

A systematic literature review on sustainable fresh food cold supply chain: state-of-the-art and future direction

Jing Liao^{1,2}, Pamela Danese¹ Andrea Vinelli¹

University of Padova, Department of Engineering and Management
Stradella S. Nicola, 3, Vicenza 36100, Italy

Jing.liao@studenti.unipd.it; pamela.danese@unipd.it; andrea.vinelli@unipd.it

Ruhe Xie²

Guangzhou University, School of Management
230 Wai Huan Xi Road, Guangzhou Higher Education Mega Center,
Guangzhou 510006 P.R.China

rhxie@gzhu.edu.cn

Jie Tang³

Guangzhou Panyu Polytechnic
1342 shiliang Road, Panyu, Guangzhou 511483, P.R.China

gzpyp@gzpyp.edu.cn

ABSTRACT

The fresh food cold supply chain industry needs to balance environmental, social, and economic aspects to maintain the market existence. Sustainable fresh food cold supply chain is one of the recent beneficial fields that can balance environmental, social, and economic aspects. To better understand the sustainable fresh food cold supply chain, it is necessary to conduct comprehensive review research. The primary purpose of this research is to explore different insights from the existed literature that can help better achieve sustainable development of the fresh food cold supply chain. To examine various insights and gaps in sustainable fresh food cold supply chain, 142 papers are selected from the SCOPUS database (January 2001 to August 2021). The selected papers are categorized on the basis of year, authors, organizations, journals, citations, status of the country. The categorization of selected papers helps to explore various gaps. Such as SFFCSC has been studied more in developed countries and less studied in developing countries during the time between 2001 and 2017, while from 2018 till August 2021, the studies of SFFCSC in developing countries are more than in developed countries. The selection of papers in this study is limited to English publications and the SCOPUS database, which are the limitations of this study.

KEYWORDS: Literature review; Sustainable fresh food cold supply chain; Sustainability; Descriptive analysis

1 INTRODUCTION

Climate change has become a global issue and is of common concern to the international community. It is also the most serious global environmental problem facing mankind (Zani, 2013). Global scientific research shows that climate change mainly depends on human activities and large-scale use of energy, resulting in excessive emissions of greenhouse gases such as carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) into the atmosphere (Ma et al., 2010). In many developed and developing countries, the food industry is the largest manufacturing sector (Egilmez et al., 2014). As the population grows, the global population is expected to exceed 9 billion in the next 30 years (Pullman & Wu, 2012). Thus, the demand for food will increase as the population expands. Simultaneously, the demand for fresh food will also continue to rise, and many natural resources will need to be consumed. However, due to the non-farming and inherent related needs of human beings-water to drink, fuel to drive, land to live on, etc., the resources available for growing and producing fresh food will be declined (Krishnan et al, 2020). At the same time, post-harvest losses in the fresh food products supply chain vary from 13% in Europe to 30%-40% in developing countries (Wakeford et al, 2015). Hence, the sustainable development of fresh food has become even more crucial to meet the future demand for fresh food as the population increases.

Compared with the conventional fresh food supply chain with a high loss rate of fresh food, the cold supply chain is a refrigerated supply chain that can maintain the low temperature required for processing, storing, distributing, and selling fresh food products. On the one hand, in the fresh food supply chain system, the cold supply chain has the potential to maintain food security and reduce food waste, which will help improve human well-being (Hu et al, 2019). But on the other hand, this requires the use of refrigerated warehouses and trucks that consume a lot of energy for refrigeration, and also there will be refrigerant gas leakage. Therefore, higher energy consumption is related to high carbon dioxide emissions in power generation equipment. In other words, the cold supply chain can be seen as a transformative technology that shifts the carbon investment from fresh food production to refrigeration, thereby reducing fresh food loss and increasing energy use. According to some research results show that in the food industry, the energy consumption of cold equipment accounts for about 50% of the total energy consumption (James & James, 2010), nearly 30% of the energy emissions in the world are caused by the cold supply chains (Kayfeci et al, 2013). With people are increasingly aware of environmentally conscious of the future, consumers will consider ecological and ethical standards when choosing fresh food products. As reported by (de Boer,2003), consumers in rich countries need high-quality, secure fresh food produced with minimal environmental effects. As a result, this increased awareness of the impact of fresh food on the environment, and consumers and policy-makers have begun to request information on the quality, safety, sustainability, source, resource consumption, and shelf life of fresh food, which affect the fresh food supply chain (FFSC) decisions directly (Beske et al., 2014).

