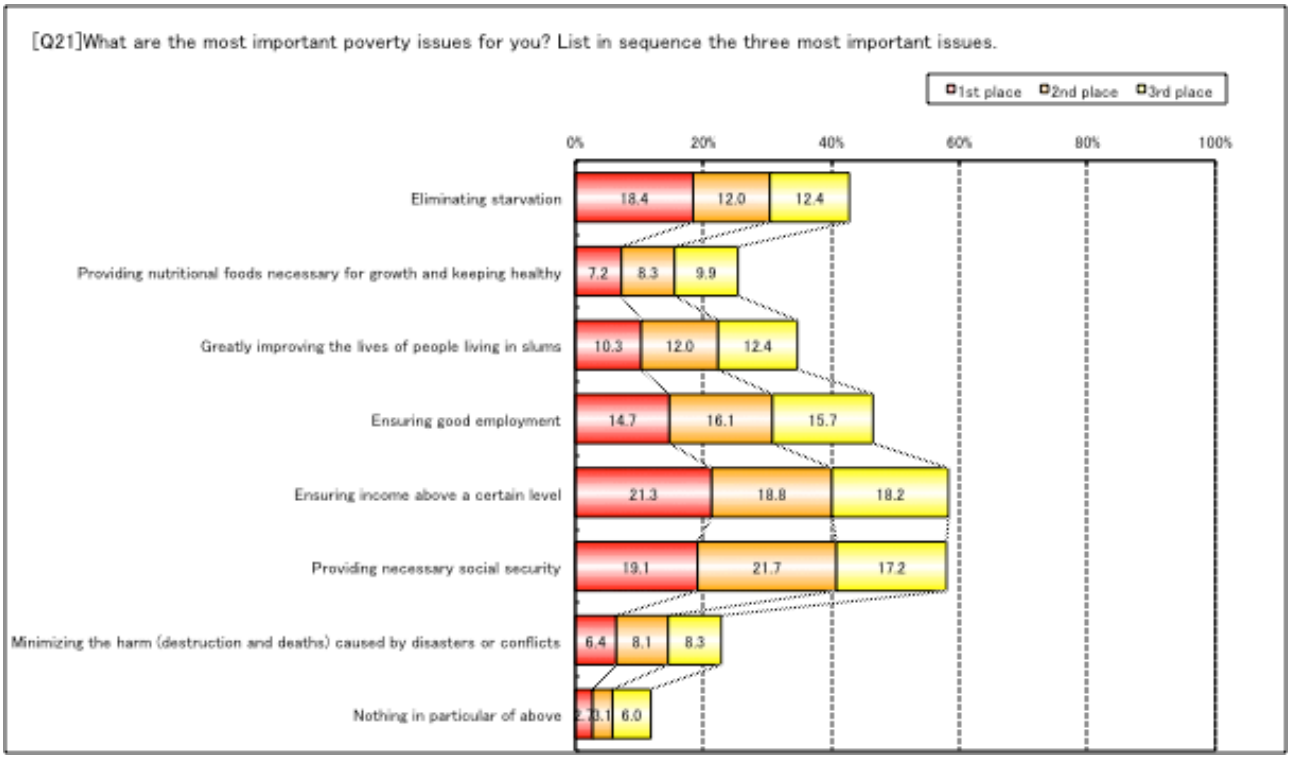


Figure 2 Distribution of public concerns over the health related issues (n=517)

