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SUSTAINABLE FRESH FOOD COLD SUPPLY CHAIN (CSC)

Coordinatore: Ch.ma Prof. Anna NOSELLA
Supervisore: Ch.ma Prof.ssa Pamela DANESE
Co-Supervisore: Ch.mo Prof. Andrea VINELLI; Ch.mo Prof. Ruhe XIE

Dottorando: JING LIAO

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List of abbreviations and acronyms

CSC - Cold Supply Chain
SC- Supply Chain
TBL - Triple Bottom Line
CO_2 - Carbon Dioxide
CH_4 - Methane
N_2O - Nitrous Oxide
MCDM - Multiple-criteria Decision Making
WCED -World Commission on Environment and Development
SLR - Systematic Literature Review
AHP/ FAHP - Analytic Hierarchy Process / Fuzzy Analytic Hierarchy Process
LRP - Location–routing Problem
DEA - Data Envelopment Analysis
TOPSIS/FTOPSIS - Techniques for Order Preference by Similar to Ideal Solution / Fuzzy Techniques for Order Preference by Similar to Ideal Solution
ANP/FANP - Analytic Network Process / Fuzzy Analytic Network Process
GTMA - Graph Theory and Matrix Approach
VIKOR/FVIKOR - Visekriterijumska Optimizacija I Kompromisno Resenje / Fuzzy Visekriterijumska Optimizacija I Kompromisno Resenje
DEMATEL - Decision-making Trial and Evaluation Laboratory
ELECTRE - Elimination and Choice Expressing Reality
GHG - Greenhouse Gas
ISM - Interpretive Structural Modelling
AS/RSs - Automated Storage and Retrieval Systems
3PL - Third Party Logistics
RFID - Radio Frenquency Identification
LP - Linear Programming
EE-IO - Environmentally Extended Input-Output
LCA - Life Cycle Assessment
SE4All - Sustainable Energy for All
FAO - Food and Agriculture Organization of the United Nations
GWP - Global Warming Potential
SFFA - The State of Food and Agriculture
VCR - Vapor Compression Refrigeration
CSR - Corporate Social Responsibility
CR - Consistency Ratio
ERP - Enterprise Resource Planning
IT - Information technology
RFID - Radio Frequency Identification
WSNs - Wireless Sensor Networks
CC_i^* - Closeness Coefficient

Summary

Since sustainable fresh food cold supply chain (CSC) has notable advantages in improving the triple-bottom-line (TBL) performance, in recent years, practitioners and scholars worldwide have aroused the interest to explore more insights. In parallel, the sustainability performance of a corporate in terms of social welfare, economic benefits, and environmental impacts is a problem increasingly concerning among customers, companies, and governments. This focus on these topics has contributed to a field of research frequently considered to implement good practices to improve sustainability performance, especially in developed countries with more experience exploring and implementing good practices to improve sustainability performance. Many scholars have recognized the enormity of fresh food waste and limited implementation of good practices in fresh food CSC in developing countries compared to developed countries. They believe that a possible solution is for companies in developing countries to learn from companies in developed countries that have extensive experience in implementing good practice to promote sustainable fresh food CSC. However, few efforts have been made to investigate the reasons for the limited implementation of good practices in fresh food CSC applied by developed countries in developing countries. The purpose of this study emerged from this idea, which is to analyze the reasons for implementing good practices and the relationship between the good practices and sustainability performance with a strong empirical focus. This study was conducted in three main phases: a relevant literature review as an exploration phase, a multiple case study analysis in four retail companies to empirically analyze the aforementioned reasons, and a fuzzy multi-criteria approach to empirically analyze the relationships between the

good practices and sustainability performance. Onsite data were collected from companies and field experts, including archival data and developing semi-structured interviews. In addition, a cross-case analysis was conducted to map the possible reasons for implementing good practices, and a fuzzy multi-criteria approach was used to analyze the impact of good practices on sustainability performance. The results of this thesis from the multiple case study highlights the importance of the current level of government regulation, customer sustainability awareness, dependence between buyers and suppliers, top management, and laws/policies that support the implementation of good practices. Moreover, the results from the fuzzy multi-criteria approach indicate that China values economic performance more, while good practice of "employee training" is the best sustainable practice for improving the sustainability performance of fresh food CSC. These findings are consistent with the preliminary evidence gained in the literature review analysis carried out in this thesis and thus provide robustness to the conclusions drawn. The results of this study provide a better understanding of the phenomenon, revealing new evidence that is particularly useful for practitioners, academics, and governments who are facing the challenges of researching, implementing, and regulating good practices, while not omitting sustainability performance goals and sharing efforts as much as possible.

Chapter I: Introduction

This introduction chapter offers a brief context to the study, then explains the issue statement and research gaps, sets the thesis goals, formulates the research questions, determines the research methodologies, and finally closes with an overview of the research by describing the structure of the thesis.

1.1 Background

Climate change has evolved into a worldwide issue that the international community is concerned about. It is also the most significant global environmental issue that humanity has ever faced (Zani, 2013). Global scientific research indicates that human activities and large-scale energy usage are primarily responsible for climate change, resulting in excessive emissions of greenhouse gases such as carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) into the atmosphere (Ma, Zhao, and Ren, 2010). The food industry is the largest manufacturing sector (Egilmez et al., 2014). The world population is likely to approach 9 billion in the next 30 years as it rises (Pullman and Wu, 2012). Thus, the demand for fresh food will increase (70% increase from its existing level) (Krishnan et al., 2020), and more natural resources will need to be consumed accordingly. However, the resources available for growing and producing fresh food will be declined because of the inherent, non-farming related needs that humans are born with, such as drinking water, residential land, fuel-driven, etc. (Krishnan et al., 2020). At the same time, postharvest losses in the fresh food products

supply chain (SC) vary from 13% in Europe up 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, especially in developing countries.

A cold supply chain (CSC) is a refrigerated SC that can maintain the low temperature required by processing, storing, distributing, and selling fresh food products, compared with the conventional fresh food SC with a high loss rate of fresh food. That is, in the fresh food SC system, the CSC is able to maintain food security and reduce food waste, which will help improve human well-being (Hu et al., 2019). Nevertheless, on the other hand, this requires refrigerated warehouses and trucks that simultaneously consume much energy for refrigeration and potential refrigerant gas leakage. Moreover, higher energy consumption is related to higher carbon dioxide emissions in power generation equipment. In other words, the CSC can be viewed 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, in the food industry, the energy consumption in food systems is estimated at 38% (FAO, 2020), and the energy consumption of cold equipment accounts for about 50% of the total energy consumption (James and James, 2010). Nearly 30% of the energy emissions in the world are caused by CSCs (Kayfeci et al., 2013, Han et al., 2018).

As de Boer (2003) reported, consumers in rich countries need high-quality, security fresh food produced with minimal environmental effects. Also, considering the environmental effect, governments have enacted tight standards and regulations on emissions from manufacturing and other industrial sectors. 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 affects the fresh food SC decisions directly (Beske et al., 2014).

Simultaneously, according to Brundtland's report to the World Commission on Environment and Development (WCED) in 1987 (WCED, 1987), sustainability was initially defined as *addressing current demands without jeopardizing future generations' ability to meet their own needs*. The triple-bottom-line (TBL) principle of sustainable development encompasses all three dimensions of sustainable development: environment, society, and economy (Ageron et al., 2012). These dimensions are present in business choices and social responsibility plans, constantly emerging and being demanded by stakeholders and institutions.

In brief, we should expand the CSC of fresh food sustainably, which poses challenges that should be addressed. To be competitive in the industry, companies must combine more fresh food products or services with higher levels of safety and quality, with significant operational efficiency improvements and cost reductions and in less waste and loss and delivery times. In parallel, companies must be aware of their impact on the environment and be socially responsible. Good practices implementation in the fresh food CSC may help companies achieve both goals if they demonstrate real commitment and awareness of sustainability, but firms should be cautious on this as implementing good practices could also lead to unexpected harmful effects.

1.2 Problem statement and research gaps

One of the most critical factors of the growing importance of the sustainable performance of fresh food CSC is the rapid depletion of natural resources, which has forced firms to continue to improve their operational efficiency in pursuit of sustainability strategy. Consequently, in line with the above sustainability principles,

the core of sustainable fresh food CSC is the circulation of fresh foods through CSC processes that minimize negative environmental impacts and maximize the economic benefits and social welfare. From this point of view, what good practices should be implemented at each stage of the fresh food CSC to improve sustainability performance is vital to practitioners and researchers, especially for companies in developing countries. Since companies in developed countries have extensive experience in exploring good practices implementation, in this context, one possible solution to improve the sustainability performance of the companies in a developing country is to learn good practices from the companies in developed countries. The objective of improving the TBL performance (economic, environmental, social) of companies in developing countries was the problem that originated this research.

Several scholars (Raut et al., 2019; Al-Refaie, Al-Tahat, and Lepkova, 2020; Turan and Ozturkoglu, 2021; Kumar, Tyagi, and Sachdeva, 2022) have recently analyzed what good practices are implemented, the possible relationships between the good practices and sustainability performance, and the reasons for implementing good practices. The results achieved to date have not always been consistent with themselves. Raut et al. (2019) have identified institutional pressures (for example, regulatory pressure) as the most important factor influencing good practices implementation. In contrast, Al-Refaie, Al-Tahat, and Lepkova (2020) strongly emphasizes that government support system is the one of the highly driving factors affecting implementing good practices. Turan and Ozturkoglu (2021) have demonstrated that employee is the most influential factor.

Regardless of the results gained by these researchers, the research on the relationships between good practices and sustainability performance has also encouraged various academics to explore new areas of study within this field. Some of

these scholars have designed assessment framework for the sustainability performance evaluation based on good practices (Green et al., 2012; Govindan, Khodaverdi, and Jafarian, 2013; Das, 2017; Wang and Jun, 2018. Raut et al., 2019; AI-Refaie et al., 2020; Kumar, Tyagi, and Sachdeva, 2022) and studied the drivers, enablers, and barriers that may counter the implementation of good practices (Yaraghi and Langhe, 2011; Beske et al., 2014; Pearce, Dora, Wesana, and Gellynck, 2018; Liu, Zhang, and Ye, 2019). In addition, other scholars have investigated the challenges of implementing good practices within diverse national contexts such as the UK, Polish, India (Ghadge et al., 2021; Kumar et al., 2020; Filina-Dawidowicz and Wiktorowska-Jasik, 2021). However, a deeper understanding of how these factors, both individually and jointly, affect a company's success in implementing good practices is still needed. Moreover, 5 out of 7 (71.43%) publications adopted case studies in the context of developed countries. Hence, there is a need to investigate contexts that are different from those investigated previously and, as a result, have remained relatively unexplored.

Therefore, three clear gaps were determined during the research of this relationship in literature. These open study opportunities guided the study carried out in this thesis. The first one is to clearly identify what good practices are being implemented by companies in developed countries. The second research gap involves a study exploring the differences and reasons for implementing good practices in fresh food CSC in developed and developing countries. The third research gap involves examining the relationships between the implementation of good practices applied by companies in developed countries and sustainability performance in developing countries contexts.

Finally, apart from research gaps, the originality of this research lies in examining the links between good practices and sustainability performance assessments found in the literature. The research and exploration of these relationships and reasons are of

great interest to researchers in the operations and sustainability areas, the decision makers and practitioners designing sustainable strategies, and governments. In addition, it provides valuable information for firms to drive demand since the company's sustainable development is a concern of more and more customers and governments, who require high-quality and safe fresh food, less waste and loss of fresh food, and minor damage to the environment in general.

1.3 Objectives, research questions (RQs), and methodology applied

The first objective of this research is to carry out a systematic literature review to understand the phenomenon and to determine good practices and sustainability performance indicators and relevant preliminary evidence regarding the reasons for implementing good practices and the relationships between good practices and sustainability performance.

According to this primary investigation, the second study objective is to empirically explore what good practices were implemented by companies in both developed and developing countries, identify the differences, and explore the reasons for implementing good practices in fresh food CSC by companies in developing countries. More precisely, this part of this research mainly intends to explore the factors that influence companies in developing countries to implement good practices that companies in developed countries have successfully implemented. The third study objective empirically explores the relationship between good practices and sustainability performance. More precisely, this part of this research intends to explore the impact of good practices on the sustainability performance of fresh food CSC.

On the basis of the preliminary exploration of the above research area and regarding the gaps and objectives of knowledge, the final RQs are:

- RQ1: What are the good practices available/used in the sustainable fresh food CSC in developed countries under government regulation?

  The aim is to identify good practices implemented in sustainable fresh food CSC in developed countries.
- RQ2: What differences exist in the good practices available/used in the sustainable fresh food CSC in a developing country? Why these differences, if any?

  The aim is to identify the differences and explore the reasons for sustainable fresh food CSC good practices implementation by companies in developing countries.
- RQ3: What are the impacts of the implementation of good practices in developed countries on the sustainability performance of developing countries?

  The aim is to explore the impact of good practices on fresh food CSC sustainability performance.

After identifying the RQs, the corresponding research methodologies were determined (Table 1). The first research question (RQ1) was answered by the systematic review, investigating the present state of the art of the corresponding study area and providing the initial insights of this thesis. For the second research question (RQ2), it was determined that the most appropriate approach was a multiple case study methodology in order to focus the study in a qualitative and empirical way. For the third research question (RQ3), it was decided to apply a fuzzy multiple-criteria approach to address this research question empirically. The multiple case studies were conducted in four retail companies to deepen the preliminary evidence already found in the literature. Within-case and cross-case analyses were then applied to investigate the firms' empirical evidence and elucidate connections between cases. Finally, survey research

was conducted to explore empirical evidence gained from the domain experts and academics in developing country contexts and to elucidate the relationship between good practices and sustainability performance.

Table 1. Objectives, research questions, and methodology

Research questions (RQs)	Objectives	Methodologies	Outputs
RQ1: What are the good practices available/used in the sustainable fresh food CSC in developed countries?	Identify good practices implemented in sustainable fresh food CSC in developed countries.	• Systematic literature review • Interview with experts • Case study of an Italian company	• Definition & categorization • Comprehensive good practices list
RQ2: What differences exist in the good practices available/used in the sustainable fresh food CSC in a developing country? Why these differences, if any?	Identify the differences and explore the reasons for sustainable fresh food CSC good practices implementation by companies in developing countries.	• Multiple case study	• The differences between the four cases of implementing good practices in sustainable fresh food CSC • The reasons for the differences
RQ3: What are the impacts of the implementation of good practices in developed countries on the sustainability performance of developing countries?	Explore the impact of good practices on fresh food CSC sustainability performance.	• Systematic literature review • Interview with experts • Questionnaire Survey	• A sustainability performance indicators list • A sustainability performance framework • Good practices ranking The reasons for the differences

1.4 Theoretical underpinning

The empirical analysis of this research builds on the insights from externality theory, the triple bottom line (TBL) model, institutional theory, and stakeholder theory.

Researches reveal that the increased installation of CSC will have positive impacts on reducing land losses (Liu et al., 2013), improving customer satisfaction (Hsu, 2019), reducing food price fluctuation (LA et al., 2019), raising corporate social responsibility (e.g., Allaoui et al., 2018; Gunasekaran et al., 2014; Gunasekaran et al., 2015), and raising rural income (Wu and Huang, 2018). However, there are also some negative impacts threaten its overall sustainable performance, including high energy consumption, carbon emissions, contamination, high costs (Shashi et al., 2018).

According to the externality principle proposed by Griffin & Steele in 1980, it can be seen that the installation of CSC in the fresh food industry has obvious externality, including positive and negative externality. In this context, reducing the negative externalities of fresh CSC is the main challenge for the industry to achieve sustainable development according to the principle of sustainability. The triple-bottom-line (TBL) principle of sustainable development encompasses all three dimensions of sustainable development: environment, society, and economy (Ageron et al., 2012). These dimensions are present in business choices and social responsibility plans, constantly emerging and being demanded by stakeholders and institutions.

Regarding the Sustainable Development Goals (SDGs), the role of CSC in both reducing food losses and controlling carbon emissions are associated with targets 12.3 and 13. Good practices implementation in the fresh food CSC may help companies achieve both goals if they demonstrate real commitment and awareness of sustainability, but firms should be cautious on this as implementing good practices could also lead to unexpected harmful effects. For example, while implementing advanced technologies in the sustainable fresh food CSC area could optimize the value chain, reduce cost, save energy, protect resource, reduce health risk, and win customer trust (Shashi, Singh and Shabani, 2016; Quayson, Bai, and Sarkis, 2020; Badia-Melis, Mishra, and Ruiz-García, 2015), some of them implementation suffer from higher costs (Toffaletti and Soldatos, 2010; Hong et al., 2011; Ghaani et al., 2016).

As both externality theory and TBL theory refer to the environmental impact of CSC expansion and implementation of good practices in the sustainable fresh food CSC. What factors influence firms to adopt good practices to reduce negative environmental externalities. The determination of these factors is related to institutional theory. This is because the institutional theory highlights the role of environmental pressure, which

explains how pressure from institutions like the government, the media, and public associations affects organizational behavior and decision-making (Varsei et al, 2014), and how this pressure evolves into institutional rules that affect the implementation of organizational practices by organizations. As Govindan (2018) argues, organizations develop structural rules and processes to enhance legality with external parties. For example, according to de Boer (2003), consumers in rich countries need high-quality, security fresh food produced with minimal environmental effects. Also, considering the environmental effect, governments have enacted tight standards and regulations on emissions from manufacturing and other industrial sectors. 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 affects the fresh food SC decisions directly (Beske et al., 2014).

Since institutional theory often involve many stakeholders, it is linked to stakeholder theory (Sarkis et al, 2011). According to Govindan's (2018), a stakeholder is "any group or individual that can influence or be affected by the achievement of organizational goals". Stakeholder theory outlines how an enterprise interacts with various society stakeholders and introduces the link between an enterprise and its stakeholders. As Zhu et al. (2008) believed that stakeholders like the government, shareholders, suppliers, employees, and customers, according to stakeholder theory, can exert coercive, normative, or imitative pressure to affect enterprises to adopt specific sustainable practices. The stakeholder theory argues that decision-makers should engage in sustainable practices because they have a moral obligation to meet the needs of various voters (Freeman, 2010). The instrumental logic of stakeholder theory suggests that firms will use sustainable supply chain practices as a tool to enhance their

legality, profitability, and competitiveness by effectively fulfilling stakeholder requirements (Wolf, 2014).

1.5 Structure of the thesis

The first two chapters are also used to introduce the research background, purpose, gaps, questions, and objectives. Specifically, Chapter II provides a systematic literature review of existing published research on sustainable fresh food CSC to provide comprehensive insights into this research topic, thereby exploring research gaps and identifying RQs. In detail, the comprehensive literature review approach used, the selection criteria for the sample of articles, also the papers found are classified based on their main characteristics, and some categories are outlined based on the evidence gained in the research featuring good practices and sustainability performance assessments and finally. In addition to the systematic literature review in this section, emerging research gaps are introduced, and then the research objectives and questions are stated to end up the chapter.

The next three chapters are the core chapters of the thesis and are used to answer the three RQs, each presenting a research phase (Figure 1). As a starting point, Chapter III provides a systematic literature review of existing published research on sustainable fresh food CSC, focusing here on research on various good practices and sustainability performance assessments. The selection criteria for the sample of articles are the same as those in Chapter II, after good practices and sustainability performance indicators determined by the systematic literature review. A case study was adopted to explore the good practices that a company has successfully implemented in a developed country.

Four cases analysis is conducted to collect the main evidence that emerged and to perform a comparison between the cases in Chapter IV. It starts with a general description of the factors that influence the implementation of good practices by

companies through reviewing the existing literature, then introduces the research methodology used in this part of the study. And then, a within-case analysis is performed for each firm, presenting empirical results that emerged from an in-depth analysis of each company. Finally, a cross-case analysis is carried out, gathering the main evidence that emerged and comparing the cases.