Based on the above background, it is obvious to expand the cold supply chain of fresh food in a sustainable way, and it poses challenges that should be addressed. SFFCSC has notable advantages in improving the triple bottom line performances, which has aroused the interest of practitioners and scholars worldwide to explore more insights in recent years. As per the existing review articles on SFFCSC, only one review article published in 2018 explored the insights of sustainable perishable food products cold supply chain. Most of the existing review articles on the fresh food cold supply chain focused on other specific topics, such as time-temperature management, vehicle routing in food cold supply chain, and cold supply chain food packaging surface, and so on. In other words, the existing review articles lack the analysis of the content of the recorded literature of SFFCSC. Since the aim of a “systematic

literature review” is to provide a unbiased, comprehensive research to identify all relevant studies (Aromataris, E., & Pearson, A. 2014). Therefore, it is critical to conduct a systematic literature review on SFFCSC to explore its insights. This study aims to explore insights from the selected literature in the time span from January 2001 to August 2021. According to the selected articles categorized by year, authors, organizations, journals, citation, the status of the country to understand the status of current research and explore future research opportunities on SFFCSC. As per each categorization, this study recorded the frequency of articles with percentage contributions to present findings. A comprehensive set of 142 articles for content analysis shows the current research status in this field is relatively more minor. Also, it demonstrated various future research directions, which must be adopted urgently for good practices for reducing the negative impacts on the environment from each stage of the cold supply chain operation to achieve the sustainable development of the fresh food cold supply chain.

The remainder of the article consists of multiple sections as follows: Section 2 describes the adopted methodology of the study. The classification of the selected articles with tabular and graphical representation is described in section 3. Section 4 discusses the findings and presents the future research direction. In the end, an overall conclusion of this study is presented in section 5.

2 METHODOLOGY

In this study, we proposed a categorization-based systematic literature review to achieve the goal of exploring the various insights of SFFCSC. To do so, we adopted the review process that is in line with the approach proposed by (Tranfield et al. 2003) . They chose a structured review to reduce the bias in the results of literature reviews through manual filtering for transparency and replicability. Also, they considered that literature review is necessary for any research plan, especially for generating a knowledge base by evaluating selected papers in the research area. It is evident that collects data from various relevant sources and then divides them into different categories to explore more insights in the research area is the most commonly used method in the existing literature (e.g. (Shashi et al, 2018) (Awad, 2020) (Ndraha, 2018)). This study analyzed the selected papers by categorization to find out the research gaps in the available literature. The analysis of these identified gaps can provide opportunities for the future, which can help to understand the research area better.

2.1 Literature Selection Criteria

The literature selection criteria adopted for a five-step methodology for this study are as below:

1. We chose the SCOPUS database to retrieve publications with a set of keywords in Title, Abstract, and Keywords. The keywords were identified by reviewing the existing review article and inquiring to experts who specialize in the sustainable cold supply chain for fresh foods. The set of keywords is represented in Table 1. In the initial stage, it came out with 481 articles.
2. We chose to consider only journal articles to improve the reliability of the data because journal articles go through a formal double-blind peer-review process. In this regard, book chapters, conference papers, review, conference review, book, editorial, short survey were not taken into account. This study considers the time span from 2001 to August 2021. These two criteria refinements resulted in 279.
3. The inclusion of subject areas like Environmental science, agricultural and biological sciences, engineering, energy, business, management and accounting, earth and planetary

sciences, social sciences, decision sciences economics, economics and finance, mathematics, multidisciplinary, materials science resulted in 247 articles.

4. We considered only English language articles because of the predominance of that language in academic research. Simultaneously, we excluded the articles that did not include the sustainability issues through title reading. This step resulted in 233 articles.
5. The last refinement criterion was abstract reading and analysis. In abstract analysis, it narrowed the scope to articles whose abstracts focus on the presence of management or technology issues in the articles. A review study also emphasized this point, stating the lack of study on management attitudes for sustainable practices (Hahn & Kühnen, 2013). The meaning of management issues are issues that are associated with inappropriate decision-making, management attitudes, strategic misalignment, low operational efficiency, and the lack of adoption of advanced technologies with sustainable practices. We not only considered the management issues but also other sustainability issues for the selection of the final articles.
6. After the above five steps, we get 142 articles, which were categorized on the basis of year, authors, organizations, journals, citation, the status of the country (Table 2).
7. The contribution of this research is highlighted in three different sub-categories, as summarized below:
 - offer an analytical overview of the available articles in the field of SFFCSC.
 - identify research gaps in the recorded literature and analyze them for providing insights into this research.
 - offer some future research directions, which need to be explored in future research to better achieve the sustainable development of FFCSC.