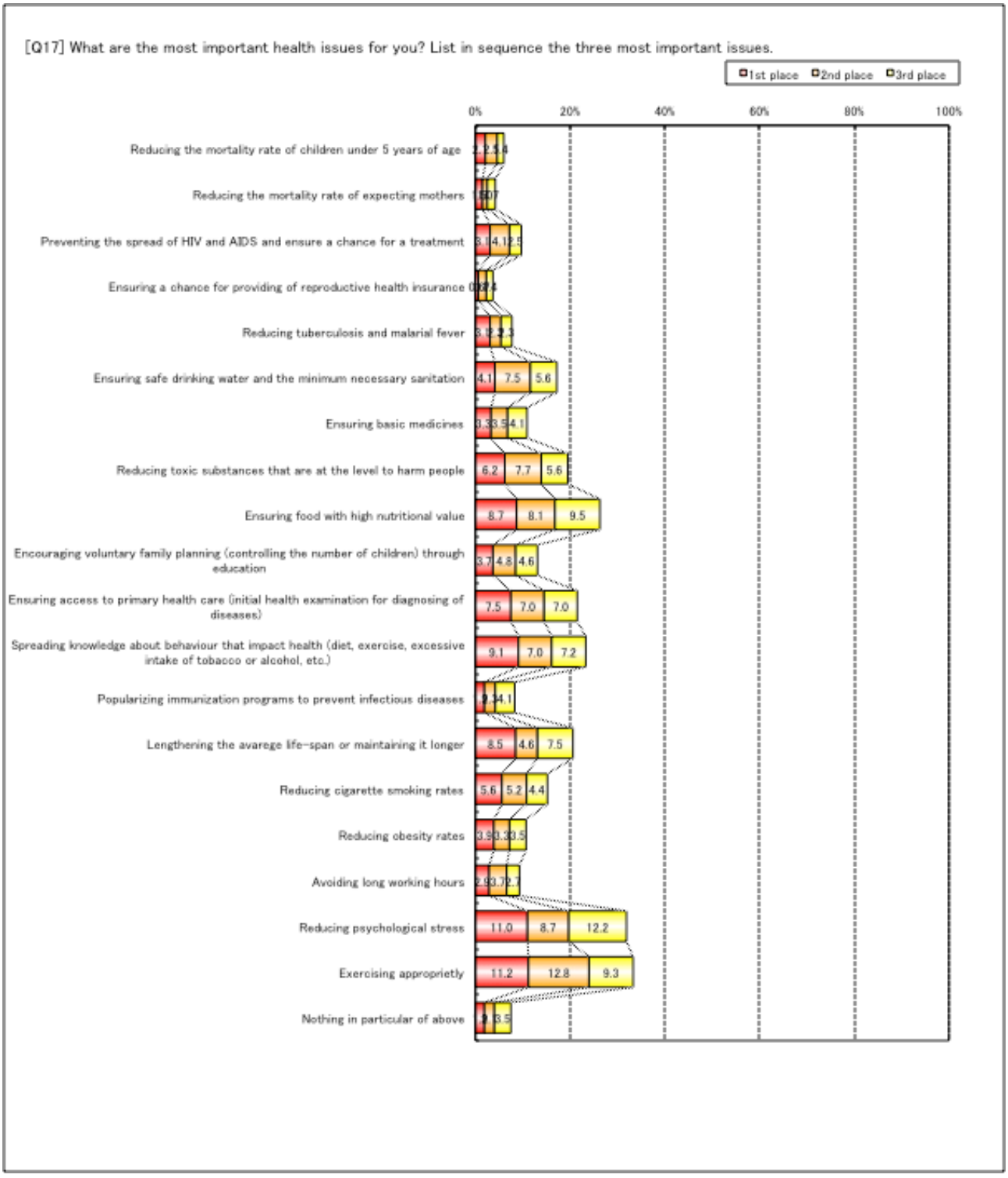
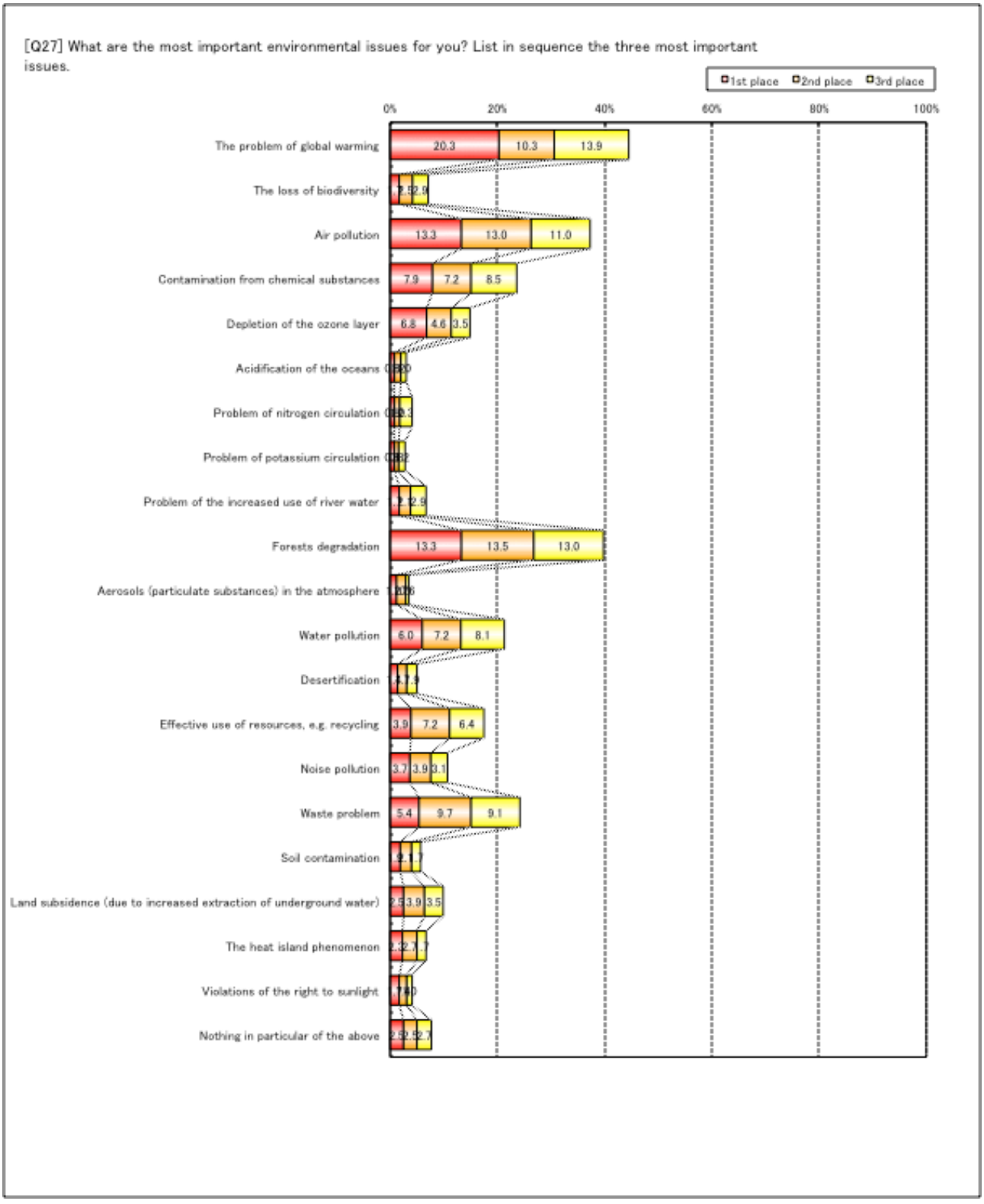


Figure 3 Distribution of public concerns over the environmental issues (n=517)



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Why Green IT is the Best Way for Organizations to Take a Significant Step in the Green Direction

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Abstract:
Information Technology (IT) is at the heart of every successful modern business. Without it, success is impossible. IT is so pervasive that energy efficiency through the implementation of green IT has moved to center stage for many organizations in their pursuit of environmentally helpful practices.

Green IT is an ideal way for most companies and other organizations to make a significant step in reducing their carbon footprint for several reasons. First, for competitive reasons most companies already refresh their computer hardware – laptops, desktops, servers and storage devices – every three to four years. That refresh cycle provides a recurring opportunity to buy increasingly energy efficient technology such as virtual servers, virtual networks, and virtual data storage. Such virtualization can easily reduce IT power consumption for the replaced equipment by 50 percent. A second compelling reason to move to green IT is that virtualization technology allows you to reduce equipment and system management costs for your data center. Data center green technology is based on a very solid business case - even before we consider the savings due to reduced energy costs.

Green IT, green data centers, and the use of cloud computing for energy efficiency are hot-topics, worldwide. At this time, the cost of power and cooling at data centers often exceeds the cost of data center hardware. This paper describes power issues at data centers worldwide along with case studies on effective solutions. The solutions to these power issues include virtualization of servers and data storage. Cloud computing has become the ultimate way to virtualize IT resources and to save energy. Case study benefits of using private clouds, especially for test and development systems, are described.

Cost savings provide the best incentive for energy savings and this paper shows how Green IT uses cost savings to provide the best way for organizations to make a significant move in the green direction.

Keywords – green IT; carbon footprint; mobile computing; cloud computing; healthcare; hospitals; IT virtualization; green data centers; energy efficiency

1. Introduction

Making Information Technology (IT) green is a significant part of the "Green" concepts that will help us reduce greenhouse gases which in turn will help reduce global warming. Recent UN and government sessions on climate change emphasize the environmental importance of "Green" projects. Implementing green data centers and green IT, in addition to helping save the world, can also be very financially rewarding. According to IDC, for every $1 spent on hardware, $1 will be spent on power and cooling. A typical 25,000 square foot data center will cost an organization about $2.5 million a year in electricity costs (at 12 cents per KWH).

Cost savings provide the best incentive for energy savings and this paper shows how Green IT uses cost savings to provide best way for organizations to make a significant move in the green direction.

There are many different aspects of green IT. In this paper we'll use the terms "green IT", "green computing", and "green data centers". Green IT - as used here - is the most comprehensive since it includes all computing, inside and outside the data center [1].

There is one significant aspect of motivation for executives to move to green IT that is not covered at any depth in this paper, and that is the area of corporate social responsibility. There is a growing body of evidence that companies can do well by doing good. The Internet's ubiquitous connectivity has created new relationships among businesses, customers, employees and partners. People now have access to massive amounts of information and opinions about products and company practices. This information is available in every part of the globe, every minute of every day. Collaboration over the Internet is taking place during a time of increased visibility of corporate actions, a time when customers' perceptions of companies - and their consequent purchasing behaviors - are fundamentally changing. Thus, having your company become part of the "green wave" based on corporate social responsibility should be an additional motivation (besides the standard business case) for organizations to pursue green IT.