In Chapter V, survey research is conducted to gather the main evidence that emerged in a developing country context. It first briefly introduces good practices and sustainability performance indicators through reviewing the existing literature, then introduces the research methodology used in this part of the study. Finally, an integrated approach AHP-Fuzzy TOPSIS is used to explore the impact of good practices on the sustainability performance of fresh food CSCs in the context of a developing country. Also, the results of AHP-Fuzzy TOPSIS can contribute to confirming and adding evidence to RQ2 (the reasons for differences)

The final chapter following the three core chapters presents a summary of the discussion and conclusions drawn from the various analysis results, as well as provides the limitations of this thesis and suggestions for further research.

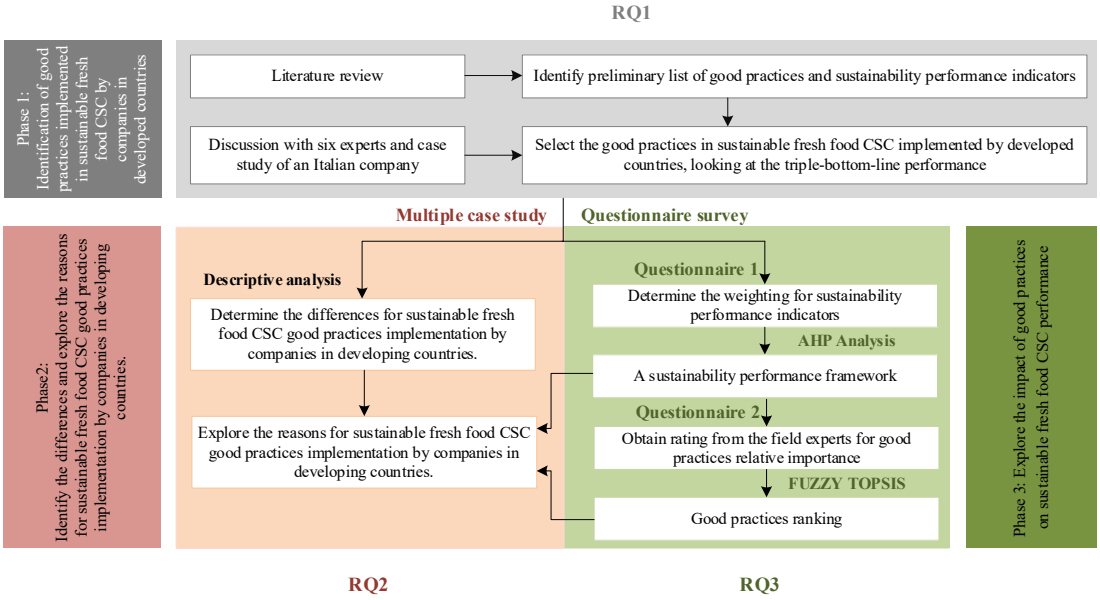


Figure 1. PhD research workflow

Chapter II: Literature review, research gaps, and research questions

This chapter presents in its first section a systematic literature review of existing published research on the sustainable fresh food CSC. The second section focuses on the research gaps identified in the existing literature. The third section outlines the RQs.

2.1 Literature review analysis

The goal of this section is to carry out a systematic literature review of existing published research documents in order to learn more about the sustainable fresh food CSC, as well as to identify good practices. First, the methodology used and the selection criteria for the articles are described in-depth. In addition, various categories are outlined based on the publication year, the status of the country, research design, sustainable dimensions, focused areas, and multiple-criteria decision-making (MCDM) techniques. Then, the analysis focuses on good practices which are more frequently implemented and the impact on sustainability performance.

This section aimed to explore various insights from the existing literature to advance the extant knowledge on the research stream in fresh food CSC (technology and management) contributing to the debate on sustainable fresh food CSC conceptualization.

2.1.1 Systematic literature review method

This subsection used a systematic literature review (SLR) methodology to analyze the existing literature. In this sense, the stages proposed by Tranfield et al. (2003) were

replicated. For transparency and replicability, they adopted a structured review to decrease bias in the outcomes of literature reviews through manual filtering. Also, they believed that a literature evaluation was essential for every research strategy, particularly for developing a knowledge foundation by analyzing chosen literature in the research area. That collects data from various relevant sources. As the most commonly used method in the extant literature, it divides them into distinct categories to discover more aspects in the study topic (see, e.g., Shashi et al., 2018; Awad et al., 2020; Ndraha et al., 2018).

2.1.2 Literature selection criteria

The following are the literature selection criteria used for a five-step methodology for this study in this chapter (Figure 2):

(1) We chose the Scopus and Web of Science (WoF) databases 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 experts who specialize in sustainable CSC for fresh foods. The set of keywords is represented in Table 2. In the initial stage, it came out with 532 (Scopus) and 323 (WoF) articles.

(2) We selected to evaluate just journal publications to increase the data's dependability because journal publications go through a formal double-blind peer-review procedure. Book chapters, conference papers, reviews, conference reviews, novels, editorials, and brief surveys were not considered in this regard. This study in this chapter considers the time span from 1987 to April 2022. As the initial date, 1987 was selected for this search because Brundtland first proposed the definition of sustainability in 1987 at the World Commission on Environment and Development (WCED). These two criteria refinements resulted in 316 and 166 articles, respectively.

(3) We considered only English language articles because of the predominance of that language in academic research. Simultaneously, we excluded the articles that did not address the sustainability or CSC problems through title reading. This step resulted in 299 and 165 articles, respectively.

(4) 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, and materials science. The exclusion of subject areas like engineering chemical; chemistry applied; agronomy; biotechnological applied microbiology; veterinary sciences; horticulture; zoology; physics applied; microbiology; chemistry physical; construction building technology; engineering mechanical; nanoscience nanotechnology. Resulted in 261 and 97 articles, respectively.

(5) The last refinement criterion was abstract reading and analysis after duplication (180 articles). The abstract and full-text analysis narrowed the scope to articles that focus on sustainability and good practices. A review study conducted by Hahn and Kühnen (2013) also emphasized this point, pointing to the lack of study on management attitudes for good practices. Management issues are associated with inappropriate decision-making, management attitudes, strategic misalignment, low operational efficiency, and the lack of adoption of advanced technologies with good practices. We considered not only the good practices implemented in the sustainable fresh food CSC issue but also other sustainability issues for the selection of the final articles.

(6) Following the five steps outlined above, we have 145 papers that have been classified by the publication year, the status of the country, research design, research

methods, sustainable dimensions, focused areas, and multiple-criteria decision-making (MCDM) techniques (Table 3).

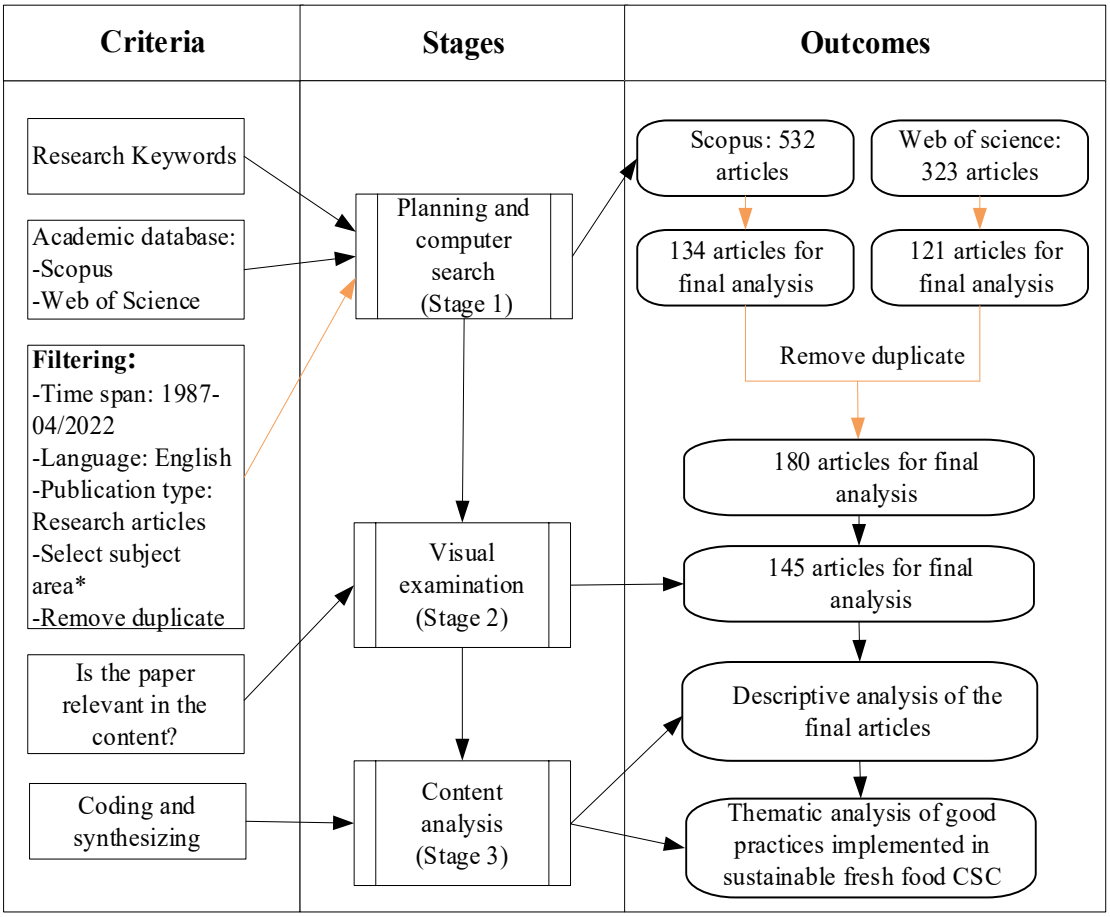


Figure 2. SLR criteria, stages, and outcomes

Table 2. 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"

Table 3. Categories considered in the study

Main classification considered in the study	sub-categories	Description
Year		Evaluating the development of the sustainable fresh food CSC area through the trend line presentation of papers from January 1987 to April 2022
Status of Country		Assessing the percentage of sustainable practices implementation of fresh food CSC in developing and developed countries
Research Design	Empirical Quantitative	This is a survey-oriented research design
	Empirical Qualitative	Practical implementation-based interview or case study-oriented research design
	Desk Quantitative	Mathematical modeling and simulation-oriented research design
	Desk Qualitative	A conceptual model, theoretical concepts, investigation for future research
	Empirical Triangulation	The research design is on the basis of the usage of two or more techniques of data collection
Research Methods	Simulation	Testing the effectiveness of the developed model for real cases
	Experiment	Describe and explain changes in information under conditions that assume to reflect changes
	Survey research	Online surveys, questionnaire-based surveys
	Conceptual/theoretical model	A symphony of concepts and theories for easy understanding
	Literature review	Literature survey for better understanding state-of-art
	Survey research + Interview	Combination of survey research and interview
	Literature review + Interview	Combination of literature review and interview
	Case study	In-depth study of individuals, groups, or specific situations and narrow the scope of real-world problems
MCDM	AHP/FAHP, DEA, TOPSIS/FTOPSIS, ANP/FANP, DEMATEL, ELECTRE, GTMA, VIKOR/FVIKOR, etc.	Selection of techniques to determine the most significant factors from a large number of available factors
Sustainable Dimensions	Environmental, Economic, Social	Determining the adoption patterns for different dimensions of sustainability
Focused Area	Good practices, Relationship between good practices and sustainability performance, etc.	Exploring focused areas of sustainable fresh food CSC

Note: Analytic Hierarchy Process (AHP)/ Fuzzy Analytic Hierarchy Process (FAHP), Data Envelopment Analysis (DEA), Techniques for Order Preference by Similar to Ideal Solution (TOPSIS)/ Fuzzy Techniques for Order Preference by Similar to Ideal Solution (FTOPSIS), Analytic Network Process (ANP)/ Fuzzy Analytic Network Process (FANP), Graph Theory and Matrix Approach (GTMA), Visekriterijumska Optimizacija I Kompromisno Resenje (VIKOR)/ Fuzzy Visekriterijumska Optimizacija I Kompromisno Resenje (FVIKOR), Decision-making Trial and Evaluation Laboratory (DEMATEL), Elimination and Choice Expressing Reality (ELECTRE).

2.1.3 Categorization of the articles

In this subsection, the 145 papers selected are classified based on various criteria in order to present in a timely manner the evolution of the publications, the research status of the country, sustainable dimensions, and focused areas of the selected papers, as well as the most used research design, research methods, and multiple-criteria decision making (MCDM) techniques within their studies.

This classification includes a frequency analysis of 145 papers on the basis of the publication year (Figure 3.).

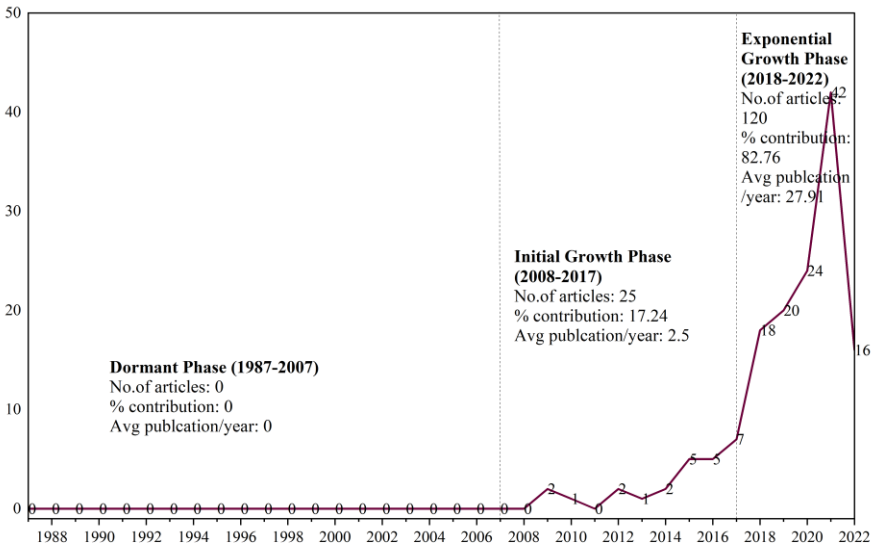


Figure 3. Publication year of the documents

The data in Figure 3 highlights the growing relevance in the literature on the topic of sustainable fresh food CSC. It is apparent that in the earlier span, the lack of attention is observed as 0 of papers are recorded between 1987 and 2007. From 2008 to 2017, this field observed initial growth as 17.24 % (25 out of 145) papers were recorded during this time span. Sustainable fresh food CSC gained a steep growth in the research from 2018 to 2022 (120 papers), contributing to 82.76 % of the total recorded literature. As can be seen from the figure, starting in 2018, this growth has been more pronounced.

Then, considering the research status of the country, the 145 articles studied were

divided into two categories, and the results are shown in Figure 4. 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.

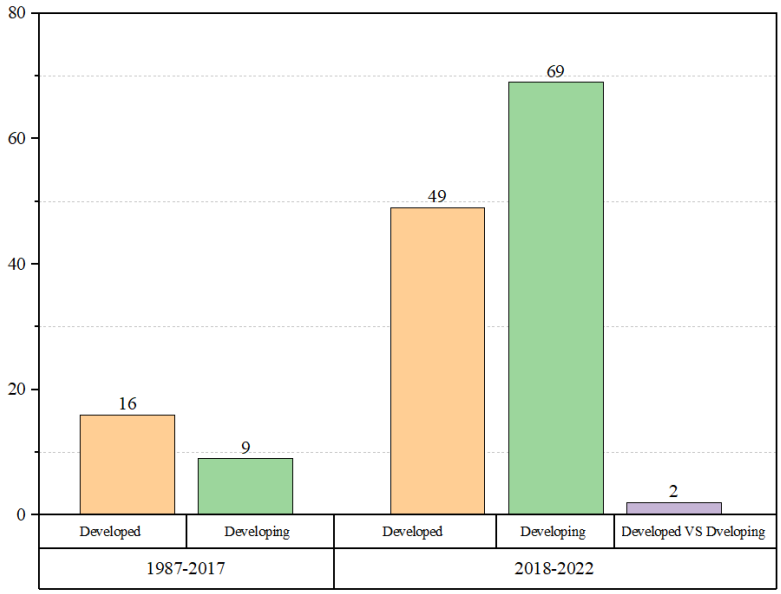


Figure 4. Article classification based on the research status of countries

Figure 4 shows the research status of countries in two different stages. Since there are 0 publications in the dormant phase, the first two phases (dormant phase and initial growth phase) are integrated into one stage. In the first stage, between 1987 and 2017, sustainable fresh food CSC was more studied in developed countries (64%) and less in developing countries (36%). While since 2018 till April 2022, the second stage (exponential growth phase), the studies of sustainable fresh food CSC in developing countries (57.5%) are more than in developed countries (40.83%). Finally, the remaining articles correspond to the 2 manuscripts (1.67%) classified as “Developing VS Developing” in Figure 4, which means that only two articles attempt to compare developed and developing countries in this research domain. Hu et al. (2019) constructed a nonlinear optimization framework to identify the optimal scale of the CSC under the constant final demand and use system dynamics to analyze the

greenhouse gas (GHG) emission reduction potential for developing and developed countries. Bonou et al. (2020) provide a comparative analysis of six post-cooling technologies for supplying pork meat to three markets: Australia, Denmark, and China.

Figure 5 presents the assortment of the articles according to which research design was used in each case. The type of research design conducted in the reviewed articles is divided into two categories, namely empirical research and desk research. These two categories are further subdivided into five types: empirical quantitative, empirical qualitative, desk quantitative, desk qualitative, and empirical triangulation (Table 3).

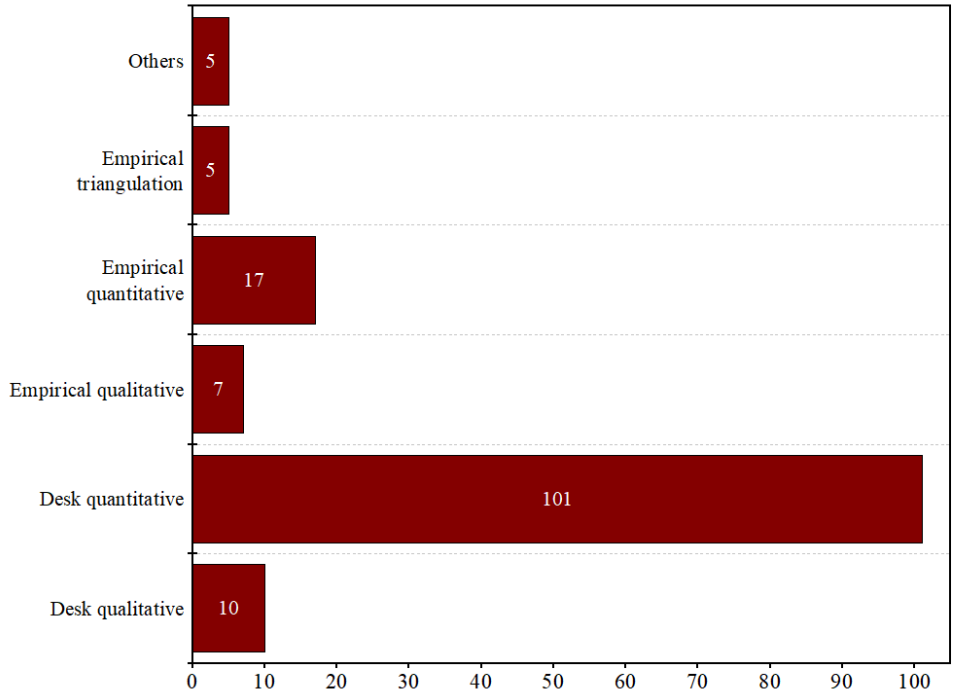


Figure 5. Research design adopted

Figure 5 presents the types of research designs that have been adopted in the reviewed papers. It can be observed that desk research design has contributed 111 (76.55%) articles and empirical research design contributed 28 (20%) articles; the rest of the papers correspond to 5 manuscripts (3.45%) classified as “Others” in Figure 5, and one of the main reasons is that the full text of these articles is not available, the research design cannot be determined based on their abstracts alone. It can also be

observed that the research of sustainable fresh food CSC is mostly persuaded towards quantitative research as it contributed 118 (81.38%) papers as compared to only 17 (11.72%) of qualitative research. Only 5 (3.45%) papers used empirical triangulation research design to solve the research problems in this research domain. For example, Raut et al. (2019) adopted an empirical triangulation research design (Survey research + Interview) to investigate the relationship between the "green practices" and "business performance" in the agriculture sector.