Table1 Proposed a Four-level Keyword

Keywords assembly structure level	Context-specific	Keywords
Level 1	Cold Chain	"Cold chain" OR "cold supply chain" OR "cold supply chain logistics" OR "cold chain logistics" AND
Level 2	Sustainability	sustainable"OR"sustainability" OR "sustainable development" OR "green" OR "environmental impact" OR "low carbon" OR "emissions" OR "social impact" OR "socioeconomic" OR "economic impact" AND
Level 3	Perishability	"food" OR "perishable " OR "fresh product" OR "agriculture products" AND NOT
Level 4	Out of Scope	"non-perishable" OR "nonperishable"

2.2 Selection of Categories

The cold supply chain development status of developed and developing countries is totally different. For example, in China, food losses and waste are partly caused by incomplete cold supply chain equipment (Zhao, 2018). In contrast, the developed countries have been trying to adopt more optimal operating strategies and technologies at all stages of the entire fresh food cold supply chain network to attain sustainable development of their FFCSC. Even developed countries recognize the value of cold supply chains in promoting sustainable development. However, most of these studies discussed the relationship between the introduction of the cold supply chain and the change of greenhouse gas emissions and concluded the positive impact of the cold supply chain on reducing total greenhouse gas emissions in general. That is not enough when considering the complexity of obtaining a

complete sustainability profile consisting of advanced environmental and socially sustainable development practices. It is vital to measure the level of adoption in developing and developed countries to map the consciousness of sustainable practices globally. The mapping of consciousness can reveal the state and differences of adopting sustainable practices both in developing and developed countries (Malviya & Kant, 2015).

Table 2 Categories Considered in the Study

Categories of Study	Description
Year	Evaluating the development of the SFFCSC area through the trend line presentation of papers from January 2001 to August 2021.
Author	Identification of most contributed authors in publishing SFFCSC research.
Organization	Identification of most active organization in SFFCSC research.
Journal	Identification of well-known journals that publish and promote SFFCSC research.
Citation	Identification of the most referred or cited articles in the SFFCSC field.
Status of the Country	Assessing the percentage sustainable practices adoption of FFCSC in developing and developed countries.

It is essential to consider the articles from the relevant authors and journals, which actively publish the papers of SFFCSC through the peer review procedure, in order to lay the foundation for research. The citation of the paper judges the quality of the study because it shows the most cited research work around the world. This study has highlighted the most referred papers so that other researchers can refer to the particular relevant work. We have also classified the selected literature papers on the basis of authors, journals in the domain of sustainable practices. We adopted these categories from the existing review papers (e.g. (Ansari & Kant, 2017) (Vrat et al, 2018)).

On the basis of the above discussion, we have finalized to categorized the selected papers on the basis of year, authors, organizations, journals, citation, the status of the country. To better understand the analytic categories of this study, Table 2 is summarized with a brief description.

3 DESCRIPTIVE ANALYSIS

This section provides the descriptive analysis of the selected papers by classifying them in various dimensions and representing them in tables, charts, and figures for better graphical representation.

3.1 Categorization on the basis of the year of publication

This categorization includes the frequency analysis of 142 papers on the basis of the publication year (Fig.1). It is apparent that in the earlier span, the lack of attention was observed as only 1.41 % of papers were recorded between the year 2001-2007. In 2008-2017, this field observed initial growth as 29.58 % (42 out of 142) of papers were recorded during this time span. SFFCSC gained a steep growth in the research during the year 2018 to 2021 (98 papers), contributing to 69.01 % of the total recorded literature. This is because, on the one hand, as the population grows, the demand for fresh food continues to increase accordingly. On the other hand, the cold supply chain's growing environmental, social, and economic concerns have created pressure to seek sustainable solutions. Over the past few years, these increased studies of SFFCSC show that academicians and practitioners have recognized the importance of initiating sustainable practices to keep up the better future.