Although this paper emphasizes the business and cost saving aspects, rather than the technical aspects, of green IT, there are sections that give technical details, including the case study sections. I'm an engineer by training, and I'm fascinated by the technical aspects of green IT. The energy used for green IT and green data centers is electricity, so I would like to give a very brief review of the familiar electricity concepts and relationship of volts, amps, and watts, since these are fundamental in our quest to reduce energy used for green IT. This also relates to the topic of STEM (Science, Technology, Engineering, and Mathematics) and our need to interest students in sustainability and saving energy.

In case you've forgotten your basic electricity, the relationship between volts, amps, and watts is this: watts = volts x amps. A watt is the measure of electrical power. Energy is power over a unit of time. We pay for electricity in terms energy used with a measure of kilowatt hours or KWH. One kilo watt hour (KWH) of electrical energy is the energy used by having 10 one hundred watt light bulbs on for one hour. In the New York City area one KWH costs about 20 cents while in West Virginia a KWH costs only about 5 cents. The big difference in cost is due to the big difference in generation costs. With the high cost of electricity, the region of the country is becoming a significant factor in deciding where to locate a new data center.

Besides the cost per KWH, another aspect of basic electricity to consider for your data center, is the voltage level. In the U.S. we typically have two voltages to use in our homes, offices, and data centers, 110 volts or 220 volts. The actual volts can fluctuate somewhat during the day (as you can

discover using a simple voltmeter) and electrical engineers often give the two voltages available as 120V or 208V. If you have an electric range, an electric clothes dryer, or a large electric air conditioner in your home, they'll be connected to the higher 208V service. The reason is that these appliances need more power; using a higher voltage gives more power and also saves energy. Higher voltage saves energy since the formula for electric losses due to transmission over a wire is $I^2 R$ where "I" represents amps and "R" is the fixed resistance of the wire. Since watts = volts x amps, we can double the power (watts) by doubling the volts or doubling the amps. However, doubling the amps would increase the losses by four times. Thus, to transmit electricity over long distances, the practice is to increase the voltage as much as possible. In high tension towers the voltage is often as high as 120,000 volts and even in the power lines outside our houses the voltage is often 4,000 volts. That voltage drops to 110V for use in our houses to reduce danger of electrocution. As noted, 220V power is used only for electric ranges, clothes dryers, etc., although in Europe the base power is 220V. One easy way to reduce energy transmission losses at data centers is to use 220V (208V) service. Higher input voltage results in more efficient operation. Most servers (just like our laptops or hair dryers) are capable of either 110V or 220V service. Older data centers often have 110V power sources for servers, but switching to 220V (208V) would provide significant savings.

In looking at green IT for this paper, we'll follow this outline:

1. Introduction
2. The Important Steps for moving to Green IT for any Organization
   - Cost savings provide great energy saving incentive
3. The significance of IT virtualization and Cloud Computing
4. Healthcare and Green IT
5. Managing Green IT and Carbon Footprint for Hospitals and other Organizations
6. Measuring green IT and a green data center in Montpelier, France
   - Examples of dashboards at a green data center
7. Private Cloud Case Studies in South Africa
8. Conclusions and next steps to help save the planet

Let's look at these areas one by one.

2. The Important Steps for moving to Green IT for any Organization

Cost savings provide the best incentive for energy savings. As stated above, Green IT is usually the best way for organizations to take a significant step in the green direction. In this section we'll take a look at the important steps for moving to Green IT.

As with the implementation of any new business process, it is very important to first "baseline" the energy use at your data centers. A measurement and monitoring process needs to be setup so you can find out where you are and how you're doing along the way.

Data centers consume more energy per square foot than any other part of an office building. However, in the big picture it's important to realize that your IT systems are part of an information and services supply chain that begins with raw materials and ends with the disposal of waste. The chain includes people, the space they occupy, and the cars they drive. This supply chain uses energy and creates greenhouse gases at every step along the way.

Your IT department is in a unique position to change that. The place to start is with the data center. Energy consumption in the data center is predominantly from two loads: servers and cooling. Figure 1 shows the process used by IBM for creating energy efficient "green" data centers by addressing the energy used by servers and cooling.

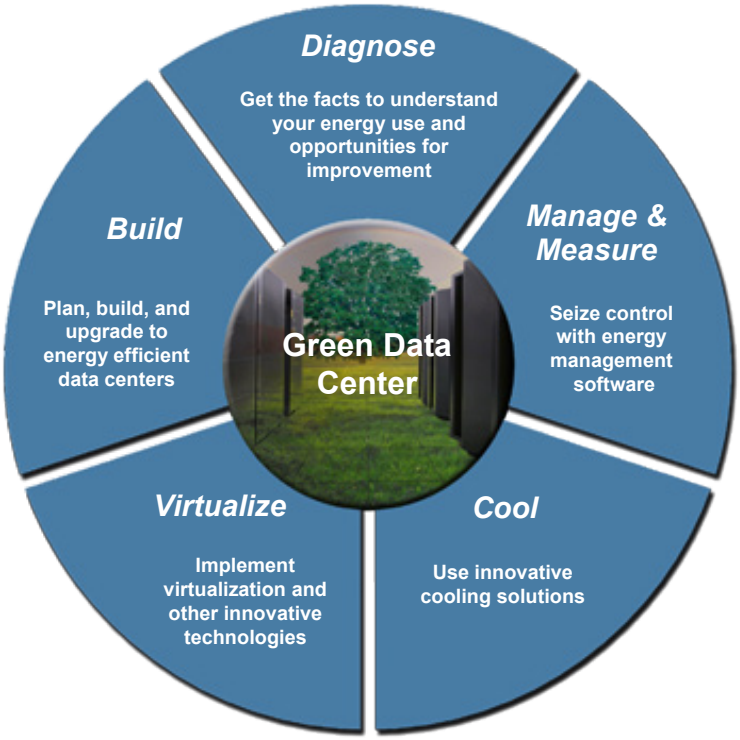


Figure 1. IBM Project Big Green Approach to Data Center Energy Efficiency (Source: IBM Big Green Team)

Five Step Process used for Data Center Energy Efficiency

As indicated in Figure 1, the five process steps are: diagnose, manage & measure, use energy efficient cooling, virtualize, and build new or upgrade facilities when feasible [1].

A. Diagnose the Opportunities and Problems

The step here is to do a data-center energy-efficiency assessment. Many data center energy consultants will bring in tools such as Mobile Measurement Technology (MMT) to look at "hot spots" in the data center and areas where cold and hot air mix too early and thereby waste energy. The assessment should include a list of unused IT equipment that can be turned off. In addition, the diagnostic phase can help encourage organizations to retire unused software applications and focus on adopting more effective software that requires fewer CPU cycles. A typical x86 server consumes between 30% and 40% of its maximum power when idle. IT organizations should turn off servers that don't appear to be performing tasks. If anyone complains, organizations should look into whether the little-used application can be virtualized. Check with your electric utility. Some utilities offer free energy audits.