Moreover, Figure 6 presents the classification of articles depending on the research methods adopted in each case. Various authors often use research methods like Simulation, Experiment, Conceptual/theoretical model, Case study, Literature review, Survey research, Survey research + Interview, and Literature review + Interview to categorize the selected literature (Table 3).

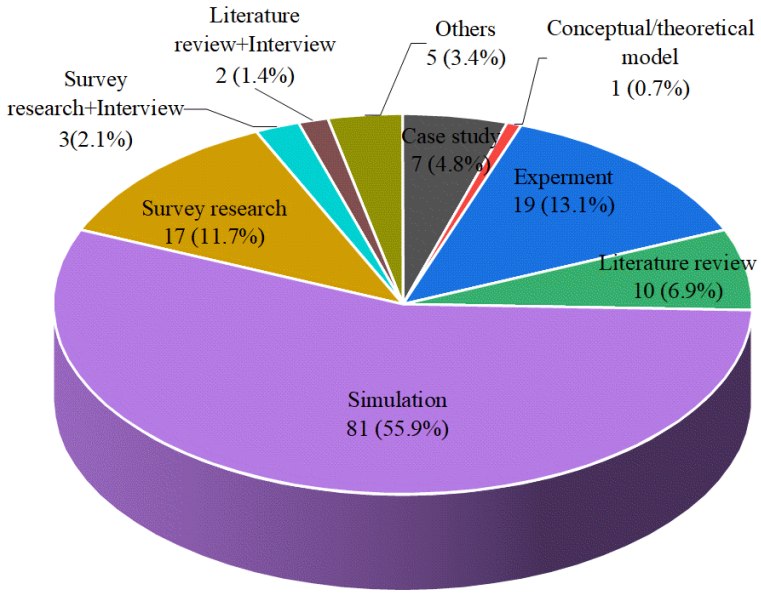


Figure 6. Research methods adopted

In particular, 81 articles out of 145 (55.9%) have adopted a simulation method, such as in this classification seems interesting the work of Zanoni and Zavanella (2012), on it the authors proposed a model to explore the relationships between the relevant parameters affecting the problems to find a possible chain optimization method, and

provided a numerical example to demonstrate the usefulness of the model. Meneghetti and Monti (2015) proposed an optimization model for the sustainable design of chilled automated storage and retrieval systems (AS/RSs) and offered a real-world case to test the effectiveness of the model. Wang, Tao, and Shi (2018) developed a green and low-carbon location–routing problem (LRP) model in the CSC to minimize total costs, including carbon emission costs. In order to solve this model, the authors designed a hybrid genetic algorithm with heuristic rules and finally provided an example to test the algorithm's effectiveness.

A total of 20 articles out of 145 (13.79%) investigated the topic through a survey research method (17 articles) and survey research + interview (3 articles). In this case, Singh, Gunasekaran, and Kumar (2018) proposed a hybrid approach to select 3 PL for CSC management under a fuzzy environment through a survey gathered from the food sector. Mor, Bhardwaj, and Singh (2018) explored the key performance indicators used as decision support tools in dairy SC practices and analyzed their interaction through a survey collected from the Indian dairy industry.

A total of 19 out of 145 (13.1%) adopted experiment methods. In this classification, it is remarkable the work made by Büsser and Jungbluth in 2009 that described and explained the impact of customers' behavior on packaging-related environmentally, Segovia-Bravo et al. (2012) described and explained how the preservation of strawberry juice at different pressure levels in hyperbaric storage at room temperature, which could reduce energy consumption in different sections of the CSC.

For its part, 10 articles out of 145 (6.9%) developed a literature review analysis. In recent research, Edwin, Nair, and Sekhar (2022), with their comprehensive literature review study, stated that the application of stand-alone and hybrid renewable energy systems in food processing, preservation, and transportation chain is relatively fresh.

Vrat et al. (2018) explored the research on sustainable freight transportation and CSC for perishable foods and unveiled that the research on sustainable freight transportation of perishable products is growing rapidly and that Italy is the most contributing country in this research field. Further on, Sadeghi Asl et al. (2021) explored and evaluated existing literature with a focus on detailing resilient SC, CSC, green SC, lean SC, and agile SC, and demonstrated that a minimum number of research on the CSC and the majority researches on the green SC had been carried out.

Moreover, 7 articles out of 145 (4.8%) have adopted the case study method. Coronado Mondragon, Coronado Mondragon, and Coronado (2015) carried out an in-depth case study analysis of a large food group in Spain and Western Europe based on the analogy methodology. Mangla et al. (2019) explored the interplay with distribution-related challenges by considering four Indian dairy product organizations, focusing on operational excellence and higher company green growth and sustainability viewpoints in food SCs. Filina-Dawidowicz and Wiktorowska-Jasik (2021) developed a case study of port cold stores in Polish seaports using a questionnaire survey, interviews, and document analysis.

Finally, the rest of the papers correspond to 5 manuscripts (3.4%) classified as "Others" in Figure 6. One of the main reasons for the "Others" classification is that the full texts of these articles are not accessible, we can only know the fields of research in these three articles. For example, Angellier-Coussy et al. (2013) only described the purpose of the article in the abstract, which is to explain the extent to which packaging can be a key factor in sustainable food consumption, but it is difficult to identify what research method was adopted in this article.

Finally, Figure 7 presents the most used MCDM techniques in the selected literature. The commonly used MCDM techniques are Analytic Hierarchy Process

(AHP), Data Envelopment Analysis (DEA), Techniques for Order Preference by Similar to Ideal Solution (TOPSIS), Graph Theory and Matrix Approach (GTMA), Analytic Network Process (ANP), Decision Making Trial and Evaluation Laboratory (DEMATEL), and Visekriterijumska Optimizacija I Kompromisno Resenje (VIKOR), ELimination and Choice Expressing Reality (ELECTRE).

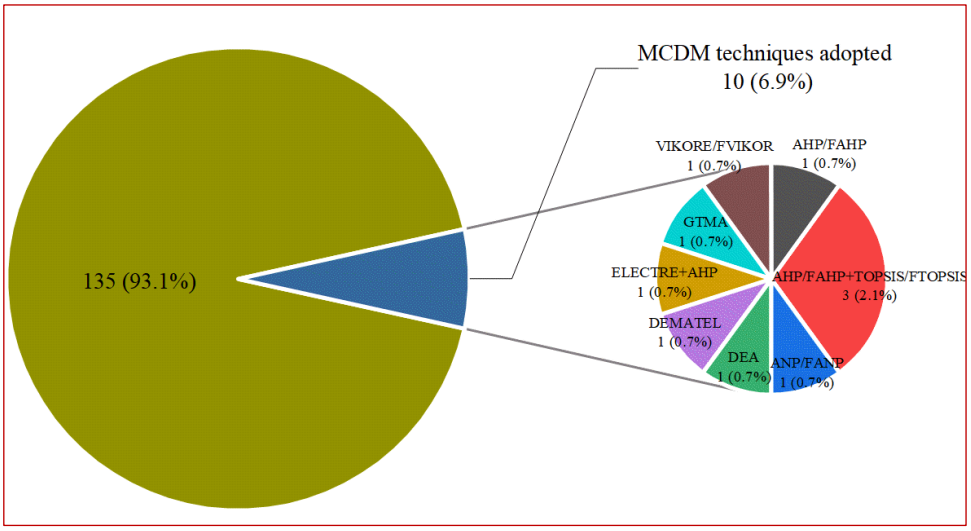


Figure 7. MCDM techniques adopted

This research reveals that researchers have limited interest in ranking and prioritizing the important factors for sustainable fresh food CSC or good practices implementation of improving sustainability performance through the use of MCDM techniques. Among the 145 papers, only 10 (6.9%) papers are reported using MCDM techniques, and three of them used both Analytic Hierarchy Process (AHP) and techniques for Order Preference by Similar to Ideal Solution (TOPSIS), and one of them used both AHP and Elimination and Choice Expressing Reality (ELECTRE). AHP/FAHP is the most used MCDM technique with 5 publications. Compared with other MCDM techniques, the greatest adoption of AHP/FAHP may be owing to the computational simplicity provided by the techniques. According to Ordoobadi (2010), AHP is a decision-making technique for figuring out the relative weights of various applicable parameters to identify their relative importance (Ordoobadi, 2010). The

selected literature on MCDM techniques shows that when many factors are classified and ranked, AHP techniques cannot provide reliable results. In the AHP technique, experts often have to modify their pairwise comparison due to inconsistency. In AHP technology, experts often have to modify their pairwise comparison due to inconsistency (Mi et al., 2019).

2.1.4 Status of research on sustainability dimensions and focused areas

In this subsection, the papers of the set were categorized again to know the frequency of research on sustainability dimensions and focused areas in the selected literature.

Figure 8 presents the focus of research in different article by highlighting the sustainability dimensions considered in the selected literature. It must be evaluated from the TBL performance, environmental impact, social welfare, and economic benefits to assess whether fresh food CSC has achieved sustainable development. The strategic business plan to balance environmental, social, and economic dimensions needs to be aligned in the fresh food CSC industry. If the fresh food CSC industry does not include any of these in its strategic planning, it will hinder fresh food CSC from achieving its sustainable development.

From the content analysis of this study in this chapter, it can be observed (Figure 8.) that most of the selected papers focus on the Environmental dimension (108). In comparison, Social (33 papers) and Economical (91 papers) dimensions are the least considered dimensions of the selected papers. There are 60 papers in the reviewed papers where both environmental and economic have been considered. There are 23 papers where social and environmental both have been considered. There are 22 papers where both social and economic have been considered. There are only 18 research records in the reviewed papers where environmental, social, and ecumenical have been

considered simultaneously from the perspective of the need for a balance between environmental protection, social welfare, and economic benefits.

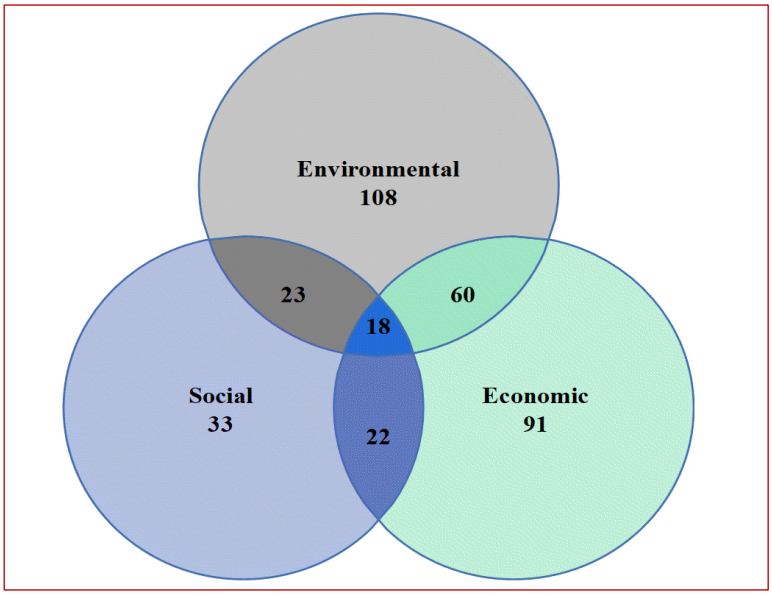


Figure 8. Sustainability dimensions

This research's findings show that most researchers only focus on environmental protection but do not pay attention to the three dimensions simultaneously (see, e.g., Bottani et al., 2019; Hsu, 2019). In this case, it will hinder fresh food CSC from achieving its sustainable development. Tao, An, and Duan (2021) proposed a CSC distribution route optimization approach for fresh food under a carbon tax mechanism and trued out that the proposed approach can effectively reduce total cost and carbon tax cost through experimental Simulation. Fan et al. (2021) proposed a simulation framework to trade off food quality, cost, and emission.

To go deeper into the current state of research in the focused areas that have been explored in the selected literature. But before doing this, since the full text of some of these 10 articles is not currently available, and some are literature reviews that only deal with the research status of the topic, in this case, these 11 articles are classified as “Other perspective” in Figure 9. Many areas in the sustainable fresh food CSC field have been explored in selected papers. Exploring the various research areas of the

sustainable fresh food CSC in the selected papers is necessary. This classification aims to identify the least researched areas in the reviewed papers and future research opportunities for sustainable fresh food CSC.

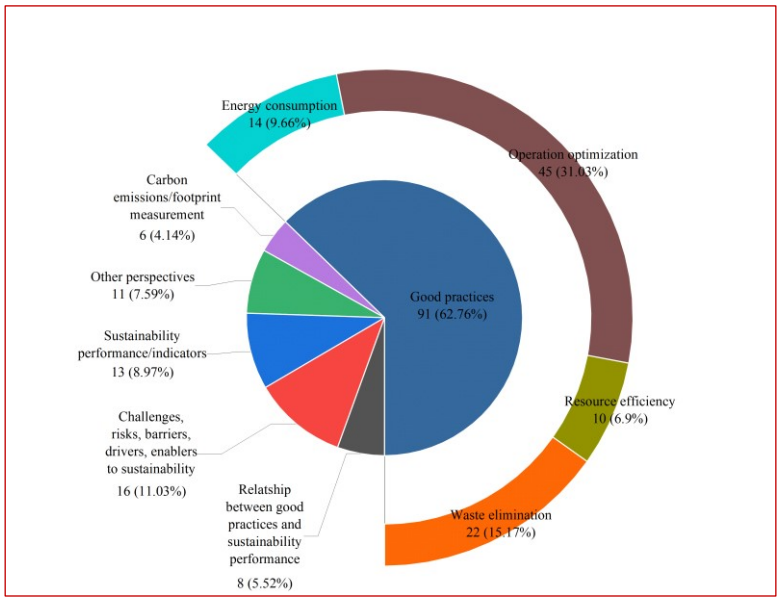


Figure 9. Research areas of sustainable fresh food CSC

Figure 9 presents the classification of the research areas of sustainable fresh food CSC in the selected literature.

In the good practice category, we categorized the objectives behind the implemented good practices, as shown in Figure 9. A total of 91 articles out of 145 (62.76%) focused on the implementation of one or more good practices to improve operational optimization (31.03%), reduce fresh food waste (15.17%), reduce energy consumption (9.66%), improve resource efficiency (6.90%).

In particular, many authors are focusing on optimizing routing problems (20 articles) to improve the operational efficiency of CSC (see Wang, Tao, and Shi, 2018; Stellingwerf et al., 2018; Chen et al., 2019; Meneghetti and Ceschia, 2020; Chen, 2021; Jaigirdar et al., 2022, etc.). For example, Shi, Zhang, and Qu (2010) first presented a real-time monitoring system for CSC distribution by incorporating sensors, radio frequency identification (RFID), and wireless communication technologies. And then

proposed a multi-stage planning model to identify optimal distribution plans to minimize the overall cost of the entire CSC network.

Several ways to reduce fresh food waste and loss have been explored in selected literature. For example, improving traceability and transparency by WSN, sensor, Internet of Things technologies (see Xiao et al., 2017; Markovic et al.,2020, etc.), improving packaging efficiency or technologies (see, Büsser and Jungbluth, 2019; Matar et al., 2021), and fresh food processing technologies (see, Kisaalita et al., 2018; Awad et al., 2021), surplus fresh food donation (Al-Khateeb et al., 2021). For instance, Defraeye et al., (2019) developed a digital fruit twin based on mechanistic modeling to reduce fresh food losses and wastes by improving the refrigeration process and logistics.

There are several approaches explored to reduce energy consumption in selected literature. For instance, some authors attempted to use passive cold devices to reduce energy consumption (see Hoang et al.; Tong et al., 2021, etc.), and some authors tried to adopt renewable energy sources to reduce traditional energy consumption, such as solar photovoltaic systems in a warehouse or transport vehicles (see, Meneghetti et al., 2018; Meneghetti, Dal Magro and Romagnoli, 2021, etc.), Gwanpua et al. (2015) adopted environmental management system to reduce energy consumption. Also, Gallo et al. (2017) proposed a mixed-integer linear programming (LP) model for optimizing the total energy consumption connected with the refrigeration operations experienced by perishable products.

Additionally, we found that in addition to reducing energy consumption, sustainable development can also be achieved through improved resource efficiency. For example, Coronado Mondragon, Coronado Mondragon, and Coronado (2015) believed that composite materials adoption is a way to increase resource efficiency. Thakur et al. (2021) proposed several solutions to improve the overall resource

efficiency of the India surimi SCs. Zhang (2017) proposed the concept of the super cold chain, which can not only guarantee the perfect quality of fresh food but also reduce the impact on the environment. Fang et al. (2018) proposed a multi-objective LP model for green CSC design to balance the total cost and carbon emissions.

For its part, 16 articles out of 145 (11.03%) focused on investigating the challenges, risks, barriers, drivers, and enablers to fresh food CSC sustainability. For instance, according to the research conducted by Filina-Dawidowicz and Wiktorowska-Jasik (2021), the most important factors are economic and organizational factors among the factors set. Qihao (2021) discussed the necessity of strengthening policy support from government regulation in order to encourage agricultural CSC firms to fulfill their duties for ecological and environmental protection actively.

Moreover, 13 articles out of 145 (8.97%) explored the sustainability indicators and sustainability performance measurement. For example, Mor, Bhardwaj, and Singh (2018) explored key performance indicators used as decision support tools in dairy SC practices, as well as analyzed their interconnections in the context of the Indian dairy industry. Khan and Ali (2021) first adopted the interpretive structural modeling (ISM) method to identify sustainability factors and then used fuzzy VIKOR to select CSC suppliers by measuring the sustainability performance in the context of Pakistan.

Additionally, as shown in Figure 9, only 8 articles out of 145 (5.52%) attempted to investigate the relationship between good practices and sustainability performance. Some researchers focused on exploring the impact of good practices implemented in the food SC on sustainability performance with simulation method (He et al., 2016), literature review + interview (Siddh et al., 2018), and survey research method (Raut et al., 2019). At the same time, some researchers attempted to investigate the relationship between good practices implemented in CSC and sustainability performance through

the survey research method (see, Al-Refaie, Al-Tahat, and Lepkova, 2020; Kumar, Tyagi, and Sachdeva, 2022) and simulation method (Dong, Miller and Keoleian, 2022). However, only one article in the selected literature by Turan and Ozturkoglu in 2021 tried to explore the impact of food CSC management on environmental sustainability performance through survey research.

Finally, 6 articles out of 145 (4.14%) were devoted to how to measure the carbon emission/footprint of fresh food CSC. Three of them used the environmentally extended input-output (EE-IO) approach or life cycle assessment (LCA) to measure the carbon emission/footprint of fresh food CSC (see, Camanzi et al., 2017; Pérez Neira et al., 2018; de Kock, Russo, and von Blottnitz, 2019). The remaining three articles to measure the carbon emission/footprint of fresh food CSC using a mathematical modeling method (see Heard and Miller, 2019; Hu et al., 2019; Dong and Miller, 2021).