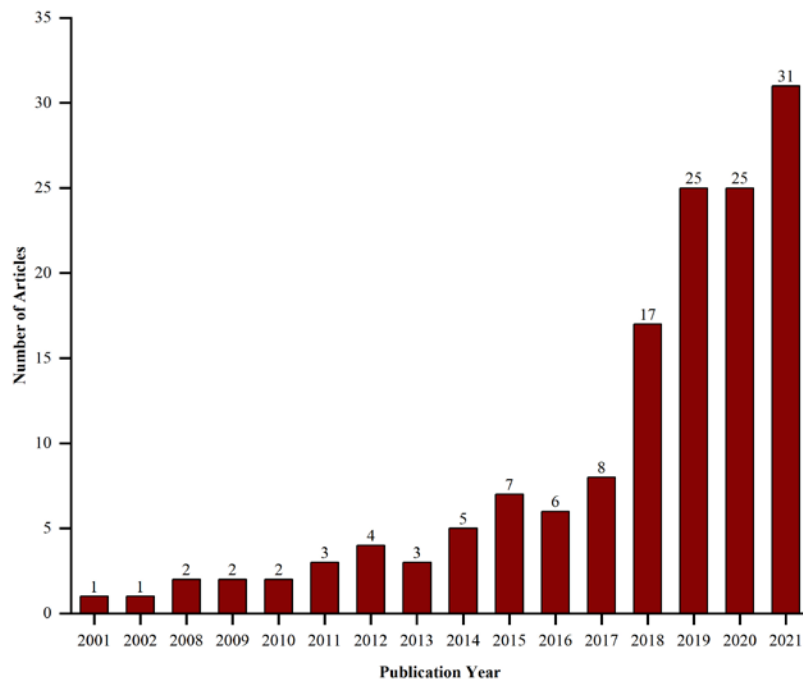


Figure 1: Categorization on the basis of year of publication.

3.2 Categorization on the basis of authors

A total of 518 authors contributed to the 142 sample papers on SFFCSC. That is, on average, each paper has 3 authors. Table 3 lists the main authors (two or more two papers each) who published research papers on SFFCSC. Meneghetti, A. seems to be the most prolific author in the field of SFFCSC with 7 papers published across different journals, followed by Miller, S.A. and Zanoni, S. publish 4 papers for each. Verboten, P., Defraeye, T., Behdani, B. Hoang, H.M., Liu, Z, Mangla, S.K., and Wu, W., contributes the research topic with 3 papers for each. While Brown, T., Fan, Y., Accorsi, R., Gallo, A., Gontard, N., Guillard, V., Guo, H., Huang, B., and Messineo, A. publish 2 papers each. Obviously, the 19 top key authors have written 38.03 % (54 papers out of 142) of all papers in academic journals. This result indicates that most of the authors have contributed to just one article in a group of journals comprising our search data. For researchers who actively and regularly publish papers in the topical field, the SFFCSC area seems relatively narrow for them in terms of applicability.

Table 3: Categorization on the basis of authors

Author	No. of articles	Percentage
Meneghetti, A.	7	4.93
Miller, S.A.	4	2.82
Zanoni, S.	4	2.82
Verboven, P.	3	2.11
Defraeye, T.	3	2.11
Behdani, B.	3	2.11
Hoang, H.M.	3	2.11
Liu, Z.	3	2.11
Mangla, S.K.	3	2.11
Wu, W.	3	2.11
Brown, T.	2	1.41
Fan, Y	2	1.41
Accorsi, R.	2	1.41
Gallo, A.	2	1.41
Gontard, N.	2	1.41
Guillard, V.	2	1.41
Guo, H.	2	1.41
Huang, B.	2	1.41
Messineo, A.	2	1.41

3.3 Categorization on the basis of organizations

A total of 251 academic universities/institutions has affiliated authors who published on SFFCSC from 2001 to 2021, while over six seventh (87.25%) contributed a single paper, indicating that SFFCSC has become a field of expertise in a few key Universities/institutions. Table 4 identifies Some of the most active universities/institutions with their frequencies in the area of SFFCSC research. The content analysis also unveils that the University of Udine in Italy leads the list with the highest publication of 7 papers. Stellenbosch University, Università Degli Studi di Brescia, and the University of Michigan ranked second in this list with 4 papers published. The list is followed by Empa-Swiss Federal Laboratories for Materials Science and Technology, ETH Zurich, Harvard University, Imperial College London, KU Leuven, Univ Montpellier, University of Bologna, University of Plymouth, and the London South Bank University, which contribute the research area with 3 papers. There are 19 universities/institutions with 2 publications. The universities/institutions with less than 2 papers (219 universities/institutions) are not included in the table due to space constraints.