B. Manage & Measure

Many hardware products have built-in power management features that are never used. Most major vendors have been implementing such features for quite some time. These features include the ability of the CPU to optimize power by dynamically switching among multiple performance states. The CPU will drop its input voltage and frequency based on how many instructions are being run on the chip itself. These types of features can save organizations up to 20% on server power consumption.

C. Cool

Many data centers may use hot aisle/cold aisle configurations to improve cooling efficiency, but there are also some small adjustments they can make. Simple "blanking panels" can be installed in server racks that have empty slots. That's a great way to make sure the cold air in the cold aisle doesn't start mixing with the hot air in the hot aisle any sooner than it needs to. Organizations should also seal cable cutouts to minimize airflow bypasses. Data organizations should consider air handlers and chillers that use efficient technologies such as variable frequency drives which adjust how fast the air conditioning system's motors run when cooling needs dip.

D. Virtualize

Virtualization continues to be one of the hottest green data center topics. Many current server CPU utilization rates typically hover between 5% and 15%. Direct-attached storage utilization sits between 20% and 40%, with network storage between 60% and 80%. Virtualization can increase hardware utilization by five to 20 times and allows organizations to reduce the number of power-consuming servers. Details on IT virtualization are the topic of section 3 of this article.

E. Build

Going Green is easiest if you are building a new data center. First, you make a calculation of your compute requirements for the foreseeable future. Next, you plan a data center for modularity in both its IT elements and its power and cooling. Then you use data center modeling and thermal assessment tools and software – available from vendors such as APC, IBM, HP and Sun – to design the data center. The next step is to procure Green from the beginning – which partly means, buy the latest equipment and technologies such as blade servers and virtualization.

Once you have the equipment, you integrate it into high density modular compute racks, virtualize servers and storage, put in consolidated power supply, choose from a range of modern cooling solutions and, finally, run, monitor and manage the data center dynamics using sensors that feed real-time compute, power and cooling data into modern single-view management software that dynamically allocates resources.

3. The significance of virtualization and cloud computing in green IT

The most-significant step most organizations can make in moving to green data centers is to implement virtualization for their Information Technology (IT) data center devices. The IT devices include servers, data storage, and clients (or desktops) used to support the data center. There is also a virtual IT world of the future - via private cloud computing – for most of our data centers. Although the use of cloud computing in your company's data center for mainstream computing may be off in the future, some steps towards private cloud computing for mainstream computing within your company are currently available. Server clusters are here now and being used in many company data centers. Although cost reduction usually drives the path to virtualization, often the most important reason to use virtualization is IT flexibility. The cost and energy savings due to consolidating hardware and software are very significant benefits and nicely complement the flexibility benefits. The use of virtualization technologies is usually the first and most important step we can take in creating energy efficient and green data centers.

A. Reasons for Creating Virtual Servers

Consider this basic scenario. You're in charge of procuring additional server capacity at your company's data center. You have two identical servers, each running different Windows applications for your company. The first server – let's call it Server A – is lightly used, reaching a peak of only 5% of its CPU capacity and using only 5% of its internal hard disk. The second server – let's call it Server B – is using all of its CPU (averaging 95% CPU utilization) and has basically

run out of hard disk capacity (i.e. the hard disk is 95% full). So you have a real problem with Server B. However, if you consider Server A and Server B together, on average the combined servers are using only 50% of their CPU capacity and 50% of their hard disk capacity. If the two servers were actually virtual servers on a large physical server, the problem would be immediately solved since each server could be quickly allocated the resource each needs. In newer virtual server technologies - e.g. Unix Logical Partitions (LPARS) with micro-partitioning – each virtual server can dynamically (instantaneously) increase the number of CPUs available by utilizing the CPUs currently not in use by other virtual servers on the large physical machine. This idea is that each virtual server gets the resource required based on the virtual server's immediate need.

My favorite diagram for describing the reasons to use server and data storage virtualization is shown in Figure 2. This diagram shows typical server utilization for stand-alone servers (i.e. NO virtualization). The multi-million dollar mainframes are typically utilized on a 24/7 basis at least partly because of the large financial investment. Mainframe "batch" processes such as running daily, weekly, and monthly corporate summary reports are typically CPU intensive and are run at night and on the weekends. The small department Windows server (labeled "Intel-based" in the diagram) is not typically used at night or on the weekends. Creating virtual servers of those Intel-based servers not only allows much better and easier sharing of resources for a mix of lightly and heavily used servers (as in the Server A/Server B example above) but also tends to spread out the utilization over 24 hours on the large physical server that houses the virtual servers.

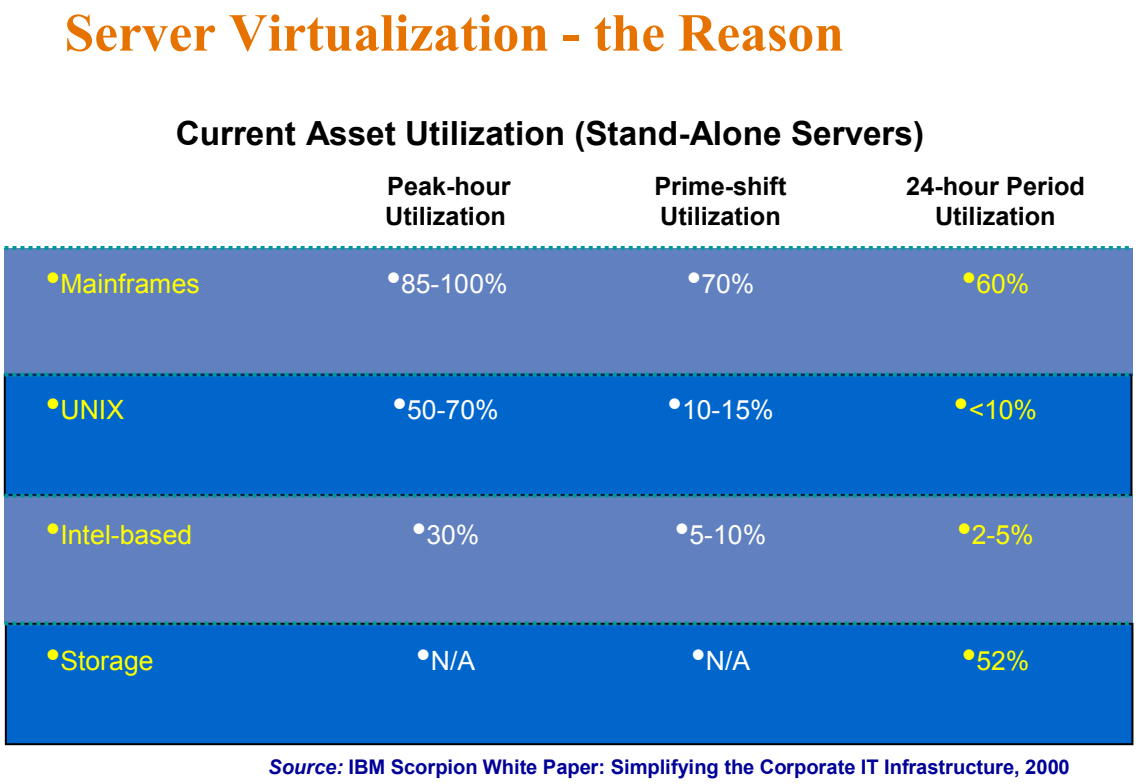


Figure 2. Server Virtualization – the Reason

B. Cloud Computing – The Exciting Future for IT Virtualization

Cloud computing is a new (circa late 2007) label for the subset of grid computing that includes utility computing and other approaches to the use of shared computing resources. Cloud computing is an alternative to having local servers or personal devices handling users' applications. Essentially, it is an idea that the technological capabilities should "hover" over everything and be available whenever