2.2 Gaps arising in the existing literature

In a systematic literature review analysis, it was discovered that the number of articles on the topics already described in this thesis had been gradually increasing over the years, especially in the past four years, the number of publications has increased sharply (see Figure 3) and that there are three research gaps exposed in addition to the conclusion outlined in the previous section.

From the key articles identified adopting the search method outlined in section 1.1.2, only 4 articles out of 91 (the classification of good practice) could be found reporting empirical research on the implementation of good practices in sustainable fresh food CSC. This means that most of the articles related to good practice implementation are explored using desk research. Therefore, it indicates that limited empirical research has been carried out in this area.

Three of these adopted case studies to explore how to improve resource efficiency

and reduce waste and loss of fresh food. The first of these studies is based on the empirical observation of a Spanish leading producer of fresh fruit juice (Coronado Mondragon, Coronado Mondragon, and Coronado, 2015), in it, the authors observed that visibility/traceability is one of the parts of a "low-tech" industry SC that can give suggestions for configuration of the composites industry SC. The remaining two articles based on the case studies found that the adoption of irradiation can not only meet a technical need but also meet a consumer need by providing quality products at competitive prices (Lynch and Nalder, 2015), and the adoption of a multidisciplinary approach that can improve resource efficiency and reduce waste is critical for sustainable development (Thakur, et al., 2021), respectively.

The rest of one article adopted survey research to explore how to improve resource efficiency and reduce waste and loss of fresh food. Markovic et al. (2020) demonstrated that continuous, context-sensitive, trustworthy temperature measurement could benefit multiple stakeholders along the delivery pathway.

It can be observed that these four articles only attempted to explore a specific good practice that can improve resource efficiency or reduce waste through empirical research and did not attempt to explore the series of good practices implemented by companies in fresh food CSC to achieve sustainable development with empirical research. Thus, the first gap in the literature is the need for empirical research related to the implementation of good practices in sustainable fresh food CSC.

Secondly, it was also observed that only 11 articles out 145 used empirical research to explore sustainable fresh food CSC development challenges, risks, barriers, drivers, and enablers. Furthermore, only 3 of these analyses were based on the case study. These 3 articles identified several drivers or enablers that play a critical role in promoting sustainability and several challenges that hinder companies from achieving

sustainability.

However, Hospido et al. (2009) only focused on the analysis of the role of seasonality in the fresh food consumption stage. Mangla et al. (2019) first identified several key challenges on the basis of literature review and experts' opinions and then analyzed the interaction between distribution-related challenges through four Indian dairy organizations. This means that this article is concerned only with the challenges of the distribution stage. In addition, the related research conducted by Filina-Dawidowicz and Wiktorowska-Jasik in 2021 only analyzed the challenge of the principles of sustainable distribution as well.

It can be observed that these 3 articles only concerned the drivers/enablers and challenges of a certain stage in the same context through a case study or multiple case studies. In this case, this is a scope for further analysis to explore the drivers/enablers and barriers to good practices implemented in different contexts through multiple case studies, due to the limited empirical research that has been carried out in this area (Sancha et al., 2015).

Since the use of empirical triangulation helps researchers to explore the multi-dimensional facts of the research problems, empirical triangulation research design can help to investigate more insights into the good practices in the sustainable fresh food CSC. From Figure 8, it can also be observed that only 18 of the 145 articles focus on all three sustainable dimensions (social, economic, and environmental) simultaneously. Specifically, even if there are 13 articles explored the sustainability indicators and sustainability performance measurement. However, only 4 articles considered the three dimensions of sustainability performance of fresh food CSCs, one for supplier selection (Khan and Ali, 2021) and one for third-party logistics selection (Singh, Gunasekaran, and Kumar, 2018). Despite the fact that some research proposed different models for

measuring CSC performance, these models are not applicable to sustainable fresh food CSC.

Furthermore, only 5 articles out of 145 (3.45%) (see Figure 5) adopted an empirical triangulation research design. Therefore, in addition to adopting multiple case studies to explore the differences and reasons for implementing good practices by developed and developing countries in the sustainable fresh food CSC, survey studies can also be used to explore the relationship between good practices and fresh food CSC sustainability performance (overall, including both economic, social, and environmental) with survey research, since only 4 articles out of 145 adopted survey research method to explore the relationship between good practices and sustainability performance.

In summary, by studying these gaps, more understanding and knowledge will be gained about the implementation of good practices in sustainable fresh food CSC.

2.3 Setting research questions (RQs)

Based on the preliminary investigation of the above research topic, literature, and research gaps in this thesis, it is determined that the RQs should be focused on:

- Identify good practices implemented in sustainable fresh food CSC in developed countries.
- Identify the differences and explore the reasons for sustainable fresh food CSC good practices implementation by companies in developing countries.
- Explore the impact of good practices on fresh food CSC sustainability performance.

Therefore, to achieve these objectives, RQs were identified as follows:

- RQ1: What are the good practices available/used in the sustainable fresh food CSC in developed countries?

The output to this research question will be a definition and categorization of good practices and a comprehensive list of good practices identified in developed countries.

- RQ2: What differences exist in the good practices available/used in the sustainable fresh food CSC in a developing country? Why these differences, if any?

  This research question is about what good practices are implemented by different companies. In addition, explore the drivers/enablers to the implementation of these good practices to analyze the reasons for these existing differences.

- RQ3: What are the impacts of the implementation of good practices in developed countries on the sustainability performance of developing countries?

  This research question is about how good practices that have been successfully implemented in developed countries affect sustainability performance in developing countries. In this sense, a list and framework of sustainability performance indicators will be established in succession. A good practice ranking will then be obtained based on an assessment of sustainability performance. Additionally, the results of the good practice ranking can help to further explain the reasons for the differences.

These RQs were considered appropriate to push the study on the proper path in order to achieve the set goals, fill research gaps and achieve the desired end outcomes.

Chapter III: Determination of good practice and sustainability performance indicators

This chapter presents the introduction of the first section that conducts the research of this chapter. The second section presents methodologies for exploring good practices implemented in sustainable fresh food CSCs in developed countries and indicators for the sustainability performance assessment of fresh food CSC. The third section focuses on the identification of good practices. The final section focuses on the identification of sustainability performance indicators.

3.1 Introduction

The sustainability management of fresh food CSC faces four significant challenges: fresh food quality and safety assurance, fresh food waste and loss elimination, operating cost reduction, and carbon emission reduction (Kumar et al., 2020).

Performance management is one of the available instruments for a company to differentiate itself from its rivals in today's competitive business market. Fresh food CSC sustainability performance measurement is a topic that both practitioners and academics are interested in. Economic performance, environmental performance, and social performance are the three primary components of sustainable fresh food CSC performance for embodying the spirit of sustainability in company performance. It enables "monitoring and tracing" of effectiveness and efficiency failures, resulting in

better-informed chain design decisions (Singh, Gunasekaran, and Kumar, 2018).

Therefore, in addition to establishing a system of sustainability performance indicators to help companies to measure their sustainability performance, we should also explore what good practices companies can adopt to pursue sustainability in fresh food CSC. With these purposes, we first concentrate on those good practices related to our conceptualization of sustainable fresh food CSC and focus on good practices that, e.g., improve operational efficiency, and reduce carbon emission. Hence, the definition of good practices is a group or organized activities to improve a company's TBL performance (economic, social, and environmental) to result in more environmentally friendly and ecologically responsible behaviors and lifestyles (Al-Refaie, Al-Tahat, and Lepkova, 2020).

Armed with the definitions of sustainable fresh food CSC and good practices, we will conduct a systematic literature review to identify good practices that have been shown in the existing literature to improve TBL performance, as well as to identify sustainability performance indicators in the fresh food CSC.

Furthermore, since the development of sustainable fresh food CSC in developed countries is ahead of developing countries. Moreover, in addition to the first research gap mentioned earlier, that is the lack of empirical research related to good practices implementation in sustainable fresh food CSC. In this context, we will conduct a case study from a company in a developed country on its successful implementation of good practices in the sustainable fresh food CSC.

3.2 Research Methods

The key issues involved in conducting this study in this chapter revolved around developing and validating scales for implementing sustainable fresh food CSC good practices in organizations and the performance assessment of different measures of

sustainable fresh food CSC. In order to address these issues, the method we adopted in this study in this chapter involves two phases, i.e., a preliminary list of good practices and a system sustainability performance indicator were identified from a systematic literature review with the help of field experts in the first phase. The second phase was a case study of a company in a developed country to identify good practices that the selected company has successfully implemented in the fresh food CSC.

3.2.1 Phase 1: Good practices and sustainability performance indicators in the literature

In the first phase, a preliminary good practices list and system sustainability performance indicators were select from the existing literature focusing on sustainability and fresh food CSCs. A systematic literature review with the help of field experts were conducted, using the same process as the systematic literature review applied in Chapter II above, provided by Tranfield et al. (2003). Start with clear goals specified in the research question, that is, what good practices can companies adopt to pursue sustainability in fresh food CSC? In the second stage, we chose the SCOPUS and Web of Science databases to retrieve publications by searching for four-level assemble structure keywords, and level one is "Cold chain" OR "cold supply chain" OR "cold supply chain logistics" OR "cold chain logistics" "sustainable" OR "sustainability" OR" sustainable development" OR "green" OR "environmental impact" OR "low carbon" OR "emissions" OR "social impact" OR "socioeconomic" OR "economic impact"; level two is "food" OR "perishable" OR "fresh product" OR "agriculture products"; level three is "performance" OR "practices"; level four is "nonperishable" OR "nonperishable." The keywords were selected based on the determined key research topics in various literature and reviews of the preliminary studies. In the third stage, we selected to evaluate just journal English publications with

a time span of 1987 to April 2022. In the fourth stage, we consider the same subject areas as we considered in Section II, for example, environmental science, agricultural and biological sciences, engineering, energy, business, and so on. The last step was abstract reading and analysis after duplication. In abstract and full-text analysis, it narrowed the scope to articles focusing on sustainability performance and good practices. After the above stages, 112 publications were finally selected for this study in this chapter.

Six open interviews were then carried out with field experts from food and management engineering institutions in order to integrate good practices and categorize sustainability performance indicators based on the findings of the above-conducted systematic literature review. The open interview begins with the following questions: Do you think it is possible to integrate these good practices identified from the literature review? Do you agree with my classification of sustainability performance indicators? Subsequently, the interviews conducted a more in-depth investigation of the objectives behind the described good practices before discussing the good practices that could be integrated and categorizing the indicators. Based on the six field expert interviews, a total of 23 good practices (Table 4), 3 sustainability performance indicators and associated 13 sustainability performance sub-indicators (Table 5) were identified.

3.2.2 Phase 2: Good practices from the field

Since the implementation of good practices is a dynamic process, there is a high focus on commercial confidentiality and limited empirical evidence. Therefore, we adopt a case study in the second phase because the investigation is exploratory in nature (Yin, 2017).

As the retail company is a comprehensive fresh food company involving the entire fresh food CSC, procurement, distribution, warehousing, and sales. Furthermore,

retailers rely on sustainability initiatives to not only encourage and drive their suppliers to adopt good practices (Jones, Comfort, and Hillier, 2005, 2011; Vadakkepatt et al., 2021) but also to increase consumer awareness and influence their shopping choices (European Commission, 2010).

In this situation, based on a preliminary good practices list obtained from the systematic literature review with the help of field expert (Table 4), the purpose of the study in this chapter was to explore good practices available/used in the sustainable fresh food CSCs in developed countries. We first developed a case study protocol for a retail company based on the preliminary data collected from systematic literature review. We selected one of the largest Italian supermarket chain companies, the first retail company in Italy to be ISO 14001 certified (in 2013), voluntarily complying with relevant regulations and laws for over 5 years and providing sustainability reporting for almost 10 years. Therefore, the selected company reflects an Italian market-leading retail company that is actively involved in sustainable good practice initiatives and has evidently improved its sustainability performance.

Data collection was from November 2020 to March 2021. The case study protocol was used for semi-structured, in-depth interviews with the selected Italian market-leading company. We conducted group interviews with the selected Italian market-leading retail company to gather information on good practices implemented in the sustainable fresh food CSC. A total of two interviews were carried out, each lasting almost two hours. To improve accuracy, each interview was recorded and transcribed. In order to reduce observer bias, five researchers took field notes. Details of the interview protocol are shown in the Appendix. In parallel, secondary data is collected and analyzed to gain a more complete picture of selected case to better address the research question, for example, public reports on sustainability and corporate social

responsibility (CSR), as well as materials, slides, and documents prepared to present their sustainability strategies and practices. The triangulation assists the research team to identify good practices implemented by the company. We used the data coding procedure recommended by Yin (2017) to identify the good practices which have been successfully implemented by the selected Italian market-leading company.

Table 4. Good practices identified from literature reviews

Good practices	Description	References
Enterprise resource planning (ERP)	Ensure faster contact with suppliers and response to customer needs, reduce inventory costs, improve service levels, and reduce CSC costs.	Al-Refaie, Al-Tahat, and Lepkova (2020), Sharma, Abbas, and Siddiqui (2021).
Cold warehousing management system	Easily identify inventory items and reduce inventory costs.	Al-Refaie, Al-Tahat, and Lepkova (2020)
Bar coding	Easily identify inventory items throughout storage, retrieval, pickup, inspection, and scheduling, save paperwork and processing time, and reduce human mistakes, thereby increasing the productivity of CSC systems via speed, precision, and dependability.	Al-Refaie, Al-Tahat, and Lepkova (2020)
Global positioning system	Support year-round, global real-time, three-dimensional positioning and navigation.	Mor, Bhardwaj, and Singh. 2018, Al-Refaie, Al-Tahat, and Lepkova (2020)
Application of passive cold devices	Unlike traditional mechanical refrigeration devices, passive cold devices can reduce the energy consumption and carbon emissions, and costs of the entire fresh food CSC.	Perez-Masia, et al. (2014) Kumar, Tyagi, and Sachdeva (2022)
Adoption of the latest refrigeration technologies	The latest refrigeration technologies will use less energy, resulting in less carbon emissions.	Al-Refaie, Al-Tahat, and Lepkova (2020), Kumar, Tyagi, and Sachdeva (2022)
Employee empowerment	Create a more open, flexible, and supportive management style so that employees can contribute their best efforts to the company's mission.	Siddh et al. (2018), Al-Refaie, Al-Tahat, and Lepkova (2020).
Employee training	In order to effectively operate the fresh food CSC, it is critical to have employees that are well-trained and qualified in terms of the understanding of fresh food processing standards and relevant latest technologies	Mangla et al. (2019), Sharma, Abbas, and Siddiqui (2021).
Application of IoT in CSC logistics	IoT applications can meet the requirements for uninterrupted information flow, helping maximize CSC operational efficiency	Coronado Mondragon, Coronado Mondragon, and Coronado (2015), Kumar, Tyagi, and Sachdeva (2022).
Use of RFID and WSNs	The improved traceability process could monitor temperature fluctuations, improve traceability and transparency, ensure quality and safety, and ultimately eliminate waste in the CSC.	Sharma, Abbas, and Siddiqui (2021), Kumar, Tyagi, and Sachdeva (2022).
Co-operation with suppliers and customers for joint action	Strengthen relationships with suppliers and customers through joint decision-making.	Siddh et al. (2018), Raut et al. (2019).

(Continue)

Reverse logistics	Reverse logistics can improve environmental performance.	Siddh et al. (2018), Raut et al. (2019).
Collaborative green transportation and cold storage	Collaboration and warehousing sharing between SC partners are required to reduce transportation and warehousing costs.	Raut et al. (2019).
Environmental design (packaging, reuse, handling)	Utilize the least number of resources and energy, allow for the reuse, recycling, and recovery of component materials and parts, and eliminate or decrease the usage of hazardous products throughout the fresh food CSC network, both inter-and intra-organizationally.	Raut et al. (2019), Matar et al. (2021).
Green manufacturing	Utilize the least number of resources and energy, and eliminate or decrease the usage of hazardous products in the fresh food production process.	He et al. (2016), Raut et al. (2019).
Optimization model	Ensure optimal utilization of resources at different stages of the fresh food CSC, such as inventory management network design, operational costs reduction, carbon emissions reduction, quality improvement, waste elimination, routing optimization, scheduling model, etc.	Zanoni, and Zavanella (2012), Chen (2021).
Green purchasing	Implement activities such as reuse, recycling, and recovery of component materials and parts with suppliers to reduce resource consumption.	Raut et al. (2019)
Implementation of ISO 14001	Implementation of ISO 14001 is the world's most recognized standard for better managing the environmental impact of CSC activities and demonstrating sound environmental management.	Al-Refaie, Al-Tahat, and Lepkova (2020)
Sensitivity analysis of climatic conditions through the whole CSC	Regular analysis of climatic conditions throughout the entire CSC to maintain fresh food quality and safety, thereby reducing fresh food waste and loss.	Siddh et al. (2018), Kumar, Tyagi, and Sachdeva (2022).
Internal environmental management	In an organizational context, environmental objectives, policy statements, and procedures must be written to implement the corrective action plan to improve internal environmental management.	Raut et al. (2019), Khan and Ali (2021).
Solar photovoltaic systems	As a renewable energy source, using solar photovoltaic systems in warehouses can reduce energy consumption and carbon emission.	Meneghetti, Dal Magro, and Simeoni (2018), Burek and Nutter (2020).
Close communication with customers/enhance quality awareness	A company holding events, such as offline courses, to raise consumer awareness of the quality dimensions of fresh food can not only reduce household food-borne disease but also improve the company's reputation and competitiveness by enhancing communication with customers.	Sharma, Abbas, and Siddiqui (2021), Al-Khateeb et al. (2021).
Surplus fresh food donation	Donating unsold food to food banks, sending food unfit for human use away for animal consumption, or making compost for agriculture is one way to reduce food waste and improve social welfare.	Burek and Nutter (2020), Al-Khateeb et al. (2021).

3.3 Results

In this section, good practices that have been successfully implemented by the Italian market-leading company and sustainability performance indicators that identified from the systematic literature review with the help of field expert will be presented in detail by discussing each one of these good practices and indicators.

3.3.1 Good practices

This present research in this chapter identified eight practices that have been successfully adopted in sustainable fresh food CSCs from literature (Table 4), expert interviews, and a case study of an Italian market-leading company.

Adoption of information technology (IT) systems in fresh food CSC. One of the main good practices that emerged from the case study was the implementation of IT systems such as ERP, Cold Warehousing Management System, Bar coding, Global Positioning System, etc. in a sustainable fresh food CSC. Since the fresh food SC involves a large number of partners, a lack of horizontal integration of farmers will result in a disaggregated and fragmented supply. According to Gardas, Raut, and Narkhede (2018) suggested that poor farmer-to-wholesalers-to-retailers integration causes economic and social unsustainability. IT is being utilized to improve inter-organizational cooperation (McAfee, 2002; Sanders, 2008), and inter-organizational cooperation has been found to positively impact select company performance (Vickery et al., 2003). (Al-Refaie Al-Tahat, and Lepkova, 2020) demonstrated that IT systems support the collaborative fresh food CSC processes, improve operational efficiency, and enhance its performance during various stages of the fresh food life cycle. For instance, ERP adoption, allows for a faster response to client requirements, lower inventory costs, higher service levels, and lower logistical costs (Liu, Su, and Liu, 2021; Li et al., 2020; Leng et al., 2020; Zanoni, Mazzoldi, and Ferretti, 2019; Xie and Li, 2019).