Table 4: Categorization on the basis of Organizations

Affiliation	No. of articles
Università degli Studi di Udine	7
University of Michigan	4
Wageningen University & Research	4
Università degli Studi di Brescia	4
Stellenbosch University	4
Harvard University	3
Université de Montpellier	3
Empa - Swiss Federal Laboratories for Materials Science and Technology	3
ETH Zürich	3
KU Leuven	3
University of Plymouth	3
University of Bologna	3
Imperial College London	3
London South Bank University	3
Beijing Normal University	2
Dalian University of Technology	2
Ghent University	2
International Livestock Research Institute (ILRI)	2
Irstea	2
King Saud University	2
Nanjing Agricultural University	2
Nanyang Technological University	2
Peking University	2
Sokoine University of Agriculture	2
South China University of Technology	2
Veer mata Jijabai Technological Institute (VJTI)	2
Tianjin University of Science and Technology	2
Transform Rural India Foundation (TRIF)	2
University of Palermo	2
Wageningen University	2
Institute of Food Science, Technology and Nutrition (ICTAN-CSIC)	2
Wageningen University & Research	2

3.4 Categorization on the basis of journals

The selected 142 papers on SFFCSC have been published across 97 different journals, as shown in Table 5. Journal of Cleaner Production is the most popular journal with 11 (7.75%) published papers. Sustainability is second on the list, with publications of 8 (5.63%) papers. The list is followed by Energies 4(2.82%), Innovative Food Science and Emerging Technologies 4(2.82%), International Journal of Production Economics 4 (2.82%). Food and Bioprocess Technology and the International Journal of Energy Research have 3 (2.11%) papers. There are 15 journals having publications of 2 papers. It can be observed that these 22 (22.68%) journals represent 47.18% of selected papers. Therefore, these journals can be regarded as the core journals on SFFCSC as the proportion of papers published in these

journals in the study area is high. It was also found that more than three quarters (77.32%) (75 papers) of journals have published only one paper on the topic. However, the 75 journals with only one publication which are not included in the table due to space constraints.

Table 5 Categorization on the basis of journals

Journal	No. of articles	Percentage
Journal of Cleaner Production	11	7.75
Sustainability (Switzerland)	8	5.63
Energies	4	2.82
Innovative Food Science and Emerging Technologies	4	2.82
International Journal of Production Economics	4	2.82
Food and Bioprocess Technology	3	2.11
International Journal of Energy Research	3	2.11
PLoS ONE	2	1.41
Acta Horticulturae	2	1.41
Annals of Operations Research	2	1.41
Energy	2	1.41
Environment, Development and Sustainability	2	1.41
Food Control	2	1.41
Food Packaging and Shelf Life	2	1.41
Fresenius Environmental Bulletin	2	1.41
International Journal of Food Microbiology	2	1.41
International Journal of Life Cycle Assessment	2	1.41
International Journal of Production Research	2	1.41
Journal of Food Process Engineering	2	1.41
Journal of Food Processing and Preservation	2	1.41
Journal of Intelligent and Fuzzy Systems	2	1.41
Transportation Research Part D: Transport and Environment	2	1.41

3.5 Categorization on the basis of citations of articles

The citation of the paper is generally regarded to be the quality of the paper, which the authors across the world validate by citing their research. The purpose of this categorization is to highlight the most referenced papers in SFFCSC and try to look into the possible reasons for their high quotation. The nine most cited articles have quotes of more than 60 are shown in Table 6. The paper entitled "Two echelons multiple-vehicle location-routing problem with time windows for optimization of sustainable supply chain network of perishable food" has the maximum citation of 359. The reason being proposed a novel multi-objective hybrid method called MHPV to explore how to integrate sustainability in decision-making which is missing in the previous literature. They also indicated that the hybrid approach is better than others (i.e., MOGA, NREGA, and NSGA-II) (Govindan, 2014). The second most cited paper entitled "Chilled or frozen? Decision strategies for sustainable food supply chains" has the quotation of 123. They explored the relationship between the relevant parameters affecting the problem (i.e., Fast vs. slower transportation, low vs. higher energy contribution, short vs. longer product lives, and storage times) to solve a possible method to chain optimization. The proposed modeling can also support decisions and improve the sustainability of the adopted solution (Zanoni & Zavanella, 2012).