a user wants. Although the early publicity on cloud computing was for public offerings over the public Internet by companies such as Amazon and Google, private cloud computing is starting to come of age. A private cloud is a smaller cloudlike IT system within a corporate firewall that offers shared services to a closed internal network. Consumers of such a cloud would include the employees across various divisions and departments, business partners, suppliers, resellers, and other organizations. Shared services on the infrastructure side such as computing power or data storage services or on the application side such as a single customer information application shared across the organization are suitable candidates for such an approach. Of course IT virtualization would be the basis of the infrastructure design for the shared services and this will help drive energy efficiency for our green data centers of the future [3, 5].

Because a private cloud is exclusive in nature and limited in access to a set of participants, it has inherent strengths with respect of security aspects and control over data. Also, the approach can provide advantages with respect to adherence to corporate and regulatory compliance guidelines. These considerations for a private cloud are very significant for most large organizations.

4. Healthcare and Green IT

Much of the information in this section relating to hospitals and healthcare, in general, comes from my collaboration with Nina Godbole, who is a PhD student at UPES (University of Petroleum & Energy Studies), in Dehradun, India. Nina works for IBM India and she asked me to me an official mentor for her PhD work on "Green IT and Hospitals" [8, 9]

Globally, the healthcare sector [10] is emerging in importance and plays a key role in our economy. Healthcare is not just another service industry; the healthcare sector is characterized by the fact that it brings together people and institutions involved in providing healthcare to those who need such services in times of need and stress. Healthcare is not only a complex industry but also a fragmented industry; it is composed of a number of sub-segments - such as hospitals (a major sub-segment), pharmaceuticals, medical insurance agencies, medical equipment manufacturers, dealers and distributors and diagnostics. Of these sub-segments, hospitals, by their very nature of operations, collect PHI - protected health information related entities as well as treatment specific confidential data.

The healthcare sector makes heavy use of technology including social media. Technological advances have brought about revolution in the healthcare industry worldwide - from modern testing techniques to improved surgical equipment, remote health monitoring technologies with the help of modern digital equipment, etc. There are a number of online healthcare portals.
The complexity and scale of the health care industry helps account for the large environmental (carbon) footprint [11]. For example, in the United States, it is estimated that health care facilities generate more than 5.9 million tons of waste annually. Hospitals contribute approximately eight percent of the greenhouse gas emissions resulting from human activity. ‘Sustainability’ in the healthcare sector can be classified into two types – (i) sustainability issues that are from non-IT areas and (ii) sustainability issues that are due to practices in the IT infrastructure of healthcare; mainly in hospitals. Of late, sustainability is getting integrated into healthcare investors’ financial strategies [12] Sustainable thinking for healthcare [13, 14] (mainly for hospitals) comes from the ‘green-triad’ – (a) green infrastructure, (b) green IT, (c) green medical technology:

- Cost savings through use of optimized and modernized heating, ventilation and cooling (green infrastructure)
- Use of optimized illumination control systems for greater comfort and energy savings (green infrastructure)

- Deployment of customized solutions, services, products, and technologies to optimize the life-cycle performance for hospitals with a view to achieve maximum energy savings, performance and sustainability without losing safety and comfort (green infrastructure)
- Reduced traveling by using modern communications systems, e.g. video conferencing, telemedicine etc. (green infrastructure) [2]
- Green transformation of healthcare data centers through use of consolidation and virtualization technologies (green IT)
- Improving data center energy efficiency - file server storage reduction, and usage of ground water for air cooling in DC (green IT)
- Green IC architectures - desktop and server virtualization (green IT)
- Energy efficient medical technologies (green medical technologies)
- Making operation of medical technologies environmentally friendly (green medical technologies)
- Healthcare waste and eWaste (electronic and electrical equipment) disposal through reduce-reuse-recycle principle (green infrastructure)

Much of the focus today is on the greening of data centers [1]. Although health care organizations use a variety of IT applications and infrastructures, patients may not always see that reflected into the costs to the patients as IT is not one of healthcare organizations' primary activities. Moreover, due to rapid obsolescence of information technology, the IT systems and applications used in healthcare need to be updated. The cost of IT systems in health care services is quite high and often, many of health care organizations pass this cost to their patients. This is how the healthcare delivery becomes expensive from an end user perspective.

Sustainability is a major aspect of healthcare sector operations worldwide, in view of the impact of CFCs (chloro-fluoro-carbon) on our environment and carbon-footprint share of the healthcare. Table 1 shows hospital functional areas in terms of their typical relative monthly energy use and carbon emissions.

Functional Area of Use	***Relative Energy Consumption (Kwh)***	***Carbon Emissions (kilograms CO2-e)***
Ward	1,350	293
Surgery areas	844	268
Back area	619	176
Consulting areas (consulting rooms etc.)	510	166
Administration & Office blocks	474	154
Corridors (24hrs)	349	95

Note - the carbon emissions were calculated using the following Scope 3 emission factors: 1 Kwh electricity = 1.35 kilograms CO2-e and 1 GJ of gas = 55.7 kilograms CO2-e

Table 1. Hospital: Functional Area-wise Typical Energy Consumption and Carbon Emissions

There have been a number of studies on green practices in the healthcare sector [14] and barriers to green practices [13, 15, 16] in the healthcare waste sector. There is indeed a need to rethink

healthcare systems. To design more sustainable health systems, advantage must be taken of demand-side opportunities.

5. Managing Green IT and Carbon Footprint for Hospitals and other Organizations

Sustainability for the healthcare sector and other organizations needs to be addressed from both energy and carbon footprint aspects [8, 9, 17]. The healthcare sector is complex. The author believes that green IT is an ideal way for hospitals to make a significant step in the green direction for several reasons. First, IT is continually being refreshed at hospitals and most organizations as part of the need for the hospitals to keep vital technology up to date. That refresh cycle is similar to the refresh cycle for our company owned laptops, i.e. every three or four years. This results in a tremendous amount of 'eWaste' i.e. electronic waste generated in hospitals and yet this is a neglected area. At all hospitals, servers and data storage are continually being replaced. Replacing the IT equipment and upgrading the application architecture with energy efficient systems such as virtual servers, virtual data storage, and efficient application and database structures, can easily reduce IT power consumption for the replaced equipment by 50 percent. A second compelling reason to move to green IT is that virtual server and virtual data storage technology are methods that allow hospitals to reduce equipment and system management costs. Include private cloud computing for both your production and test / development systems, and the savings are even greater. So the latest green technology is based around a very solid business case without even considering the savings due to reduction in energy costs.