Application of RFID and WSNs for monitoring the status (temperature, humidity, storage time, etc.) of fresh food. A second good practice that emerged from the case study was the implementation of RFID and WSNs in a sustainable fresh food CSC. Since fresh foods are temperature sensitive and begin to undergo a chemical reaction and lose their quality when the temperature exceeds the range that is allowed, it is necessary to keep within their permissible sustainable temperature range to retain their quality and safety requirements. If adequate temperature monitoring is not given, it may cause fresh food to freeze or overheat, ultimately resulting in a loss of quality and wealth (Ashok, Brison, and LeTallec, 2017; Chen, 2020). Xiao (2021) proposed an improved traceability process to eliminate frozen tilapia waste in the CSC. Results showed that the improved traceability process could monitor temperature fluctuations, improve traceability and transparency, ensure quality and safety, and ultimately eliminate waste in the CSC.

Adoption of Solar photovoltaic systems in the warehouse. In terms of reducing fossil fuel usage and energy efficiency, energy conservation has emerged as one of the most critical performances to attain in a long-term perspective (Schirone and Pellitteri, 2017). The Sustainable Energy for All (SE4All) program of the United Nations is based on three interconnected global goals that must be met by 2030: (1) guaranteeing universal access to modern energy services; (2) doubling the pace of development in energy efficiency worldwide; and (3) doubling the global use of renewables in the energy mix. Since the input of the refrigeration system in a CSC will consume more energy than a conventional SC, one of the main challenges facing sustainable CSCs is reducing energy consumption. The adoption of Solar photovoltaic systems can be considered as one of the most useful ways to reduce energy consumption in sustainable fresh food CSCs. For example, Meneghetti, Dal Magro, and Simeoni (2018) conducted

a case study applying photovoltaics to an automated refrigerated warehouse in north-eastern Italy, and the results showed that photovoltaics installation could lead to both energy and total yearly cost-saving. Likewise, applying photovoltaics to the distribution of palletized frozen food delivery would show that each truck can significantly reduce greenhouse gas emissions (Meneghetti, Dal Magro, and Romagnoli, 2021; Meneghetti, Pagnin, and Simeoni, 2021).

Eco-design. Klassen and McLaughlin (1993) claim that environmental excellence begins with initial product and process design. Manufacturers must design goods that utilize the least amount of resources and energy, allow for the reuse, recycling, and recovery of component materials and parts, and eliminate or decrease the usage of hazardous products throughout the production process, according to eco-design (Zhu Sarkis, and Lai, 2008). Except for adopting reusable energy, organizations can adopt the recycling of pallets and plastic baskets in the entire fresh food CSC based on the coordination among SC partners to improve resource efficiency and reduce energy consumption (Batista et al., 2019); organizations can use reusable packaging materials (Dieckmann et al., 2019; Moreira et al., 2011), adopt passive cold devices (Xu, Zhang, and Liu, 2018), use the latest refrigeration technologies (James and James, 2010), and optimize CSC logistics distribution (Chen et al., 2019; Liu, Su, and Liu, 2021; Stellingwerf et al., 2021; Wang, Tao, and Shi, 2018) to reduce the impact on the environment.

Application of environmental management system for monitoring the environmental impact. In the implementation of the fresh food CSC sustainability initiative, the commitment of top and mid-level managers plays a significant role (Quazi, 1999; Rice, 2003; Zhu, Sarkis, and Lai, 2008). Certifications like ISO 4001, and ISO 9000 promote industries to improve quality with an eco-friendly methodology (Holt

and Ghobadian, 2009; Jabbour, 2015). Organizations must follow and track the government's environmental standards and regulations in order to avoid paying penalties for breaking the law. Environmental objectives, policy statements, and procedures must be created in an organizational setting in order to implement corrective action plans to improve internal environmental management (Li, 2011; Nagel, 2003). Once companies adopt sustainable development as a strategic imperative and the imperative obtains the commitment and support from the top and mid-level management, the application of an environmental management system helps to check and control all environmental activities.

Employee training. Training has been shown to improve lean performance (Chaplin, Heap, and O'Rourke, 2016; Herron and Braiden, 2006). Therefore, for a sustainable fresh food CSC, it is critical to have well-trained and qualified employees to understand fresh food processing standards and relevant latest technologies. However, since fresh food CSC is a comprehensive and interdisciplinary applied discipline (Han et al., 2021), skilled employees in this industry are still scarce. In addition, for fresh foods, due to poorly skilled employees (David et al., 2019), cross-docking and a reliable temperature assessment will affect CSC management (Oliva and Revetria, 2008). (Pearce et al., 2018) conducted a case study to determine factors driving sustainable performance, and one of the results showed that the efforts of training are great for those who feel they were building a career in industry to cultivate long-term enthusiasm and commitment to the job, which also supported by (Vinodh, Ramesh, and Arun, 2016; Vinodh, Ruben, and Asokan, 2016).

Offering some courses to raise consumers' awareness about the quality dimensions of fresh food. Another good practice that emerged was to offer some courses to communicate closely with customers/enhance quality awareness. According

to reports, 45% of food losses and 87% of foodborne diseases in Europe happened at the household level (Redmond et al., 2018; Gustavsson et al., 2011). Consumer behavior and household environment substantially influence household fresh food loss rates and incidence of food-borne illness; efforts should thus be taken to eliminate these risk factors. Regular temperature verifications, cleaning, and disinfection are required in terms of customer behavior to limit temperature fluctuations and levels of microbiological contamination (for example, bacteria and fungi) in refrigerators (Ye et al., 2019). Since retailers play a critical role in increasing consumer awareness (European Commission, 2010), therefore, community supermarkets can set up some offline courses to raise consumers' awareness of the high quality of fresh food, which is a potential way to reduce household food-borne illness while enhancing communication with customers to improve their reputation and competitiveness.

Surplus fresh food donations. According to a rough estimate by FAO (Food and Agriculture Organization of the United Nations) in 2011, about a third of the world's food is lost and wasted every year (*The State of Food and Agriculture 2019*, 2019). Taking FAO as a reference, food waste is defined as «referring to the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food service providers and consumers» (SFFA,2019). In other words, waste refers to when food is discarded even though it is still edible. As Parfitt, Barthel, and Macnaughton (2010) believed that fresh food waste usually happens at the end of the fresh food SC (distribution and consumption), that is, when the food is finished and ready for consumption but not provided to the final consumer. In addition, they will also be removed from the shelves due to errors in the best-before or in labeling date. Hence, its conversion into waste can be avoided because the product will not endanger human health if it is eaten. What's more, there are still 820 million people worldwide go hungry

every day (*The State of Food and Agriculture 2019*, 2019). All of this converts surplus foods into "potential waste," which can be avoided through reuse and recycling. These two aspects are critical to waste reduction (do Carmo Stangherlin and De Barcellos, 2018). In France, since 2016, a regulation (No.2016-138, February 11) has prohibited French supermarkets from throwing away unsold food, requiring them to donate unsold food to food banks, give food not suited for human use away for animal consumption, or manufacture compost for agriculture (Sasot Salas, 2018). Italy has also enacted a law against waste (No. 2016-166, August 19) to promote food donation by producers or business owners and to allow individuals to remove leftover food from a restaurant (Cane and Parra, 2020).

These practices will be linked to sustainability performance as the core theoretical contribution of this research. Therefore, it is necessary to introduce sustainable fresh food CSC performance evaluation indicators based on the literature review.

3.3.2 Sustainability performance indicators

According to the literature analysis, the opinions of field experts, and the previously mentioned TBL concept, the present research work identified the system of indicators for the sustainability performance evaluation of fresh food CSC. Finally, the three essential indicators and thirteen sub-indicators for fresh food CSC sustainability performance evaluation were selected. A comprehensive explanation of each dimension is in Table 5.

(1) Environmental sustainability performance evaluation indicators

Companies adopting environmental management practices are more likely to evaluate their environmental performance. Environmental performance may be measured using a variety of performance indicators. One of the most critical and significant challenges facing fresh food CSC is to reduce the emission of global houses

gases and refrigerant leaks that contribute to the sharp increases in greenhouse gases and global warming potential (GWP) (Adekomaya et al., 2016; Hariga, As' ad, and Shamayleh, 2017; James and James, 2010; Saif and Elhedhli, 2016). Maintaining a precise temperature range in fresh food CSC is an energy-intensive procedure. If this energy is generated by a coal or gas power plant, it would become expensive and produces a significant quantity of GHG emissions, rising global temperatures. A huge level of energy use also leads to the depletion of natural energy supplies, posing a potential threat (Lennon et al., 2017; Saif and Elhedhli, 2016). In the study conducted by (She et al., 2018), it is reported that in refrigeration (industrial, commercial, household, refrigerated transport) and air conditioning (domestic and automotive) applications, vapor compression refrigeration (VCR) units are the most widely used systems (market share of 80%). And these systems are responsible for around 15% of the world's electrical energy usage. That is, how improving energy efficiency has become the key to reducing the environmental impact of fresh food CSC. Efficient packing procedures are critical for preserving and managing activities, such as storage and distribution, in order to efficiently prevent loss and ensure the safety of fresh food in the CSC (Galić, Šćetar, and Kurek, 2011). Based on the above revelation, carbon emission reduction, energy consumption reduction, and packaging use reduction are the main items that have been considered in the present research for evaluating environmental performance.

(2) Social sustainability performance evaluation indicators

The outstanding performance of a company in the social dimension has become a source of competitive advantage as proposed through the resource-based view of the firm (Barney, 1991). However, evaluating a company's social performance for both employees, ISO 4001 certification (Al-Refaie, Al-Tahat, and Lepkova, 2020; Jabbour

et al., 2015), and the community requires a sufficient amount of time for management to assess how much the investment in practices for employee, practices for environmental protection and practices for community has contributed to improving employees' professional skills and creating an enabling environment for the surrounding community (Zhu, Liu, and Lai, 2016; Zhu and Zhang, 2015). Similarly, due to the characteristics of the fresh food cold supply, an increase in stakeholder and customer satisfaction (Hsu, 2019; Shen, Tao, and Wang, 2018; Zulvia, Kuo, and Nugroho, 2020) and assuring fresh food safety and quality (Adekomaya et al., 2016) are also the social performance indicators adopted in the present research. For example, according to Lamberti and Lettieri (2009), for the first time, an Italian food company has considered improving food safety within the SC as CSR.

(3) Economic sustainability performance evaluation indicator

Economic benefit implies the extent of improvement in company performance in terms of reducing costs and increasing efficiency throughout the entire fresh food CSC. A decrease in fresh food waste and losses was suggested by Parfitt, Barthel, and Macnaughton (2010), Bourlakis et al. (2014), and Ketzenberg, Bloemhof, and Gaukler (2015). A decrease in the operating cost was recommended by Zhang (2017), Ketzenberg, Bloemhof, and Gaukler (2015), Nakandala, Lau, and Zhang (2016), Zulkefly et al. (2021), Ma et al. (2021), and Saif and Elhedhli (2016). An increase in profit was recommended by Butnariu and Avasilcai (2015), Ocampo et al. (2016), and Ahmad, Wong, and Rajoo (2019). A decrease in fines for non-compliance was suggested by De Giovanni and Vinzi (2012), Green et al. (2012), and Zailani et al. (2012).

Table 5. Sustainable fresh food CSC performance indicators

Dimensions	Indicators	Definition	References
Environment impact	Carbon emission reduction (En1)	Total carbon emissions reduction during the entire fresh food CSC.	Adekomaya et al. (2016), Hariga, As' ad, and Shamayleh (2017), James and James (2010), Saif and Elhedhli (2016)
	Energy consumption reduction (En2)	Total energy consumption reduction throughout the fresh food CSC.	Defraeye et al. (2015, 2016), Esfahbodi, Zhang, and Watson (2016), Sharma, Chandna, and Bhardwaj (2017), Lennon et al. (2017), Saif and Elhedhli (2016)
	Packaging use reduction (En3)	Total packaging usage reduction throughout the fresh food CSC.	Aramyan et al. (2007), Liao, Chang, and Chang (2011), Esfahbodi, Zhang, and Watson (2016), Galić Ščetar, and Kurek (2011)
Social welfare	Fresh food safety and quality (So1)	The quality of the fresh food is healthful and nutritious. The fresh food does not exceed the tolerable rate for foodborne disease risk.	Zhu Martinez (2014), Aworh (2015), Defraeye et al. (2015), Nakandala, Lau, and Zhang (2016), Shashi, Singh, and Shabani (2017), Adekomaya et al. (2016)
	Increase in support for the communities (So2)	Total amount of sponsored products for the communities.	Hutchins and Sutherland (2008), Mani et al. (2016), Govindan, Khodaverdi, and Jafarian (2013), Zhu, Liu, and Lai (2016), Zhu and Zhang (2015)
	Increase in stakeholder satisfaction (So3)	Improved rural employability and entrepreneurship, improved revenue generation, increased market share.	Priyadarshi, Routroy, and Garg (2021), Mehregan et al. (2014), Ghadge et al. (2021), Mc Carthy et al. (2018)
	Increase in customer satisfaction (So4)	The degree of customer satisfaction with fresh food consumption.	Bourlakis et al. (2014), Defraeye et al. (2015), Sharma, Chandna, and Bhardwaj (2017), Hsu (2019); Shen, Tao, and Wang. (2018), Zulvia, Kuo, and Nugroho (2020)
	Employees' professional skills enhancement (So5)	Total spending on employee training.	David et al. (2019), Oliva and Revetria (2008)
	ISO 4001 certification (So6)	The obtainment of ISO 4001 certification.	Jabbour et al. (2015), Sharma, Chandna, and Bhardwaj (2017), Al-Refaie, Al-Tahat, and Lepkova (2020)
Economic benefit	Food waste reduction (Ec1)	Total food waste reduction across the fresh food CSC.	Sharma, Chandna, and Bhardwaj (2017), Shashi, Singh, and Shabani (2017), Yan, Song, and Lee (2021), Parfitt, Barthel, and Macnaughton (2010), Bourlakis et al. (2014), Ketzenberg, Bloemhof, and Gaukler (2015)
	Operating cost reduction (Ec2)	Total costs reduction for warehousing, transportation, energy, labor.	Al-Refaie, Al-Tahat, and Lepkova (2020), Filina-Dawidowicz and Wiktorowska-Jasik (2021), Zhang (2017), Ketzenberg, Bloemhof, and Gaukler (2015), Nakandala, Lau, and Zhang (2016), Zulkefly et al. (2021), Ma et al. (2021), Saif and Elhedhli (2016)
	Increase in profit (Ec3)	The total profit increased.	Sharma, Chandna, and Bhardwaj (2017), Yan, Song, and Lee (2021), Butnariu and Avasilcai (2015), Ocampo, Clark, and Promentilla (2016), Ahmad, Wong, and Rajoo (2019)
	Decrease in fines for non-compliance (Ec4)	The total reduction in the fine for environmental protection and quality of fresh food as compared to last year.	De Giovanni and Vinzi (2012), Green et al. (2012), Zailani et al. (2012), Zhu and Sarkis (2004), Zhu, Sarkis, and Lai (2008, 2012), Zhu et al. (2010)

3.4 Conclusions

The purpose of this chapter was to identify good practices that have been successfully implemented in sustainable fresh food CSCs by a company in a developed country, using a systematic literature review and a case study to execute this research. In addition, with the assistance of systematic literature from expert interviews, a system of sustainability performance indicators for fresh food CSCs was established. The results of the analysis revealed a total 8 good practices and 13 sustainability performance indicators.

Since there is a scarcity of real-world case studies related to the implementation of good practices in sustainable fresh food CSC, this study in this chapter provides the benchmark for conducting more research on what kind of these good practices have been implemented by companies in developing countries. In addition, the factors that influence the implementation of these good practices by these companies can be further explored.

Furthermore, according to the findings of this study in this chapter, even though good practices identification was based on TBL theory, there is a lack of research on the relationship between good practices and sustainability performance, especially in developing country contexts (Balaji and Arshinder, 2016). There is a need to investigate the relationship between these good practices and the sustainability performance of fresh food CSCs in developing country contexts.

Therefore, next, we will explore what good practices have been implemented by companies in developing countries and what factors influence companies to implement these good practices in Chapter IV. Furthermore, Chapter V will explore the relationship between these good practices and sustainability performance of fresh food CSCs in developing country contexts.

Chapter IV: The implementation of good practices in sustainable fresh food CSC

This chapter presents this first section introduction for presenting the background and purposes of this study. The second section will show a literature review on the topic, including sustainable fresh food CSC good practices, divers, and enablers, and a conceptual framework is proposed at the end. The third section of this chapter will introduce the research methodology we adopted in this chapter. The fourth section will present the results of this chapter. The final chapter focuses on the discussion and conclusion of this chapter.

4.1 Introduction

Due to rapid population growth and significant existing food safety issues (International Inst. of Refrigeration, 2009; United Nations, 2015), developing countries have realized that sustainable fresh food CSC is critical not only to economic growth but also to environmental and social performance improvement. According to the forecast of the International Institute of Refrigeration in 2009, if the level of refrigeration used in developing countries is similar to that in developed countries, they can save more than 200 million tons of fresh food every year, accounting for about 14% of their consumption. However, the sustainable development of fresh food CSC has been considered both critical and challenging (Kumar et al., 2020; Ghadge et al., 2021;

Cooper et al., 2022) because CSCs are complex and dynamic in nature (Salin and Nayga, 2003; Joshi, Banwet, and Shankar, 2009; Rodrigue, 2014; Han et al., 2021). However, the development status of sustainable fresh food CSC in developing countries is poorly understood (Sangle, 2010; Hodges et al., 2011) as research on the sustainability of fresh food CSC in developing countries is still in its infancy and fragmentation (Shukla and Jharkharia, 2013; Balaji and Arshinder, 2016).

Despite significant efforts by policy-makers, researchers, and practitioners to examine the environmental (Dong, Xu, and Miller, 2020), economic (Skawińska and Zalewski, 2022.), and social (Liu, Liu, and Li, 2018.) impacts of CSCs, practical solutions for sustainable fresh food CSC remain to be developed (Shashi et al., 2021). Organizational implementation of good practices for sustainability is relatively new in the fresh food CSC. It usually includes key activities such as government regulation, different stakeholders' involvement (management, suppliers, customers, etc.), and assessment and evaluation (Young et al., 2018; Burek and Nutter, 2020;). Recent research has made efforts to explore the challenges (Ghadge et al., 2021), risks (Zhang, Li, and Peng, 2020), barriers (Sharma, Abbas, and Siddiqui, 2021), and drivers and enablers (Su et al., 2022) of fresh food CSC sustainability, but deciphering fresh food CSC companies' various outcomes has been a challenge. Specifically, different companies that have experienced similar institutional developments seem to have different performances in implementing good practices (Filina-Dawidowicz and Wiktorowska-Jasik, 2021). Such challenges have led to a barrier to sustainable fresh food CSC: policy-makers and management may be perplexed as to why some companies have effectively implemented good practices while others have not, adding uncertainty to their strategy for investing resources in sustainability initiatives, such as the adoption of solar photovoltaic systems, environmental management systems,

donations of surplus fresh food. Despite such a barrier, most the existing research has focused on exploring the challenges of fresh food CSC sustainability (Kumar et al., 2020; Filina-Dawidowicz and Wiktorowska-Jasik, 2021). Empirical evidence is lacking on the factors that influence the implementation of good practices by companies.

A multiple-case study was designed to investigate the implementation of good practices in the fresh food CSC by retailers. The dominant position of retailers in the food SC (Dobson and Waterson, 1999; Harris and Ogbonna, 2001; Mena et al., 2011) has drawn attention to how to evaluate ways to make food consumption more sustainable (Sustainable Development Commission, 2005, 2007; Bonini and Oppenheim, 2008; Jones et al., 2009). In addition, while the government, the scientific community and even the media sources play a role in promoting food choice through guidance, information and labeling, food retailers bear much of the potential and obligation (European Commission, 2012). Retailers rely on sustainability initiatives not only to encourage and drive their suppliers to implement good practices (Jones, Comfort, and Hillier, 2005, 2011; Vadakkepatt et al., 2021), but also to increase consumer awareness and influence their shopping choices (European Commission, 2010). Hence, the implementation of good practices by retailers is critical to improving the sustainability performance of fresh food CSCs. However, even if a retailer's sustainability initiative remains a top consumer demand (Vadakkepatt et al., 2021), sustainable SC management is poorly understood in the retail sector (Vadakkepatt et al., 2021).