Table 6 Categorization on the basis of citations of articles

Authors	Title	Year	Source title	Cited by
Govindan, K., Jafarian, A., Khodaverdi, R., Devika, K.	Two-echelon multiple-vehicle location-routing problem with time windows for optimization of sustainable supply chain network of perishable food	2014	International Journal of Production Economics	359
Zanoni, S., Zavanella, L.	Chilled or frozen? Decision strategies for sustainable food supply chains	2012	International Journal of Production Economics	123
Molins R.A., Motarjemi Y., Käferstein F.K.	Irradiation: A critical control point in ensuring the microbiological safety of raw foods	2001	Food Control	93
Jacxsens L., Devlieghere F., Debevere J.	Predictive modeling for packaging design: Equilibrium modified atmosphere packages of fresh-cut vegetables subjected to a simulated distribution chain	2002	International Journal of Food Microbiology	91
Hospido A., Milà I Canals L., McLaren S., Truninger M., Edwards-Jones G., Clift R.	The role of seasonality in lettuce consumption: A case study of environmental and social aspects	2009	International Journal of Life Cycle Assessment	77
He, X., Qiao, Y., Liu, Y., (...), Yin, C., Martin, F.	Environmental impact assessment of organic and conventional tomato production in urban greenhouses of Beijing city, China	2016	Journal of Cleaner Production	74
Franz E., Tromp S.O., Rijgersberg H., Van Der Fels-Klerx H.J.	Quantitative microbial risk assessment for Escherichia coli O157:H7, Salmonella, and Listeria monocytogenes in leafy green vegetables consumed at salad bars	2010	Journal of Food Protection	64
Büsser S., Jungbluth N.	The role of flexible packaging in the life cycle of coffee and butter	2009	International Journal of Life Cycle Assessment	63
Meneghetti, A., Monti, L.	Greening the food supply chain: An optimization model for sustainable design of refrigerated automated warehouses	2015	International Journal of Production Research	62

3.6 Categorization on the basis of the status of the country

Table 7 shows the contribution percentage of each country and the country category (developing and developed). It is done on the basis of the country represented by the authors of the selected papers. A total of 35 countries are featured in the 142 publications, and 51.43% (18 countries) of these countries published just one paper. China leads the list with 40 (28.17 %) papers. The second country on the list is Italy, with 19 (13.38%) papers. Other countries having evidence of SFFCSC research after China and Italy are: USA 11 (7.75%), Uk 8 (5.63%), India 8 (5.63%), France 6 (4.23%), and Netherlands 5 (3.52%) papers. On the basis of the published report (Indexes, 2011), the list of countries was divided into two groups, i.e., developing countries and developed countries. This categorization shows that 48.59% of publications have been recorded in developing countries and 51.41% in developed countries (Figure 2).

Table 7 Categorization on the basis of the status of the country

Country	No. of Articles	Percentage	Category
China	40	28.17	Developing
Italy	19	13.38	Developed
USA	11	7.75	Developed
UK	8	5.63	Developed
India	8	5.63	Developing
France	6	4.23	Developed
Netherlands	5	3.52	Developed
South Africa	4	2.82	Developing
Switzerland	4	2.82	Developed
Spain	4	2.82	Developed
Belgium	3	2.11	Developed
Australia	2	1.41	Developed
Germany	2	1.41	Developed
Iran	2	1.41	Developing
Poland	2	1.41	Developing
Pakistan	2	1.41	Developing
Denmark	2	1.41	Developed
Turkey	1	0.7	Developed
Israel	1	0.7	Developed
Argentina	1	0.7	Developing
Chile	1	0.7	Developing
Canada	1	0.7	Developed
Brazil	1	0.7	Developing
Egypt	1	0.7	Developing
Finland	1	0.7	Developed
Indonesia	1	0.7	Developing
Jordan	1	0.7	Developing
Latvia	1	0.7	Developing
Malaysia	1	0.7	Developing
Philippines	1	0.7	Developing
Tanzania	1	0.7	Developing
South Korea	1	0.7	Developing
Singapore	1	0.7	Developed
Saudi Arabia	1	0.7	Developed
Russian Federation	1	0.7	Developed