The following information on the process for creating green IT at a hospital is based on the extensive work done for green IT in other sectors (mainly data centers) in effectively measuring and improving IT energy efficiency. The following six tasks are applicable to all green IT projects, including hospitals.

A. Communicate Green IT Plans and Appoint an Energy Czar

Being able to measure the current state of affairs, energy-wise, is one of the first steps to take. You need a baseline on which to start measuring the impact of your hospital's energy-saving initiatives in the green IT area. Of course, you must also communicate your proposed energy-efficiency initiatives right away. Let all hospital employees know about the plans and goals to save energy via green IT. Besides communicating with your hospital employees, set up an organization to drive the effort. You may start by making one person responsible; give that person a title ("energy czar").

B. Consolidate and Virtualize

Consolidating IT operations, and using virtualization to reduce server footprint and energy use, are the most well-recognized and most-often-implemented efficiency strategies of the past few years. Most of the largest technology organizations in the world have completed major data-center consolidation projects. The projects included server consolidation and virtualization.

C. Install Energy Efficient Cooling Units

Cooling can account for almost half of your IT electrical energy use. State of the art cooling technology can significantly reduce cooling costs.

D. Measure and Optimize

The metrics used to measure Green IT for data centers are the Power Usage Effectiveness (PUE) and the related Data Center Infrastructure Efficiency (DCiE) [3].

In 2008 The Green Grid modified the PUE metric to make it simpler to understand. The new metric is called Data Center Infrastructure Effectiveness (DCiE). The following graphic describes both metrics:

Then PUE = (Meter Total Power) / (UPS output power). A PUE below 1.5 is considered excellent (a PUE of 1.0 is "perfect"). See Figure 3.

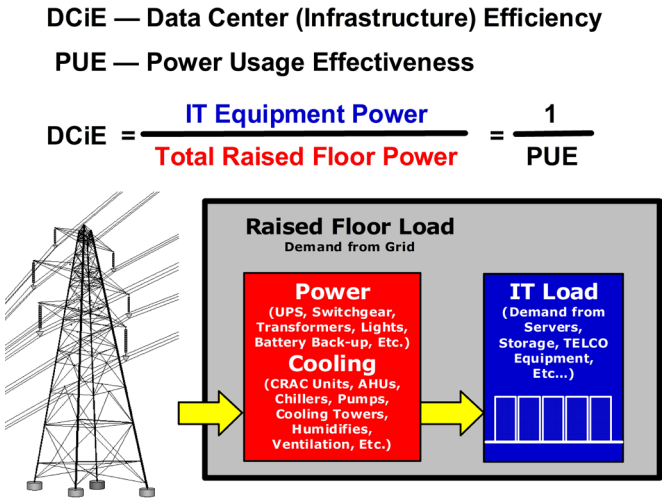


Figure 3. Data Center Metrics DCiE and PUE

The fast way often used to compute PUE at a data center is to use information from the Uninterrupted Power Supply (UPS). The output of the UPS is the power used for IT. The meter reading for the data center gives the total power needed.

E. Implement Efficient Applications and Deduplicate Data

Software and application efficiency can be very significant for green IT. The author has had recent experience where the procedure for creating a data warehouse report was reduced from eight hours to eight minutes merely by changing the Oracle data warehouse search procedure (e.g. don't search the entire database each time when only a much smaller search is required). During the eight hours required to create the report, the large server was running at near peak capacity. Sure, that type of significant application inefficiency has been created and fixed many times over the history of programming. But what about the cases where a few application efficiencies will make an application run 20% faster"? That 20% more efficient application will also result in 20% lower energy use. The steps required to improve application efficiency by a few percent are often not easy to determine. However the added incentive of saving energy – while making the application run faster - is a significant plus.

Data-storage efficiency, such as the use of tiered storage, is also very significant. Data deduplication (often called "intelligent compression" or "single-instance storage") is a method of reducing storage needs by eliminating redundant data. Only one unique instance of the datum is actually retained on storage media, such as disk or tape. Redundant data are replaced with a pointer to the unique data copy. For example, a typical email system may contain 100 instances of the same one-megabyte (MB) file attachment. If the email platform is backed up or archived, all 100 instances are saved, requiring 100 MB storage space. With data deduplication, only one instance of the attachment is actually stored; each subsequent instance is just referenced back to the single saved copy. In this example, a 100 MB storage demand can be reduced to only one MB.

Data deduplication offers other benefits. Lower storage space requirements will save money on disk expenditures. The more efficient use of disk space also allows for longer disk-retention periods, which provides better recovery time objectives (RTO) for a longer time and reduces the need for tape backups. Data deduplication also reduces the data that must be sent across a WAN for remote backups, replication, and disaster recovery.

Data deduplication uses algorithms to dramatically compress the amount of storage space needed. Many organizations are dealing with increased scrutiny of electronically stored information because of various regulations; this need to preserve records is driving significant growth in demand for storing large sets of data. Depending on the type of information being compressed, deduplication can enable a compression rate of between 3:1 and 10:1, allowing businesses to reduce their need for additional storage equipment and associated tapes and disks. Many businesses are already using the technology.

F. Make use of Rebates and Incentives

More utility providers are offering rebates or other incentives that encourage businesses to update equipment and adopt efficient operational practices that can help reduce peak and total power demands.

Since power companies don't want to have to build all the new capacity that may be required to keep all these new and growing data centers in operation, everyone has ended up happy. The facilities guys didn't have to build as much space, the IT organization and engineering groups got new equipment that was smaller, cooler and faster than before, and the power company was happy to eliminate a big chunk of demand.

6. Measuring Green IT and a Green Data Center in Montpelier, France

"If You Can't Measure It, You Can't Manage It" (Quote attributed to many, including W. E. Deming and Peter Drucker). In order to measure green IT, we must have standards as to what constitutes green IT. The standards are IT energy-use metrics. In addition to measurements for IT energy use, there are also the measurements for green buildings, such as the Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC). LEED provides a suite of standards for environmentally sustainable construction. LEED does not relate directly to green data centers, but rather to the overall building.

Another metric for green IT is EPEAT, the Electronic Product Environmental Assessment Tool. EPEAT was created through an Institute of Electrical and Electronics Engineers (IEEE) council because companies and government agencies wanted to put green criteria in IT requests for proposals. The Standard Performance Evaluation Corp. (SPEC) benchmark information has been used for years to compare servers from a power aspect. In the author's experience, companies are very interested in SPEC marks when comparing new servers. Customers use the SPEC marks in order to compare relative power. Here's the SPEC homepage: http://www.spec.org/. SPEC now has a benchmark to compare the power consumed by a server with its performance - a metric designed to aid users in boosting data center efficiency.

A. Energy-Use Dashboards at Montpelier, France

The demo data center in Montpelier, France is called the PSSC (Products and Solutions Support Center) Green Data Center of the Future. The main idea was to create a customer friendly real-time green showcase production data center that will demonstrate a large percentage of the currently available best practices in IT and facilities energy conservation, integrating at least one bleeding-edge major conservation technology [7, 1]. The information on the use of a live camera, thermal

camera, and green IT energy use real-time dashboards available to IT personnel through a portal are interesting innovations that can help communicate the energy efficiency of the data center to all interested employees.