The purpose of this section of the research is to help have a better understanding of the phenomenon of retailers implementing good practices in sustainable fresh food CSC, as well as to determine critical factors that facilitate the implementation of good

practices by retailers. Specifically, the following three specific RQs were intended to answer.

RQ1: What difference exists in the good practices available/used in the sustainable fresh food CSC?

RQ2: What are the drivers/barriers to the implementation of good practices?

RQ3: How do drivers/barriers affect the implementation of good practices in sustainable fresh food CSC?

The reminder of the chapter continues as follows. In section 4.2 we discuss the literature on sustainable fresh food CSC good practices, drivers, and enablers and propose a conceptual framework. In Section 4.3 we show the research methodology. In Section 4.4, we present and analysis the results. In Section 4.5 we discuss and conclude this article.

4.2 Literature review

In the following section, the literature on sustainable fresh food CSC good practices, drivers, and enablers determined in the relevant literature are discussed, and a conceptual framework is proposed at the end.

4.2.1 Sustainable fresh food CSC good practices

It is vital to measure the level of adoption in developing and developed countries in order to map the consciousness of good practices globally. The mapping of consciousness can reveal the state and differences in adopting good practices in developing and developed countries (Malviya and Kant, 2015). Due to the enlarging demand for reducing the negative impact of the fresh food quality and maintaining natural resources, fresh food CSC companies will become difficult to survive if they continue their conventional operations. The fresh food CSC needs to adopt good practices to reduce its negative impacts on society and the environment to show its

active response to this threat. This leads to the question of which good practices are commonly implemented in sustainable fresh food CSC (Beske et al., 2014). We analyzed the operation of the fresh food CSC from existing literature to identify the situation of the entire CSC of the fresh food that is prone to environmental degradation and lacks good practices.

- **Adoption of information technology (IT) systems in fresh food CSC:** the adoption of IT systems can not only improve the operational efficiency (Li et al., 2020; Leng et al., 2020; Liu, Su, and Liu, 2021) of an organization, but also enhance inter-organizational cooperation (McAfee, 2002; Sanders, 2008), and inter-organizational cooperation has been proved to have a positive influence on select company performance (Vickery et al. 2003).

- **Application of RFID and WSNs for monitoring the status (temperature, humidity, storage time, etc.) of fresh food:** the improved traceability process could monitor fresh food temperature/humidity/location (Han et al., 2021), improving traceability and transparency, ensuring quality and safety, ultimately eliminating waste and loss (Xiao et al., 2017; Islam, Manning, and Cullen, 2021), as well as improving the operational efficiency of fresh food CSC (Shi, Zhang, and Qu, 2010; Wang et al., 2022).

- **Adoption of Solar photovoltaic systems in the warehouse:** as a renewable energy source, the use of solar photovoltaic systems in the warehouse can reduce energy consumption and carbon emission (Meneghetti, Dal Magro, and Simeoni, 2018; Edwin, Nair, and Sekhar, 2022).

- **Eco-design:** utilize the least number of resources and energy, allow for the reuse, recycling, and recovery of component materials and parts, and eliminate or decrease the usage of hazardous products throughout the fresh food CSC network, both

inter-and intra-organizationally (Wang, Tao, and Shi, 2018; Batista et al. 2019; Dieckmann et al. 2019; Liu, Su, and Liu, 2021; Stellingwerf et al. 2021; Jaigirdar et al., 2022).

- **Application of environmental management system for monitoring the environmental impact:** if a company proactively develops sustainability initiatives, environmental objectives, policy statements, and related operating procedures will be included in order to implement the corrective action plan to improve internal environmental management (Nagel, 2003; Li, 2011; Gwanpua et al., 2015; Kumar et al., 2020).
- **Employee training:** in order to effectively operate the fresh food CSC, it is critical to have employees that are well-trained and qualified in terms of the understanding of fresh food processing standards and relevant latest technologies (Vinodh, Ramesh, and Arun 2016; Vinodh, Ruben, and Asokan 2016; Pearce et al., 2018).
- **Offering some courses to raise consumers' awareness about the quality dimensions of fresh food:** a company holding events, such as offline courses, to raise consumer awareness of the quality dimensions of fresh food can not only reduce household food-borne disease (Bornkessel, et al., 2014; Hamad and Ahmed, 2018), but also improve the company's reputation and competitiveness by enhancing communication with customers (Ekelund et al., 2014).
- **Surplus fresh food donations:** donating unsold food to food banks is one way to reduce food waste and improve social welfare (Swinburne and Sandson, 2019; Al-Khateeb et al., 2021).

4.2.2 Sustainable fresh food CSC drivers

In this study in this chapter, we define the factors that initiate and motivate companies to implement good practices as drivers (Foerstl et al. 2015). We identified three factors that initiate and motivate companies to implement good practices, namely government regulation, customer sustainability awareness, and dependence (Preuss, 2002).

As Delmas and Toffel (2004) suggested that government regulation is coercive power. That is, if a firm violates an environmental regulation, the firm will be fined. On the other hand, government regulation featuring precise requirements for environmental protection helps companies overcome organizational inertia (Darnall, 2003; Darnall, Jolley, Handfield, 2008; Kirwan, Maye, and Brunori, 2017; Sharma et al., 2019). On the contrary, lack of government regulation is commonly seen as one of the priority challenges facing sustainable fresh food CSC in developing countries (Kumar et al., 2020). Hence, government regulation is a major driver of firms' environmental efforts (Beamon, 1999; Zhu, Sarkis, and Geng, 2005).

Customers can also drive and motivate fresh food CSC companies to implement sustainability initiatives (Green et al., 1996; Peattie, 2001, 2010). According to Smith and Perks (2010), as customers grow increasingly aware of the environmental impact of their purchasing habits, the demand for ecological products is increasing, which requires companies to provide green products and services in a way. For example, as Lehner (2015) explained in his research of the Swedish food retail industry, retailers not only influence physical exchanges, but the shop themselves as "points of interaction between retailers and consumers, plays a critical role in achieving sustainable consumption... as a place to exchange information, ideas, and understanding what sustainable consumption means."

A further driver is the dependence relationships between buyers and suppliers. Some studies provide evidence that buyer-supplier dependence positively impacts the implementation of good practices (Hoejmose, Brammer, and Millington, 2012; Hoejmose, Grosvold, and Millington, 2014). One way to enhance buyer-supplier dependences is to develop and maintain long-term relationships with their SC partners, which have been shown to facilitate the implementation of good practices (Wolf, 2011; Lee, 2015). For example, based on the supplier's dependence on the buyer, the buyer can persuade the suppliers to devote resources to implementing latest technologies and procedures that could significantly alter suppliers' present operations in order to meet the sustainability standards of the buyers (Todorova and Durisin, 2007; Horisch, Johnson, and Schaltegger, 2015).

4.2.3 Sustainable fresh food CSC enablers

Instead, we use the term enablers to refer to those factors that assist companies implement good practices (Gimenez and Tachizawa, 2012).

The top management support and commitment is a vital factor that assists companies in the successful implementation of good practices (Zhu et al., 2008). Managers that take advantage of environmental concerns to adopt proactive environmental initiatives will provide their organizations with more legitimacy to implement good practices (Sharma, Pablo, and Vrendenburg, 1999; Min and Galle, 2001; Walker et al., 2008). Further, the commitments of the top management toward implementing good practices enable companies to adopt appropriate environmental management systems (Ramus and Steger, 2000; Bowen et al., 2001; Pujari, Peattie, and Wright, 2004; Pagell and Wu, 2009; Hoejmose Brammer, and Millington, 2012; Dai, Montabon, and Cantor, 2015). Top management commitment also helps to gain employee commitment to the environmental aspects of their actions and encourages the

emergence of an ecological culture and attitude within the organization (Zhu, Sarkis, and Geng, 2005; Handfield, Sroufe, and Walton, 2005; Holt and Ghobadian, 2009; Large and Thomsen, 2011; Hoejmose Brammer, and Millington, 2012; Dubey, Gunasekaran, and Ali, 2015).

Laws/policies support is another main enabler for implementing good practices (Green et al., 1996; Uhlaner et al. 2012; Giunipero, Hooker, and Denslow 2012). For example, Henzelmann et al. (2011) believed that supranational organizations like the United Nations play a vital role in establishing environmental sustainability norms and broad agendas that provide a picture for developing context-specific national laws/policies. According to Weale (1992), the role of government laws/policies are not only to respond to the actual needs and preferences of individuals, but also to encourage environmentally conscious actions while discouraging activities that destroy the environment. Furthermore, Kumar et al. (2020) noted in their study that experts believe that government support is required for CSC operations to be economically sustainable. Environmental sustainability of food production (Biggs et al., 2015; Agovino, Cerciello, and Gatto, 2018) and consumption (Reynolds et al., 2019) is often the goal of policy interventions the environmental responsibility of retailers for their own practices is less involved. Lai et al. (2010) pointed out that policy-makers should develop appropriate environmental laws/policies as well as voluntary practices to promote sustainable development in the retail industry. As Giunipero, Hooker, and Denslow (2012) believed that the lack of international environmental standards increases the complexity of the implementation of good practices in global SC networks.

4.3 Research Methodology

The implementation of good practice in sustainable fresh food CSCs is a dynamic process with a high focus on commercial confidentiality, so current empirical evidence

is limited (Sancha, Longoni, Gimenez, 2015). According to Yin (2017), a multiple case study is an excellent approach when answering the “how” RQs and investigating recent or contemporary events. Therefore, the investigation is exploratory in nature, and we used a multiple case study approach (Yin, 2017). Furthermore, the approach has been extensively used in qualitative sustainability study to comprehend emerging phenomena and multidisciplinary issues.

4.3.1 Case selection

As suggested by Yin (2017), the selection of cases should be based on replication of literature and theory. We specifically looked for companies demonstrating variations and similarities in implementing good practices in sustainable fresh food CSC (e.g., IT system application, eco-design etc.). Furthermore, we endeavored to include in our sample which companies are implementing good practices both within and across partners to present a more comprehensive description of the phenomenon and make conclusions more general. We began by compiling a list of prominent Italian and Chinese retail companies in order to identify the cases. This is because the retail company is a comprehensive fresh food company, involving the entire fresh food CSC, procurement, distribution, warehousing, and sales. This was made possible by internet searches and retail stores we see or shop at. We selected a reference case (an Italian market-leading retail company) based on four criteria. First, the retail company must have committed to sustainability and voluntary compliance with the relevant regulations and laws over 5 years. Such case selection ensures that a reference case can represent an Italian case for the study. Second, the retail company has achieved the ISO 14001 certification. Third, we selected the reference case by ensuring that good practices are implemented not only within the company, but also among its partners. Fourth, we can collect publicly available data and information on good practices

implemented by the company. Eventually, the Italian market-leading retail company has been committed to sustainable development and voluntary compliance with relevant regulations and laws for more than a decade and was Italy's first modern retail company to achieve the ISO 14001 certification (in 2013), as well as has implemented good practices within the company and among its partners. Its strategy is aligned with the UN 2030 Agenda's sustainable development goals. We can visit its official website to download the integrated annual report to learn about the company's sustainability strategy and sustainability performance. Therefore, the reference company reflects an Italian market-leading retail company that have been actively exploring and implementing good sustainability practices and has evidently improved its sustainability performance.

We selected Chinese cases based on two criteria. First, all-Chinese retail companies must have a certain degree of similarity and comparability with the Italian reference company in the implementation good practices. Second, we can collect data and information on good practices implemented by the company. The all-Chinese retail companies can represent the various of operation modes of retail companies in China. The Chinese sample reflects the multiple forms of Chinese retail enterprises and involves all customer groups. Eventually, one Italian reference retail company and three Chinese retail companies were included in the final sample. Table 6 provides the overview of the Italian reference company and Chinese retail companies in the sample.

Table 6. Overview of the cases

Case	CSC members involved	Year of foundation	Number of employees	Number of stores	Location	Target customers positioning	Interviewees
R1	(1) Fresh food suppliers (ESD Italia, a central purchasing and marketing group that negotiates supply contracts with domestic consumer goods industries on behalf of its shareholders.) (2) Third-party logistics (3) Retail company 1 (storage; distribution; selling)	1960	8517	(1) 247 direct retail stores (2)323 franchise retailers	Italy	All	(1) Warehouse manager
R2	(1) Fresh food suppliers (farmers, wholesale market) (2) Third-party logistics (3) Retail company 2 (storage; distribution; selling)	2015	5000	(1) 24 direct retail stores	China	Medium-level (Generation Z (7-22) & Millennials (23-38))	(1) Public affairs manager (2) Purchasing Manager (3) Fresh Food's Sales manager (4) Public affairs General Manager
R3	(1) Fresh food suppliers (farmers, wholesale market) (2) Third-party logistics (3) Retail company 3 (storage; distribution; selling)	1994	988	(1) 71 direct retail stores (2) 4 franchise retailers	China	Ordinary (Boomers (55-74))	(1) CSC logistics operating manager (2) Third-party logistics operating manager
R4	(1) Fresh food suppliers (farmers, wholesale market) (2) Third-party logistics (3) Retail company 4 (storage; distribution; selling)	2012	1500	(1)250 direct retail stores (2) 300 franchise retailers	China	High-end (Millennials (23-38) & Generation X (39-54))	(1) CSC logistics operating manager (2) Sales Operation Manager (3) Third-party logistics operating manager

4.3.2 Data collection

Data collection was from November 2020 to March 2021. We used semi-structured interviews to collect primary data, as suggested by Eisenhardt and Graebner (2007), because they are an efficient technique for gathering rich empirical data.

At the beginning of the initiative (November 2020), we designed a questionnaire to collect the operational information of the fresh food CSC by email from Italian reference retail companies. Afterward, we conducted group interviews with Italian reference retail companies to gather information on good practices implemented in the fresh food CSC. At the closure of the initiative (December 2020 to March 2021), we identified good practices implemented by the Italian reference retail company and the reasons for the implementation of these good practices in its fresh food CSC. We decided to interview the three Chinese retail companies (June to December 2021). In order to develop the research protocols for the Chinese retail companies to enhance reliability and validity (Yin, 2017), we not only directly translated from English to Chinese the research protocols we used in the Italian reference retail company but also participated in several big China's CSC industry annual conferences to understand the development status of China's CSC, and interviews were conducted in the conferences. We designed interview questions for the three Chinese retail companies based on 1) existing literature on sustainable fresh food CSC; 2) materials for the initiatives, which provide the good practices implemented in the fresh food CSC by the Italian reference retail company. The key questions of the interview focus on the following aspects:

- Good practices implemented in the sustainable fresh food CSC by the company;
- Reasons for the implementation of good practices in sustainable fresh food CSC;
- Reasons for not implementing good practices in sustainable fresh food CSC;

- The relationship between the company and its suppliers, including supplier development experience, regular monitoring, and auditing, communication;
- Environmental pressure on companies from government regulation;
- Management roles, responsibilities, and structures for addressing supplier environmental and social sustainability issues, and the specific roles of the sustainability team (if any);

We gathered information from multiple respondents (Table 6) (Rs) in order to obtain data from various perspectives, decrease Rs' biases and achieve data and theoretical saturation. As Pandey and Patnaik (2014) suggested, although all Rs were asked about all questions in the research protocol, the level of detail with which differences and reasons were discussed would vary from respondent to respondent. For instance, when interviewing the CSC operating manager, we focused on the reasons for the implementation of good practices in the entire fresh food CSC, whereases with the sales manager, we focused on the characteristics of the company-supplier relationship, etc.

For the collection of primary data, mainly through face-to-face, on-site interviews. As Creswell (2013) advised, we conducted video conferences with Rs (three interviewees) in northern Italy due to the Covid-19 pandemic. A total of 10 interviews were carried out for all cases, taking into account all the Rs of companies.

To improve accuracy, each interview was recorded and transcribed. In order to reduce observer bias, five researchers took field notes. Details of the interview protocol are shown in the Appendix. Each interview lasted between 120 and 180 minutes on average. We chose to offer interviewers with a structured overview of the verbatim transcripts of the interviews, containing all pertinent information for which feedback was required, in order to verify information or rectify any misunderstandings. Instead,

rather than offering the Rs with the entire transcript, this structured overview maximized the probability of obtaining feedback from them, thereby minimizing the risk of bias.

As suggested by Yin (2017), we also triangulated the data using multiple sources of information to improve the reliability of the study and the validity of the analysis. In addition to interviews and observations from the research team, other sources included four retail companies' public reports on sustainability and CSR, as well as materials, slides, and documents prepared to present their sustainability strategies and practices. The triangulation allows the research team to 1) identify the good practices implemented by companies; 2) learn about the sustainability performance of the company; 3) obtain evidence of the reasons for implementation good practices in the fresh food CSC. 4) understand the dependence between the retailers and suppliers.

4.3.3 Data analysis

According to Yin (2017), the case analysis was performed in two steps: within-case data analysis and cross-case pattern search.

In the first step of within-case data analysis, we first created a detailed record for each case. The large amount of information collected are then aggregated via data reduction: we broke down the data and describe each case in terms of a set of variables that describe the enablers and drivers of implementing good practices (Table 7 and 8). To identify variables, we used the data coding procedure recommended by Yin (2017). As in Voss et al. (2016) argue that this process was cyclic and iterative, which is typical in theory-building case-based studies. We defined the relevant concepts in this research by starting with existing research on good practices implementation and the enablers and drivers of its implementation (Section 4.2). Specifically, we identified a number of good practices that may contribute to improving fresh food CSC sustainability

performance (Chapter II), as well as variables that drive and enable organizations to implement good practices in fresh food CSC according to the investigation of this research field. While some differences in the implementation of good practices clearly emerged from the use cases. Therefore, abductively identifying relevant variables required a close examination of the evidence emerging from the data. The determined variables were rated based on precise rules, and data comparisons across cases were central to defining these rules (Section 4. 4, table 7 and 8).

As a result of this coding, two categories were chosen to characterize good practices implementation in sustainable fresh food CSC: environmental/social good practices and operational efficiency good practices, inter-organizational good practices and intra-organizational good practices and two categories to characterize the reasons for implementing good practices in fresh food CSC: enablers (top management support and government involvement) and drivers (Government regulation, fresh food CSC's members' involvement, power relationship, and economic efficiency).

Data were organized in table form (see Section 4.4) as Miles and Huberman (1994) recommended, which facilitated both within-case analysis and cross-case comparisons. There are two main columns including in the table that were used to present a description of each case, one for the relevant variables, and one for each variable with an associated rating for based on the rules of Table 7.

Cross-case analyses was then performed by organizing the data into multiple variable matrices and two-variable matrices (Figure 10) in order to discover commonalities and differences between cases. The results of the case analysis are then summarized into propositions.