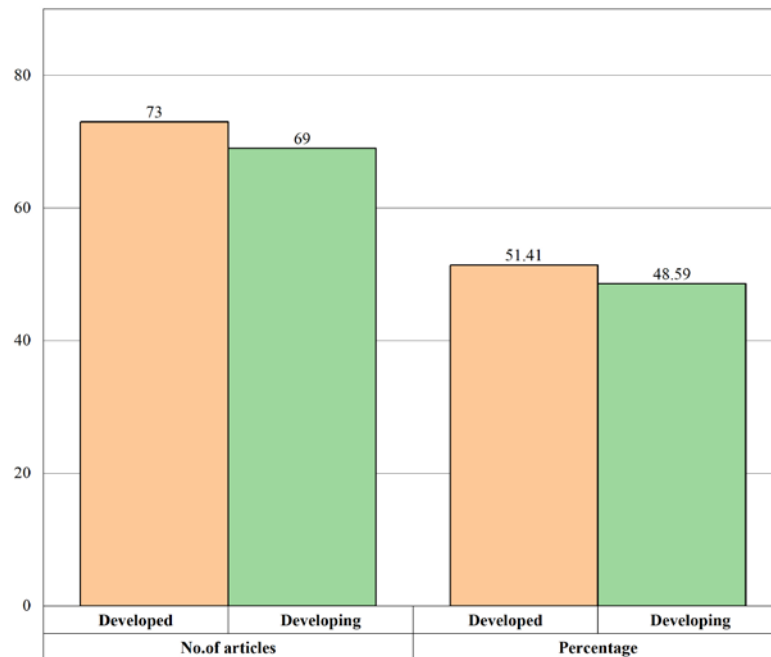


Figure 2: Articles on the basis of the status of the country.

4 OUTCOMES

The contribution of this research is presented through significant findings and discussion as well as future research directions.

4.1 Significant findings and discussion

This section is going to present various significant findings based on the descriptive analysis of the selected papers. It will also provide a discussion of the various reasons for the determined results. This section will also discuss various gaps and future opportunities that need to be solved to understand SFFCSC better. Significant findings and discussion of these findings have been emphasized in this section are as below:

The categorization of selected papers on the basis of the publication year (Figure 1) exposes that a number of publications over the past three years (2018-2020) and till August-2021 have been demonstrating an upward trend. Especially in 2021, even if we only collect the literature published before September, that is, two-thirds of this year, the number of publications has increased sharply compared with last year, demonstrating the growing interest of scholars and practitioners towards SFFCSC adoption. One of the main reasons for the increased interest can be that strict environmental regulations and government legislations constrain the fresh food cold supply chain industries to adopt the traditional supply chain mode. At the same time, another main reason for the increased interest can be that the demand for fresh food continues to increase because of the population growth. The consciousness of sustainable practices has found that more adoption of the cold supply chain in the fresh food supply chain will have positive impacts on society, economy, and environment, for example, reducing energy consumption ((Hu et al, 2019), reducing land losses (Liu et al, 2013), Improving customer satisfaction (Hsu, 2019), reducing food price fluctuation (La Scalia et al, 2019),

reducing transportation and operating cost (Chen et al, 2019), and raising rural income (Wu & Huang, 2018).

Journal of Cleaner Production is the most popular journal with 11 published papers followed by Sustainability 8, Energies 4, Innovative Food Science and Emerging Technologies 4, International Journal of Production Economics 4. Food and Bioprocess Technology 3, International Journal of Energy Research 3, PLoS ONE having publications 3, and 14 journals having publications of 2 papers. The contribution of the above 22 journals is 47.24% which demonstrates their interest in considering and promoting SFFCSC as one of the most important study fields to improve sustainable performance. The main reason for the highest publication of 11 papers in the Journal of Cleaner Production is that the journal is an interdisciplinary publication outlet. The journal is directly related to environmental and environmentally sustainable development issues, such as corporate social responsibility, sustainable consumption/development, and sustainable services, which are integral to SFFCSC. The content analysis also exposes that the publication of SFFCSC study work is not limited to specific sustainable development-related journals. Many journals that are not dedicated to sustainable development issues have also published papers on SFFCSC.

The current investigation analysis on the selected literature exposes that SFFCSC has been studied more in developed countries and less studied in developing countries during the time between 2001-2017. The reasons behind this difference may be due to the availability of funds for SFCSC projects, supportive government regulations, advanced technologies, etc., in the developed countries. While since 2018 till August 2021, the studies of SFFCSC in developing countries are more than in developed countries (Figure 3). One of the main reasons for this surprising difference may be the rapid awareness of the benefits of developing refrigerated fresh food supply chains in developing countries (Kitinoja, 2013). Another main reason for this surprising difference may be that the research topic focuses on the fresh food industry.