The Power Usage Effectiveness (PUE) is the metric used to measure the energy efficiency of a data center. Both IT and non-IT resources' energy consumption are gathered. Two PUEs are measured: overall and high-density zone. For demo purposes you can show in real time the PUE of the PSSC Green Data Center. Although the PSSC green data center is for demo purposes, these energy use dashboards would be useful for any data center to raise company awareness on IT energy efficiency. These dashboards remind me of the real time gas mileage graphics on the Toyota Prius automobile I recently rented. The graphics on the Prius' dashboard constantly reminded me that I was getting around 42 miles per gallon and informed me when the car was using the electric motor and when it was using the gas engine (and charging the battery). The data center energy use dashboard for the Montpelier demo center is shown in Figure 4.

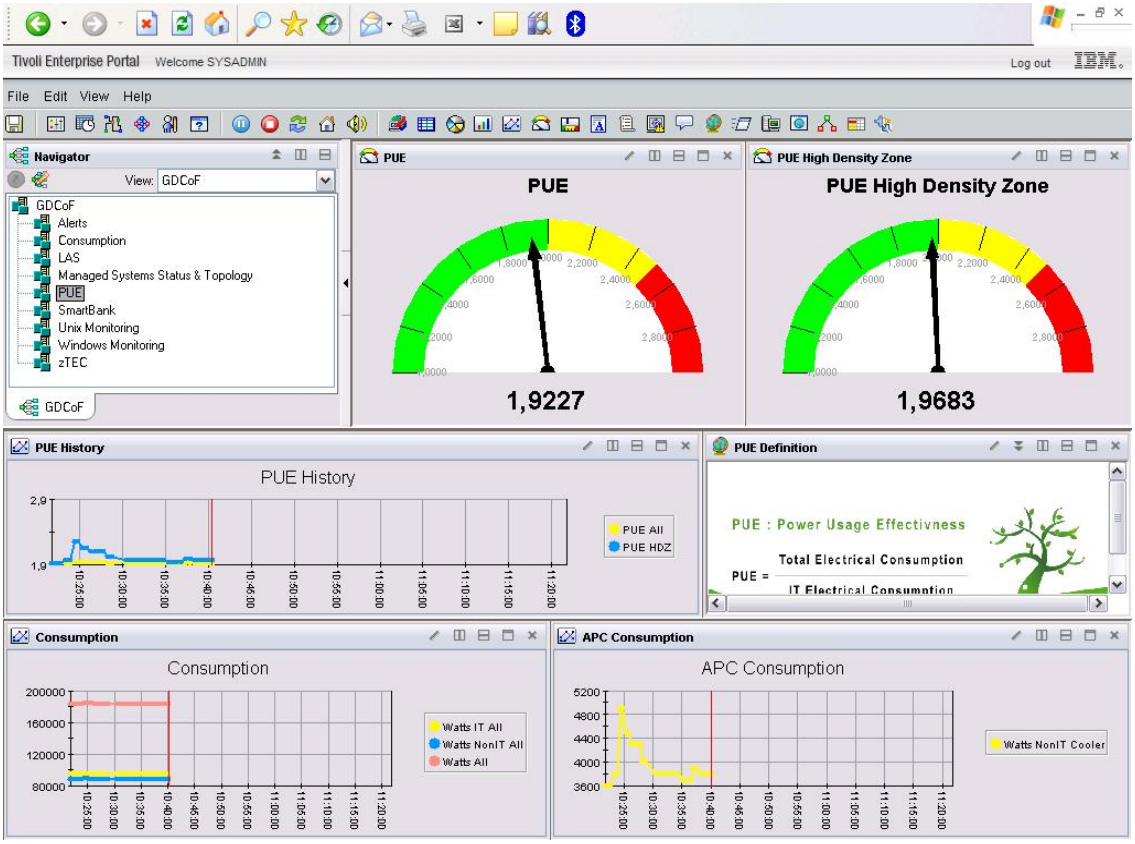


Figure 4. Montpelier PSSC Green Data Center Energy Use Dashboard
(Source: IBM Montpelier PSSC Green Data Center Team)

7. Private Cloud Case Studies in South Africa

My involvement with green IT and private cloud case studies in South Africa is based on my work at a mobile telephone customer site in Johannesburg as an enterprise IT architect from March 2009 to April 2010 on an IBM International Assignment [3].

During that time there were several complete power outages at the data center location (power lost in all the surrounding area). This is a problem throughout sub-Saharan Africa. The main customer data center in South Africa could not add any new servers since the power company was already supplying maximum power available.

These power issues provided great incentive to reduce servers and power required with server virtualization and cloud computing. There were several long term benefits to a strong policy to reducing energy and increasing data center efficiency since the mobile telephone company is in 21 countries throughout Africa and Middle East with over 100 million customers.

A. Cloud Computing and Private vs. Public Clouds

Cloud computing is a style of IT delivery in which applications, data, and IT resources are rapidly provisioned and provided as standardized offerings to users over the web in a flexible pricing model. The resources are provisioned "on demand".

A cloud computing platform dynamically provisions, configures, reconfigures, and deprovisions servers as needed. Servers in the cloud can be physical machines or virtual machines. Clouds typically also manage other computing resources such as storage area networks (SANs) and network equipment.

A public cloud or external cloud describes cloud computing in the traditional mainstream sense, whereby resources are dynamically provisioned on a fine-grained, self-service basis over the Internet,

Private clouds describe offerings that emulate cloud computing on private networks. These (typically virtualization automation) products offer the ability to host applications or virtual machines in a company's own set of hosts.

B. Private Cloud Case Study for a Large Cell Phone Company in South Africa

This case study is for a large cell phone company in South Africa [3]. The cell phone company was experiencing very typical concerns for large companies with their test and development environments. The concerns included:

- Test environment resource availability. This was for both hardware and people resource, especially in an end to end testing environment.
- There was no good scheduling process for shared resources.
- There was significant amounts of test server waste due to lack of governance and management – for example every project gets servers for testing and the servers were often not released when testing is completed.

A private cloud was proposed to manage the company's virtualized test environments. The private cloud was designed to provide tight governance around automated provisioning and de-commissioning of environments allocated to projects. Based on their analysis, the cloud proposal team believed a private cloud for test and development environments would offer the company benefits in the form of;

- Greatly reduced time to procure test servers/systems
- Allow tight scheduling and governance of test systems
- Significantly reduced number of servers used for test
- Significantly reduced number of people resources for test
- Reduced test server waste because of lack of governance and management
- Eliminate cloud security concerns since the private cloud is installed at the customer's data center
- Governance that makes sure servers provisioned for testing are released when testing is completed.

During 2010, the cell phone company's South Africa IT landscape continued to increase in size and complexity, here is analysis of benefits to a cell phone company.