Table 7. Data reduction and operationalization

Variable	Definition	Rating
Enablers	In this paper, we use the term enablers to refer to those factors that assist companies implement good practices (Gimenez and Tachizawa, 2012).	
Top management support	The extent of top manager's support and commitments to sustainable fresh food CSC	*Strong:* Assurance that the fresh food CSC achieves sustainable development, the top management voluntarily complies with the government's environmental protection requirements and formulates a sustainable development strategy consistent with the Sustainable Development Goals (SDGs). *Null:* lack of top management support for environmental sustainability
Laws/polices support	The extent of laws/policies regarding grants and technical support for environmental sustainability	*Strong:* Assurance that the fresh food CSC achieves environmentally sustainable development, the government has taken action to increase awareness among organizations about environmental management knowledge, collaborate with and provide financial resources to the sustainable fresh food CSC initiatives, as well as issue laws/ policies and standards as a guideline for organizations to implement environmentally good practices. *Limited:* The government has only issued some laws/policies and support programs (financial resources) to environmental protection, which are not comprehensive. Such as, there is no policy on how to deal with surplus fresh food. In addition, the government has not popularized the knowledge of these policies, support programs, and environmental management.
Drivers	Instead, we define the factors that initiate and motivate companies to implement good practices as drivers (Foerstl et al. 2015)	
Government regulation	The Extent of government regulation on fresh food quality and safety and environmental management	*Strict:* The government takes strict regulatory actions and penalty mechanism to ensure the quality and safety of fresh food provided by retail companies and that the activities across the entire fresh food CSC carried out by retail companies are environmentally friendly. Therefore, the strategic choices of the enterprise are made in accordance with the requirements of the institutional environment. Under the pressure of environmental institutions, stakeholders would force enterprises to adopt proactive environmental strategies, alter their business models, and reallocate their resources. *Weak:* Government regulatory actions on fresh food quality and safety and environmental management are infrequent. In this case, enterprises would not allocate their resources to environmental management.
Customers' sustainability awareness	Environmental management knowledge and awareness level of customers	*High level:* The customers prefer to buy fresh food products with sustainability, and resource consumption information. *Limited:* The customers have started to care about environmental sustainability. *Null:* The customers have no awareness of environmental sustainability.
Dependence	The level of dependence between suppliers and buyers	*Strong:* Buyers and suppliers establish long-term relationships through contracts, where they make decisions together and share information with each other. That is, suppliers and buyers depend on each other's resources. *Weak:* Buyers and suppliers did not establish long-term relationships through contracts. That is, suppliers and buyers have more commercial autonomy and do not rely much on each other.

Table 8. Within-case analysis

Case	Description	Variable	Rating
Drivers			
R1	The Governance system - aligned with both international and national best practices—has been continually enhanced to manage the complexity of the conditions in which the Company operates and the challenges that must be overcome in order to implement a clear and sustainable development strategy since 2005. In this sense, R1 serves not only as an intermediary between producers and customers but also as a source of information and education for the latter. R1 has pursued several good practices focused on economic efficiency improvement as well as environmental and social issues. These good practices included the application of IT systems, Application of RFID and WSNs for monitoring the status (temperature, humidity, storage time, etc.) of fresh food, adoption of solar photovoltaic systems in the warehouse, eco-design, application of environmental management system for monitoring the environmental impact, employee training, offering some courses to raise consumers' awareness about the quality dimensions of fresh food, surplus fresh food donations.	Government regulation	Strict
	The customers of fresh food have formed a similar consensus on how to implement good practices. That is, customers have the demand for learning information (growing location, post-harvest time, storage period, etc.) by scanning the QR code on the package.	Customers' sustainability awareness	High level
	As part of a growing strong commitment to monitoring and controlling the impacts of the fresh food CSC, R1 has prepared a checklist for private label product manufacturers to promote their environmental sustainability strategies. And required that its suppliers have joined the IT system and adopted RFID and WSNs. Synergies between the Company's employees and suppliers are achieved throughout the fresh food CSC to maintain a strong professional relationship, curb costs, and reduce impacts. The application of coordinated management among fresh food CSC partners is a core part of the eco-design practices implemented by R1 and its suppliers. That is, suppliers do not rely much on R1, but jointly make decisions.	Dependence	Strong
R2	As CSC's infrastructure and equipment investment require a lot of assets. In order to shorten the payback period, the company only implemented good practice (Eco-design) that not only focuses on environmental protection but also improves operational efficiency. R2 has no plan to adopt solar photovoltaic systems in the warehouse and environmental management systems for monitoring the environmental impact yet.	Government regulation	Weak
	Most of the target customers of R2 are white-collar workers with limited sustainability knowledge. They won't require stores to have renewable packaging for fresh food, but they do start to care about fresh food information (growing location, post-harvest time, storage time span, etc.).	Customers' sustainability awareness	limited

(Continue)

	In order to maintain strong relationships with its suppliers, R2 contracts with all its suppliers once a year. At the same time, R2 also sent teams to some agricultural product bases to help farmers scientifically produce agricultural products to meet R2's requirements for fresh food quality and safety. And its suppliers have joined the IT systems and adopted RFID and WSN in accordance with the requirements of R2. The application of coordinated management among fresh food CSC partners is a core part of the eco-design practices implemented by R2 and its suppliers. Suppliers do not rely much on R2, but jointly make decisions.	Dependence	Strong
R3	As CSC's infrastructure and equipment investment require a lot of assets, in order to shorten the payback period, the company only implemented good practice (Eco-design) that not only focuses on environmental protection but also improves operational efficiency. R3 has no plan to adopt solar photovoltaic systems in the warehouse and environmental management systems for monitoring the environmental impact yet.	Government regulation	Weak
	Most of the customers of R3 are retirees. Due to their dietary habits, they are more inclined to buy fresh foods (especially red meat) that are not temperature controlled. That is, they have limited demand for CSC. In this case, their knowledge of the sustainability of fresh food CSC is null.	Customers' sustainability awareness	Null
	Since most the fresh food is purchased from wholesale markets. R1 has failed to require its suppliers to join its IT systems, adopt RFID and WSN, as well as implement eco-design together. Suppliers have more commercial autonomy and do not rely on R3.	Dependence	Weak
R4	As CSC's infrastructure and equipment investment require a lot of assets, in order to shorten the payback period, the company only implemented good practice (Eco-design) that not only focuses on environmental protection but also improves operational efficiency. R4 has no plan to adopt solar photovoltaic systems in the warehouse and environmental management systems for monitoring the environmental impact yet.	Government regulation	Weak
	Most of the target customers of R4 are white-collar workers with limited sustainability knowledge. They won't require stores to have renewable packaging for fresh food, but they do start to care about fresh food information (growing location, post-harvest time, storage time span, etc.).	Customers' sustainability awareness	limited
	In order to maintain strong relationships with its suppliers, R4 contracts with all its suppliers once a year. And its suppliers have joined the IT systems and adopted RFID and WSN in accordance with the requirements of R4. The application of coordinated management among fresh food CSC partners is a core part of the eco-design practices implemented by R4 and its suppliers. That is, suppliers do not rely much on R4, but jointly make decisions.	Dependence	Strong
Enablers			
R1	Sustainability drives R1's mission, vision, and values. Top management is committed to sustainability and has established a Sustainability Center. The "Environmental and Occupational Safety Policy" of R1, signed by the Directors, ensures the protection of the environment and people's health as part of an integrated system in accordance with the standards ISO 14001 and ISO 45001.	Top management support	Strong

(Continue)

	The UN 2030 Agenda sets out 17 goals (SDGs) - divided into 169 targets - to promote fair and long-term global growth and was adopted by 193 countries, including Italy, which are committed to ensuring sustainable production and consumption patterns. R1 remains consistent with its choices when it comes to sustainability also as part of its financing activities and prefers working with credit institutions that have implemented policies and decisions in this sense. In 2020, the Company entered into a Positive Loan agreement at a reduced rate based on the achievement of environmental sustainability results as measured by specific indicators.	Laws/policies support	Strong
R2	Top management of R2 values more economic sustainability over environmental and social sustainability. And they lack environmental management knowledge.	Top management support	Null
	The Chinese government has indeed issued some laws and policies related to environmental protection in recent years, for instance, the goal of Peaking Carbon Dioxide emissions and Carbon Neutrality. Unfortunately, the popularization of knowledge of these policies, support programs, and environmental management by the government is very low. Also, the government does not have any policies or laws on what to do with the surplus fresh food. For instance, R2 is unaware of the government's financial subsidy program for solar installation in the warehouse.	Laws/policies support	limited
R3	In order to meet the stockholder's requirement, the top management of R3 does not have the energy to learn about the new environmental regulations issued by governments.	Top management support	Null
	The Chinese government has issued some laws and policies related to environmental protection in recent years, for instance, the goal of Peaking Carbon Dioxide emissions and Carbon Neutrality. Unfortunately, the popularization of knowledge of these policies, support programs, and environmental management by the government is very low. Also, the government does not have any policies or laws on what to do with the surplus fresh food. For instance, R3 is unaware of the government's financial subsidy program for solar installation in the warehouse.	Laws/policies support	limited
R4	In order to meet the stockholder's requirement, the top management of R4 does not have the energy to learn about the new environmental regulations issued by governments.	Top management support	Null
	The Chinese government has indeed issued some laws and policies related to environmental protection in recent years, for instance, the goal of Peaking Carbon Dioxide emissions and Carbon Neutrality. Unfortunately, the popularization of knowledge of these policies, support programs, and environmental management by the government is very low. Also, the government does not have any policies or laws on what to do with the surplus fresh food. For instance, R3 is unaware of the government's financial subsidy program for solar installation in the warehouse.	Laws/policies support	limited

4.4. Analysis and results

4.4.1 Retailers' implementation of good practices

We identified eight good practices from a literature review and a case study of an Italian reference retail company (see Chapter III). We then analysed three other cases to identify good practices they had already implemented. The four cases were examined in aggregate to determine the characteristics of different types of existing good practices implemented in the reference case (an Italian market-leading company) and three Chinese companies. Case comparison showed the existence of differences in the implementation of good practices by retail companies. The variables were identified by using the data coding procedure suggested by Yin (2017). We divided the eight good practices into two types of categories: operational efficiency, environmental/social, and inter-/intra- organizational good practices based on the goals and scope of implementation. Implementation goal category: an operational efficiency good practice often has high priority objectives for economic performance improvement; thus, a retailer tries to implement those high operational efficiencies, cost-effective, feasible good practices; an environmental/social good practice typically aims to improve environmental/social performance, and the retailer implements these good practices to meet sustainability requirements. Implementation scope category: an inter-/intra-organizational good practice usually depends on SC partnerships, and whether the retailer implements inter-organizational or intra-organizational good practices is very dependent on the relationship with its suppliers. All types of good practice categories lead to sustainability performance improvement.

4.4.2 Drivers

(1) Role of government regulation

As we all know, members of the fresh food CSC need to invest in refrigeration equipment and infrastructure to ensure the proper temperature and humidity of fresh food, and these investments are much more expensive than the traditional SC of fresh food. Furthermore, operating cost reduction is one of the critical sustainability performance indicators for evaluating sustainable fresh food CSC performance (Al-Refaie, Al-Tahat, and Lepkova, 2020; Filina-Dawidowicz and Wiktorowska-Jasik, 2021; Zulkefly et al., 2021; Ma et al., 2021). The case evidence implies that if the government does not take strict regulatory action and penalty mechanism to ensure the quality and safety of fresh food provided by retail companies, the activities across the entire fresh food CSC carried out by retail companies are environmentally friendly. The operations managers from R2, R3, and R4 agreed that their companies do not have any plans to implement some good practices for environmental protection or allocate resources to environmental management. They can only focus on reducing costs and improving economic performance. For example:

"In order to survive, we have to provide customers with some higher-cost services, such as online-offline services, free home delivery service, and lower sales prices; all these actions will only increase the burden of reducing operating costs. Especially when we see a lot of retail companies went bankrupt in recent years. We have to go all out to increase market share, and improve customer satisfaction and competitiveness. In this case, we really do not have the energy to learn about the new environmental laws/policies issued by governments. To top it off, when we find that the government is not going to take strict regulatory action against us, at least at this stage." (*operations managers of the fresh food CSC, R2*)

(2) Role of customer sustainability awareness

We find that, in order to increase customer satisfaction and be more responsive to customer needs, the level of sustainability awareness of consumers directly affects the efforts companies make to ensure the quality and safety of fresh food. Since the awareness of sustainability in the whole society is still weak in developing countries. And here, we analyse the level of sustainability awareness of consumers refers to the customer's prior knowledge of sustainability. The results reveal that the levels of customers about sustainability are also different due to the different positioning of target customers positioning in each case. For example, the target customer positioning of R2 and R4 are high-income people aged 30-50, and the target customer positioning of R3 is people who have retired over the age of 60.

The evidence reveals that most retirees prefer to buy fresh food daily and are more inclined to buy fresh food (especially red meat) without temperature control because of their dietary habits. That is to say, such consumers have little demand for CSCs and do not care about sustainability. In contrast, high-income people do not care about the price, only the freshness of the fresh food; furthermore, since they have more access to the latest technologies (e.g., track/trace technology) and knowledge, they have a higher demand for CSC, and start to care about the environmental sustainability. In this case, their demand for CSC is high. The operations managers from R2, R3, and R4 agreed that the first task for their companies is to determine their target customers' positioning. This is because the determination of target customers' positioning is directly related to customer satisfaction. For example,

"I attended R2's first store opening, and I was shocked by R2's operating model. Then I learned some good practices from R2 and implemented these good practices in my company for a few months. Unfortunately, I failed. This is because I found that my sales were down. And I did a survey with my old customers, and it turned out that these

good practices just did not work for them. They could not stand the increase in sale prices. But you know, the implementation of these good practices has increased my operating costs, and I have no choice but to increase the selling price. Otherwise, I will not be as profitable as before." (*operations managers of the fresh food CSC, R3*)

(3) Role of dependence

We find that the dependence between retail companies and their suppliers is critical in influencing the impact of implementing good practices in sustainable fresh food CSC networks. The results reveal that, even when the criteria for selection of suppliers and the way of coordination with them are different, the dependence between buyers and suppliers can be characterized using the qualitative descriptions below:

1) Buyers and suppliers have established a long-term relationship through contracts;
2) Buyers and suppliers depend on each other's resources;
3) Buyers and suppliers make decisions together (for example, the choice of packaging materials, the size of fresh food, etc.) and share information with each other.

We find that strong retail companies can leverage their powers' dependence on them to allow better implementation opportunities for the standards, plans, ideas, and inter-organizational projects of sustainable fresh food CSC good practices to improve operations. For example,

"My company have a team to help our suppliers to join our IT system, at the same time, we also have a team to help some farmers to be scientific grow agricultures, in order to help them meet my company's requirements" (*operations managers of the fresh food CSC, R2*)

"Since most of our company's purchases are made in the wholesale market, we do not have fixed suppliers. In this case, it is impossible to ask them to join our IT system and access their fresh food data." (operations managers of the fresh food CSC, R3)

As retail companies face customers directly, they have more opportunities to know the consumer demand and consumption preferences for fresh food. In this case, based on data shared by retail companies, suppliers can know how much fresh food to produce to balance supply and demand and reduce fresh food waste and loss due to market uncertainty. That is, retail companies influence suppliers' decisions by providing these data. Furthermore, the retail companies are the last stage for consumers to obtain fresh food, and in order to ensure the quality and safety of fresh food, they must monitor the temperature and humidity of fresh food throughout the CSC network. In this context, in order to achieve this goal, retail companies must depend on the upstream data about fresh food (e.g., temperature, humidity, location, time window). Strong buyer-supplier dependence means that the suppliers and buyers depend on each other's resources. Weak buyer-supplier dependency indicates that suppliers and buyers have more commercial autonomy and are less dependent on each other.

4.4.3 Enablers

(1) Role of top management support

Our analysis implies that the support level of the top management for the sustainable development of the fresh food CSC resides in the formulation of sustainable development strategies, the establishment of departments centred on sustainable development and the commitment to sustainable development. They ultimately lead to improving sustainability performance of the company. The idea of sustainability is comprehensive and constantly growing on the basis of the increasing support level given to sustainable development by top management, resulting in result that three

retailers admitted that they considered themselves that "all of their current sustainability strategies are prioritizing economic sustainability without adequate consideration of environmental and social sustainability."

We find that government regulations, suppliers, and customers are the main drivers of increased support for sustainability among top management in retail companies. We also find that top management of retail companies increases their support for sustainability to 1) meet the compliance requirement of government regulations, 2) remain competitive among peer retail companies, and 3) respond to sustainability-related concerns from customers, community, and the media. Nevertheless, operations managers of the fresh food CSC from R2, R3, and R4 agreed that they have limited energy to explore and implement some good practices to improve environmental and social sustainability performance due to the high pressure of operating cost reduction and weak government regulatory.

Overall, the results show that the top management of retail companies with the highest level of support in the sustainable development of fresh food CSC will develop sustainable development strategies and voluntarily comply with the government regulations on sustainability. Such retail companies would also have a better opportunity to "focus on the innovative explorations in social welfare and environmental management, instead of just trying to improve economic performance." (*operations managers of the fresh food CSC, R1*)

At the same time, all interviewees emphasized that transferring individual sustainability knowledge into organizational actions is a complex process which is related to the roles and skills of the persons in charge. For example,

"It is not easy to simply teach my staff and colleagues the newest issued laws/policies that I got - I will put together a team to digest all the laws/policies issued

by the government on sustainable development and develop a sustainability strategy that is relevant to our environment and daily practices. It may take months or even years to complete the 'delivery' and has to be constant." (*operations managers of the fresh food CSC, R1*)

(2) Role of laws/policies support

Our analysis indicates that in order to ensure that fresh food CSC companies are environmentally sustainable, laws/policies play an important role in guiding companies to implement good practices to achieve this goal. Since fresh food CSC is a multi-disciplinary industry (such as food engineering and technology, SC management, food safety, logistics management, etc.), involving many standards such as surplus fresh food disposal, fresh food processing, CSC procedures, fresh food storage temperature/humidity, etc. In this context, we find comprehensive laws/policies critical to helping companies implement the good practices that require government support, such as the good practice of "surplus fresh food donation."

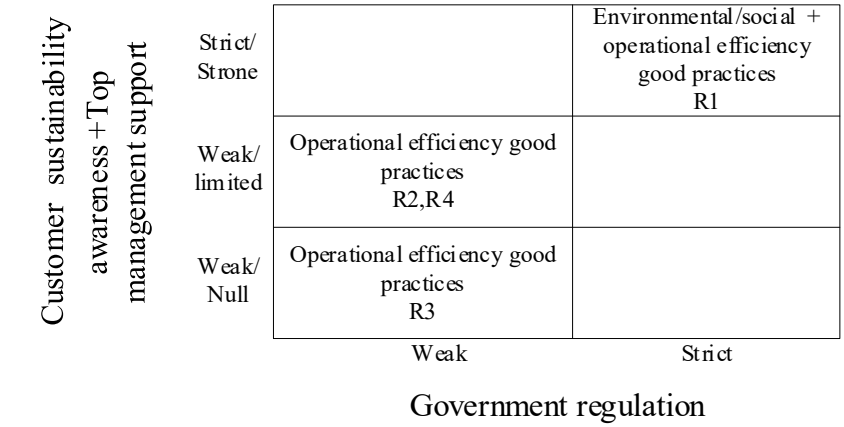
"My company tried to donate the remaining fresh food to some organizations or individuals. But unfortunately, because there is no fresh food bank in China, we cannot go through the process protected by law. Finally, because we cannot guarantee the safety of fresh food after donation when food is donated to an organization/individual, and a food safety accident occurs, we have to accept the accusation because of the quality of the fresh food. We will also be punished accordingly (paying medical expenses, etc.), and in the end, we not only lose our interests but also lose the reputation of our company." (*operations managers of the fresh food CSC, R3*)

The case evidence also suggest that laws/policies cannot simply be enacted. Knowledge of these laws/policies needs to be popularized to society, including all stakeholders (top management, employees, customers, etc.). The operations managers

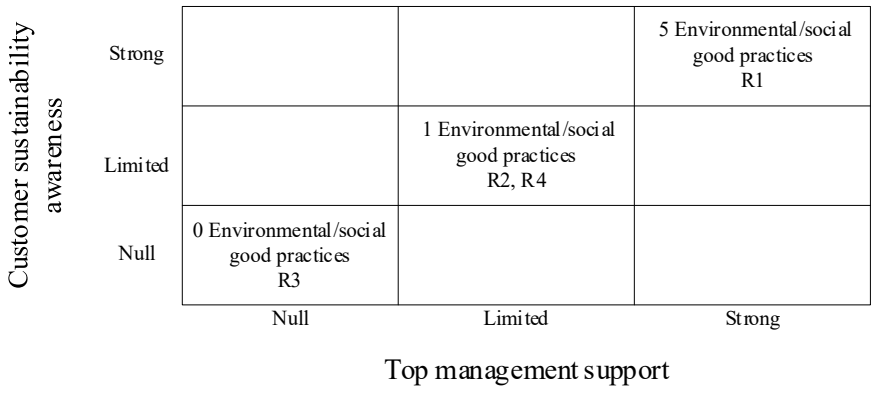
from R2, R3, and R4 agreed that they do not know much about the laws/policies related to environmental protection, such as the application of solar photovoltaic systems application in the warehouse.