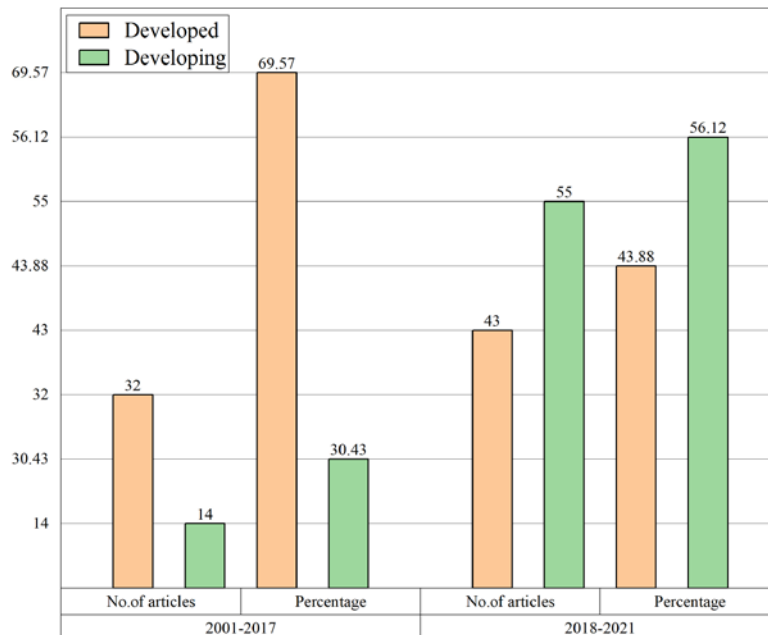


Figure 3: Articles on the basis of the status of the countries in different time span.

4.2 Future research directions

Based on the findings and discussion of this research, the future research directions have been determined in this section are as follows:

- In recent years, consumers and policy-makers in developing countries have begun to have higher requirements on the quality of fresh food and environmental protection. Since 2018, compared with developed countries, developing countries have conducted more research on SFFCSC. However, few studies have considered the comparison of the good practices of SFFCSC in developed and developing countries. Based on the contextual difference between developed and developing countries, this is an opportunity for developing countries to achieve the sustainable development of the cold supply chain industry by learning from the good practices of developed countries.
- As few studies have stated that the adoption of advanced information technologies (e.g., the IoT, big data, cloud computing, blockchain, etc.) have good benefits for the development of the FFCSC industry, for example, providing a major data platform for fresh food cold supply chain actors such as business, government, and consumers to control, trace, and optimize the business process in real-time (Verdouw et al, 2016). It is necessary to conduct more research on assessing the benefit of advanced information technologies adoption in facilitating the sustainable development of FFCSC.

4.3 Limitations of this research

- This study is limited to the SCOPUS database for the search of the papers for review. Though the SCOPUS is an extensive database that consists of huge publications, many related papers on SFFCSC outside the SCOPUS database may not have been included in this study.
- As only English publications were incorporated in this research, other papers related to SFFCSC in other languages were not considered. In this case, considering papers in other languages may lead to changes in the findings and conclusions of this research.

5 CONCLUSION

The strict government legislations and environmental regulations have restricted the fresh food cold supply chain industry from utilizing operations that negatively impact the environment. It is necessary to carry out more efficient operations to combine governmental legislations of environment protection with economic benefits. This research provides a categorical analysis to describe the level of effort that has been made by scholars, engineers, and practitioners in developing sustainable cold supply chain ways to distribute fresh food products. This research conducted comprehensive descriptive research by a systematic literature review of 142 selected papers (January 2001 to August 2021), emphasizing how SFFCSC research has grown over the past few years. The selected papers were classified on the basis of year, authors, organizations, journals, citation, the status of the country. The selected papers were presented in each category in different figures and tables. The analysis

of these figures and tables helps to identify the various insights and unresolved aspects of sustainability from the selected literature.

When we look at the number of papers published on SFFCSC, it indicates that there is a lot of work has been reported in the SFFCSC literature. However, there are still various opportunists (section of future research directions) that need to be urgently considered in future research. The significant future research opportunities are: more studies should be conducted to consider the comparison of the good practices of SFFCSC in developed and developing countries, more research should be initiated to explore the differences and reasons that exist in the type of best practices adopted in developed countries and developing countries, and more research should be carried out to find the means and ways to attain a balance between environment, economy, society to adopt SFFCSC effectively, and more research should be conducted to assess the benefit of advanced information technologies adoption in facilitating the sustainable development of FFCSC. This research attempts to deepen the knowledge and understanding of SFFCSC by evaluative research. We believe that the discussions provided in this research will help policy-makers, the scientific community, and practitioners to better understand the issues of SFFCSC. The discussed findings, the proposed future directions, and the limitations of this research may offer scholars and practitioners various opportunities to further expose the various unrecognized aspects of SFFCSC.

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