- 1100+ Server Instances – The number of instances has grown exponentially over the past 5 years
- 40% - 60% - estimated spend on maintaining current IT infrastructures versus adding new capabilities
- 87.03% Avg. idle – The company has an average of 12.97% CPU usage across platforms – test is lower

Cell Phone Company Server Roles and Tech Refresh

- Estimated 40% of servers are used in pre-production roles
- Pre-Production servers consume up to 40% of power and cooling (339,509 Watts)
- There are 231 End of Life servers as of April, 2010.
- 149 Windows Servers. Approx. 80 Pre-Prod
- 44 AIX Servers. Approx. 25 Pre-Prod
- 38 Linux Servers. Approx. 20 Pre-Prod

An example of the server breakdown between production and pre-production (Dev/Test) is given in Table 2.

	Server Count	% of Total	CPU Count	% of Total	Power Watts	% of Total
Prod + DR	447	58%	2839	65%	515,436	60%
Pre-Prod + Unknown	323	42%	1558	35%	339,590	40%
Totals	**770**	**100%**	**4397**	**100%**	**855,025**	**100%**

Table 2. Cell Phone Company Server Counts and Power Consumption

A detailed spreadsheet was developed to determine the projected financial benefit from the use of a private cloud. The spreadsheet indicated projected server and labor resource savings due to use of a private cloud for test and development servers. The projections indicated that when 280 application test/dev environments were moved to a private cloud, the number of servers could be reduced by 62%. The time (days) to provision the test environments would be reduced from 33 days to 5.4 days and the number of test team members needed to provision the test environments would go from 16 team members to 2 team members.

The cloud estimations spreadsheet described in the section above proved to be a good way to present savings due to the use of cloud for test/dev. Much of the projected savings was due to reduced labor (i. e. testers). Overall, a private cloud provides a way to greatly improve test and development environments for 1) speed in setting up test environments 2) saving hardware, software, and labor for testing.

C. Private Cloud Benefits for Bank in South Africa

This case study for a bank in Johannesburg, South Africa provided much of the incentive for the cell phone company described above. With their private cloud for test and development systems, the bank reported:

- **Speed:** Test system setup that previously took two weeks now takes two hours.
- **Energy Savings:** The bank reported a reduction of virtual servers by half, reducing power and cooling in half.

8. Conclusions and next steps to help save the planet

This paper has provided information on why Green IT is the best way for organizations to take a significant step in the green direction. Green IT is the best way since cost savings provide the best incentive for energy savings and green IT will provide significant cost savings, better than any other green initiative. Other green initiatives such as the use of solar energy and wind energy are still only economically viable with rebates.

The future of green IT is being shaped now - based on university, corporate, and government research, regulations, incentives, etc. Because of the dynamic aspect of IT, we have already made significant progress with green computing and can build on that past.

For success with green IT, every green project needs to be a very collaborative endeavor. Energy utilities, government regulators, environmental advocates, and the groups involved in helping build data centers – including the Infrastructure Technology Providers – all need to collaborate with IT providers and IT customers. As discussed in the paper, Green IT provides an excellent STEM project for student involvement. Healthcare costs are a major concern worldwide. Success with healthcare initiatives to reduce cost and improve services will be significantly influenced on the success of healthcare Green IT initiatives. As discussed in this paper, emerging technologies such as mobile computing and cloud computing hold great promise to reduce costs and significantly improve services in the healthcare industry and all organizations.

One of the most important arenas for development of green IT is that we must have better measurements in order to better manage energy use at data centers and throughout the corporation. All organizations need an inexpensive power/energy monitoring appliance that will provide information on the power and energy use for each IT device. Then we will be able to see real-time energy reduction results of using virtualization and other energy saving initiatives, as demonstrated with the real-time energy measurements at the data center in Montpelier, France.

Our case studies focused on Green IT and Cloud Technology for South Africa. Green IT (including Cloud) Technology is essential in Africa and all countries. Power outages and inability for the power company to supply sufficient power are common throughout Africa. It is important to remember at data centers, efficient cooling, UPS, and air handling can be as important as efficient IT devices (e.g. IT virtualization). The latest technologies, such as Private Cloud, have great promise at data centers not historically tightly governed and managed.

Going forward, we all have a role in data center and IT energy and cost efficiency and can help save the planet!

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References

1. Lamb, John. “The Greening of IT - How Companies Can Make a Difference for the Environment”, Pearson Education/IBM Press, May 2009
2. Nicol, Dirk, “Mobile Strategy - How your Company Can Win by Embracing Mobile Technologies”, Pearson Education/IBM Press, April 2013
3. Lamb, John. "Green IT and use of Private Cloud Computing in South Africa", CEWIT 2011 Conference, Copyright IEEE, November 2011.
4. Shah, Rushabh. "Eco-Friendly IT: Greener Approach to IT", Journal of Management and Business Research, ISSN 2162-8955, Vol. 2, No. 2, April 2012
5. Isom, Pamela K., and Kerrie Holley. “Is Your Company Ready for Cloud?”, Pearson Education/IBM Press, July 2012.
6. Molla, Alemayehu and Abareshi, Amed. "Organizational Green Motivations for Information Technology: Empirical Study", Journal of Computer Information Systems, Spring2012, Vol. 52 Issue 3, 2012.
7. Rodriguez, Jean-Michel. "PSSC Green Data Center of the Future", several IBM presentation, 2008 through 2013.
8. Godbole, N and Lamb, J. "Calculating a Hospital's IT Energy Efficiency and Determining Cost Effective Ways for Improvement", CEWIT 2014 Conference, Copyright IEEE, 2014.
9. Godbole, N and Lamb, J. "The Triple Challenge for the Healthcare Industry: Sustainability, Privacy, and Cloud-Centric Regulatory Compliance", CEWIT 2013 Conference, Copyright IEEE, 2013.
10. Overview of Healthcare Industry -http://www.technofunc.com/index.php/domain-knowledge/healthcare-industry/item/overview-of-healthcare-industry
11. "Healthcare accounts for eight percent of U.S. Carbon Footprint" - http://www.uchospitals.edu/news/2009/20091110-footprint.html
12. Four Reasons Why Sustainability Investments Are Vital to Hospital Finance Strategies - http://www.beckershospitalreview.com/racs-/-icd-9-/-icd-10/4-reasons-why-sustainability-investments-are-vital-to-hospital-finance-strategies.html
13. "Sustainable Health Systems: Visions, Strategies, Critical Uncertainties and Scenarios", World Economic Forum 2013 report prepared in collaboration with McKinsey & Company
14. 500-plus Hospitals join forces to Green the Healthcare Industry - http://www.greenbiz.com/blog/2012/04/05/500-plus-hospitals-join-forces-green-health-care-industry
15. Hussain A. Al khuwaildi. "Green Techniques in The Healthcare System", a Thesis In Partial Fulfilment of the Requirements for the Degree Master of Science, Jordan University of Science and Technology, Jordan, May 2010
16. "The Growing Importance of More Sustainable Products in the Global Health Care Industry", research study by Johnson & Johnson - http://www.jnj.com/wps/wcm/connect/ef4195004cca13b8b083bbe78bb7138c/JNJ-Sustainable-Products-White-Paper-092512.pdf?MOD=AJPERES
17. Franchetti, M. J. "Carbon FootPrint Analysis", 1st Ed, CRC Press, 2013. ISBN 978-1-4398-5783-0.

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