"I only know that my company may be funded by the government if we replace electric energy with solar photovoltaic energy in the warehouses, but we do not know how to apply for it, and we also do not know if I can get the benefits directly, since the warehouse operated by our company is not owned, but rented from the logistics park." (*Warehouse managers of the fresh food CSC, R4*)

4.4.4 Propositions



(1)



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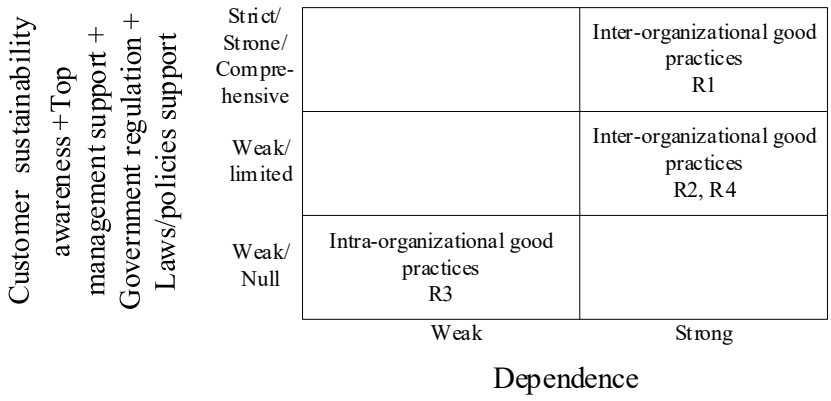

(3)

Figure 10. Cross-case analysis

The findings related to the government regulation, customer sustainability awareness, dependence, top management support, laws/policies support, and implementing good practices by retailer companies are summarized in Table 9-Table 10.

Table 9. Cross-case comparison on drivers and enablers

Retailer	Drivers		Dependence	Enablers	
	Government regulation	Customer's sustainability awareness		Top management support	Laws/policies support
R1	Strict	Strong	Strong	Strong	Comprehensive
R2	Weak	limited	Strong	limited	limited
R3	Weak	Null	Weak	Null	limited
R4	Weak	limited	Strong	limited	limited

Table 10. Cross-case comparison on implementation of good practices

Retailer	Implementation of good practices								Type of good practices (total number of projects)			
	P1	P2	P3	P4	P5	P6	P7	P8	Environmental/Social	Operational efficiency	Inter-organizational	Intra-organizational
R1	√	√	√	√	√	√	√	√	5	3	3	0
R2	√	√		√		√			1	3	3	0
R3	√	√				√			0	3	0	2
R4	√	√		√		√			1	3	3	0

The results reveal that one retail company (R1) has strong top management and comprehensive laws/policies support and is under high pressure due to strict government regulation and strong customer sustainability awareness compared to the other three retail companies. It has implemented 5 environmental/social good practices, 3 operational efficiency good practices, and 3 of which are inter-organizational good

practices in the sustainable fresh food CSC, whereas two of the three other retail companies have only implemented 1 environmental/social good practice out of 5, the other one retail company has not implemented any environmental/social good practices and implemented only 2 intra-organizational good practices. The finding thus suggests strict government regulation, high customer awareness, and strong top management support plays critical roles for the retail company in implementing good practices. Good practice entangles systematic changes to a retail company's current processes and operations. Therefore, the retail company has to redesign its fresh food CSC network, and doing so depends on the top management and laws/policies support, government regulation, and customer awareness of sustainability.

Based on this evidence, we developed the following proposition:

P1: In a developed country (strict government regulation, high customer awareness, strong top management support), the implementation of good practices contemplates good practices oriented towards environmental/social and efficiency goals, both inter- and intra-organizational.

In cases R2, R3, and R4, the case evidence further suggests that retail companies under weak government regulation can implement operational efficiency good practices in fresh food CSC because those good practices are relatively easy and do not increase too much burden on operations and processes. When implementing operational efficiency good practices in sustainable fresh food CSCs, retail companies only need to adapt existing good practices and systems that are dependent on incremental improvement.

The following proposition summarizes this evidence:

P2: In a context of weak government regulation, companies tend to implement more good practices oriented toward operational efficiencies, such as the application of IT systems for fresh food CSC, application of RFID and WSNs, and employee training.

As for different good practices (environmental/social and operational efficiency) implementation, Figure 10.1 suggests that the government regulation level is linked to the customer's sustainability awareness and top management support level: from weak government regulation when it has weak/null/limited customer's sustainability awareness and top management support, to strict/strong customer's sustainability awareness and top management support when it under strict government regulation.

In addition, we find that R2 and R4 have implemented 1 environmental/social good practice in fresh food CSC compared with R3. This is because top management and customers of R2 and R4 started to care about sustainability. Most importantly, one of environmental/social good practices has been implemented by R2 and R4, "eco-design", which not only protects the environment and improves social welfare but also reduces operating costs. And the customer of R3 care more about the selling price than the freshness of fresh food, and to top it off, its top management do not have the energy to learn environmental sustainability knowledge for the company's survival.

According to this evidence, we developed the following proposition:

P3: The implementation of environmental/social good practices can be favoured by a higher customer's sustainability awareness and top management support (e.g., Eco-design).

The pattern in Figure 10.2 links the top management support to the level of customer awareness of sustainability.

In cases R1, R2, and R4, we find that when the retail company has established a long-term relationship with its suppliers, it requires drives suppliers to improve their

awareness level of suppliers on sustainability and implement the sustainability knowledge and skills acquired during the supplier screening procedures. In Case R3, when a retail company has not kept a long-term relationship with its suppliers, suppliers care less about the retail company's supplier screening procedures. Supplier decisions are less influenced by retail companies, and they are less care about sustainability or invested in absorbing the sustainability knowledge learned through supplier screening procedures. As a result, it is difficult to ensure the sustainable development of the entire fresh food CSC.

The findings indicate that retail companies and their suppliers have strong dependencies that drive suppliers and buyers together to implement inter-organizational good practices in the entire fresh food CSC networks, i.e., strong buyer-supplier dependencies increase the impact of a supplier's sustainability awareness on the implementation of inter-organizational good practices in the fresh food CSC networks. The evidence from R1, R2, and R4 support this finding: although they all have implemented the 3 operational efficiency good practices in fresh food CSC, due to the strong interdependence of R1, R2, and R4 on their suppliers, R1, R2, and R4 implement inter-organizational good practices in the fresh food CSC network; in contrast, as the weak interdependence of R3 on its suppliers, R3 only implement intra-organizational good practices in the fresh food CSC.

The following proposition summarizes this evidence:

P4: The scope of good practices depends on the dependence level between buyers and suppliers.

Further relationships represented in Figure 10.3 link the customer's sustainability awareness, top management, government regulation, laws/policies support, and dependence level between buyers and suppliers.

4.5 Discussions and conclusions

4.5.1 Theoretical contribution

We reveal that retail companies may implement environmental/social, operational efficiency, inter/intra organizational good practices are affected by customer's sustainability awareness, top management, government regulation, laws/policies support, and dependence level between buyers and suppliers. The findings extend current literature on sustainable fresh food CSC by providing a possible explanation of why China or other developing countries have not been able to implement the good practices that developed countries have successfully implemented (Mangla et al., 2019; Kumar et al., 2020; Ali et al., 2021; Gutema et al., 2021) and by revealing when a retail company's fresh food CSC sustainability initiatives are effective from the perspective of different stakeholders (top-management, government, customers) (Dimaggio and Powell, 1983; Bowen et al., 2001; Pujari et al., 2004; Pagell and Wu, 2009; Hoejmose et al., 2012; Dai et al., 2015;). For example, Nielsen Insights (2015) suggested that Generation Z and Millennials customers are willing to pay more for goods and services dedicated to environmental and social causes. This study in this chapter also provides theoretical reasoning and empirical evidence that government regulations play a key role in implementing good practices for sustainable fresh food CSC, enhancing existing knowledge on how to implement good practices in developing countries (Darnall, 2003; Delmas and Toffel, 2004; Darnall, Jolley, and Handfield, 2008; Wu, Ding, and Chen, 2012;).

Our findings suggest that due to the high costs associated with implementing good practices, fresh food CSC companies will not proactively adopt these good practices without strict government regulation, even with laws/policies support (at least initially). We find that in the absence of strict government regulation, companies in developing

countries tend to implement more good practices oriented towards operational efficiency due to the high operating costs of CSCs (Filina-Dawidowicz and Wiktorowska-Jasik, 2021). It advances existing research on the antecedents of sustainable fresh food CSC in developing countries (Wu, Ding, and Chen, 2012; Ye et al., 2013; Zhu, Sarkis, and Lai, 2013).

We also reveal the mechanisms by which buyer-supplier dependence on their buyers influences the implementation of good practices for sustainable fresh food CSC. We find that researchers should take a contingency viewpoint while taking their interactions in fostering sustainable fresh food CSCs into consideration, thereby enhancing existing knowledge of the impact of dependence on buyer-supplier relationships (Cheng, 2011; Hoejmose, Brammer, and Millington, 2012; Hoejmose, Grosvold, and Millington, 2014). The results suggest that a retail company will implement inter-organizational good practices based on the buyer-supplier dependence. The findings link a company's external dependencies and offer empirical evidence that the impact of dependence relationships on the implementation of good practices should be investigated, thereby improving the current understanding of how to develop a sustainable fresh food CSC (Zhao et al., 2008; Chkanikova, 2016).

4.5.2 Managerial and policy maker implications

The study in this Chapter offers guidelines on how enterprises in developing countries can increase the sustainability of their fresh food CSCs. First, we recommend that retail enterprises classify good practices that have been successfully implemented by companies into different categories based on the objectives of good practices implementation when designing new sustainability strategies and draw on the experience of companies that have successfully developed and implemented sustainability strategies (Matzembacher and Meira, 2018; Bravo, Moretto, and Caniato,

2021). Second, this research forwards the theoretical basis of the fresh food CSC expansion and provides suggestions for managers, companies, and policymakers to support the fresh food industry towards a sustainable fresh food CSC. In particular, we warn policy-makers to not only consider the formulation of sustainability policies but also to take strict action to supervise companies' compliance with these issued policies (Darnall, 2003; Delmas and Toffel, 2004; Darnall, Jolley, Handfield, 2008; Vo and Arato, 2020). Specifically, the government should also popularize and attach importance to environmental management systems certification (e.g., ISO 4001). Top management of retail companies should develop a code of conduct and establish a system to document past experience of implementing good practices to improve sustainability performance.

Third, we suggest that raising awareness of sustainability among top management of companies and customers is critical and urgent to help companies proactively comply with relevant sustainability policies. Specifically, we suggest that the sustainable development education of customers and top management should be strengthened from a various channel such as government, companies, or institutions. For example, retail companies can use their communication channels to influence the food waste behaviour of customers to improve the sustainability performance of fresh food CSC (Young et al., 2018). In addition, we also suggest that the government should give recognition and reward when companies or customers have high performance on sustainability.

Fourth, we suggest that retail companies establish long-term relationships with their suppliers to enhance the level of dependence with suppliers, thereby facilitating the implementation of inter-organizational good practices throughout the sustainable fresh food CSC (Wolf, 2011; Lee, 2015). For example, top management should not only commit to sustainability but also oversee the practices implemented throughout

the fresh food CSC. In addition, they should be empowered to correct unsustainable behaviour and be given an adequate budget to adopt good practices. Retail enterprises may provide training programs not only for their employees, but also for their suppliers to improve their fresh food production and processing capabilities. Specifically, retail enterprises can develop training programs for their employees and suppliers based on the past experiences and good practices in sustainability, and maintain these experiences by establishing information and database systems and operating procedures. Furthermore, retail enterprises can strengthen the relationships between buyers and suppliers by contracting and engaging activities with other supplier to increase their supplier dependence on them.

4.5.3 Limitations and future research directions

In addition to the theoretical contributions and managerial and policy maker implications described above, this study in this chapter has several limitations that need to be acknowledged, which may open the way for future research. For instance, this study in this chapter considers only one Italian market-leading company as a reference case study and three Chinese cases in the sample. As a result, the findings' generalizability is limited. Large-scale surveys could be carried out in the future research to empirically test and validate the propositions. Further, this study in this chapter did not consider the impact of the stages of industrial development on the implementation of more good practices oriented towards operational efficiency by companies in developing countries. Future research could investigate at what stage industrial development companies in developing countries would begin implementing environmental/social good practices. In addition, researchers have found that government regulations play a critical role in implementing good practices in sustainable fresh food CSC. Future studies could explore how implementing good

practices in sustainable fresh food CSC are affected by government regulations. Finally, since this study in this chapter considers three Chinese cases with different target customers, we only consider the impact of government and customer pressure on implementing good practices. Although the target customers are different, competitive market pressure may also influence the implementation of good practices in sustainable fresh food CSC. Future research could investigate the impact of competitive market pressure on the implementation of good practices.

Chapter V: Fresh food CSC sustainability performance evaluation

This chapter presents this first section introduction for presenting the background and purposes of this study. The second section will show a literature review on the topic, including sustainable fresh food CSC good practices, sustainability performance indicators, and research methods. The third section of this chapter will introduce the methodology we adopted in this chapter. The fourth section will present the results of this chapter, which includes the sensitivity analysis results. The final chapter focuses on the discussion and conclusion of this chapter.

5.1 Introduction

Fresh food CSCs involve a range of activities from cultivation to distribution, transporting fresh food from the farm to the final customer (Aramyan, 2006). The features of fresh food mainly include perishability, sensitivity to temperature, unsustainable consumption of natural resources, and seasonality, which all have an impact on the effective management of fresh food CSC (see, e.g., Amorim et al., 2013; Siddh et al., 2017). In view of government regulations and customer expectations that pay such attention to fresh food CSC, fresh food companies are starting to realize the significance of the sustainable aspects of their fresh food CSC, which is in line with the CSR dimension (see, e.g., Allaoui et al., 2018; Gunasekaran et al., 2014; Gunasekaran,

Subramanian, and Rahman, 2015). At the same time, the demand for fresh food has constantly increased as the world's population continues to grow, resulting in consuming a large portion of natural resources for fresh food production and CSC operation. That is, the sustainability management of fresh food CSC faces three major challenges: fresh food quality and safety assurance, minimization of operating costs, and carbon emission reduction (Zhang et al., 2020; Kumar et al., 2020). In this case, it has been difficult for the fresh food CSC in developing countries to continue its conventional operation, which improves the risk of a large amount of fresh food waste and loss and risk of natural resources consumption. Therefore, the decision-makers and management of fresh food CSC need to implement some good practices to reduce its negative impact on the environment, society, and economy to show its active response to these risks.

Since the development status of sustainable fresh food CSC in developed and developing countries is very different. For example, due to the incomplete infrastructure and equipment of China's CSC industry, a large amount of fresh food is lost and wasted (Zhao et al., 2018). Further, companies have been slow in the uptake of good practices in developing countries (de Boer 2003; Ghadge et al., 2021; Kumar, 2020). One possible solution is for companies in developing countries to learn from the good practices of some companies in developed countries in order to find and implement good practices suitable for companies in developing countries. Therefore, it is crucial to assess the impact of the implementation of good practices in developed countries on the sustainability performance of developing countries. The current study endeavor intends to answer the particular issue based on the aforesaid motivation and discussions with area experts:

RQ: What are the impacts of the implementation of good practices in developed

countries on the sustainability performance of developing countries?

The current issue is an operation research-based decision issue, since the overall purpose is to assist decision-makers and management in developing countries to prioritize the implementation of good practices that can improve their organizational sustainability performance. Therefore, a theory-based decision approach is followed to obtain their priority weights and order of preference. A multi-criteria decision-making (MCDM) technique can be used to deal with the scenario. The choice of a most suitable method relies on the scenario (for example, describing one of several possible alternatives, ranking determination, or subjective or objective kind of weight formation). To determine the criterion's preference, ODU (2019) believed that subjective type optimization issues rely on expert judgment/opinions to (in terms of ranking or weights); in contrast, Aldian and Taylor (2005) believed that objective-type optimization methods use data generated by mathematical models rather than expert views to assess weights. a hybrid AHP-Fuzzy TOPSIS approach was found appropriate for solving this kind of research questions (Kumar, Tyagi, and Sachdeva, 2022). This is because the AHP and TOPSISI approaches have inherent advantages over other tools to address these particular problems. According to the decision theory, the approach route for the current issue includes

- articulate good practices (that is, the alternatives) and sustainability performance indicators (that is, the criteria), using literature and expert interviews;
- hierarchical decomposition of the set of sustainability performance indicators to produce a cognitive knowledge of their contextual interrelationships; and
- generate weights and priorities for good practice based on pairwise comparisons of "importance" indicators.

On the basis of the literature analysis and the opinions of experts, eight good practices implemented by an Italian market-leading company, the three most essential indicators, and thirteen sub-indicators for fresh food CSC sustainability performance evaluation were selected (see Chapter II).

5.2 Literature review

The development status of sustainable fresh food CSC in developed and developing countries is very different. For example, due to the incomplete infrastructure and equipment of China's CSC industry, a large amount of fresh food is lost and wasted (Zhao et al., 2018). That is, the development of sustainable fresh food CSC in China is still in its infancy. Conversely, in developed countries, such as Italy, companies must follow the government regulations to adopt some more optimized operational strategies and advanced technologies at all stages of the entire fresh food CSC network in order to reduce the negative impact on the environment and society and fresh food loss and waste, resulting in achieving the sustainability of fresh food CSC (de Boer, 2003; Ghadge et al., 2021). One possible solution is for companies in developing countries to learn from the good practices of some companies in developed countries in order to find and implement good practices suitable for companies in developing countries. In this case, after identifying good practices implemented by companies in developed countries, it is crucial to assess the impact of the implementation of good practices in developed countries on the sustainability performance of developing countries.

After determining the most important good practices and related sustainability performance indicators and their sub-indicators, aim to obtain their priority weights and order of preference. A MCDM technique can be used to deal with the scenario. There are a variety approaches that can be used to address specific issues involving multiple decision attributes, for instance, VIKOR, WSM, TOPSIS, ELECTRE, Analytic

Hierarchy Process (AHP), WPM method, and Entropy method.

In the study work in this chapter, use opinions of experts to identify priority weights of the indicators and sub-indicators. Hence, the issue can be handled as a weight identification issue of subjective type. Since the AHP approach has inherent advantages over other MCDM tools to address this particular problem, for instance, providing a pairwise comparison-based hierarchical order of questions; the capability to verify for consistency; and the ability to dissect a decision-making issue into its sub-elements; and providing decision-makers with the flexibility to keep results concise. Since Saaty's introduction of AHP in 1980, various authors have introduced many variants to overcome the obstacles of AHP. For example, Tyagi et al. (2018) believed that AHP is a technique for addressing complicated decision-making problems with a set of attributes/criteria by decomposing them into sub-problems and assigning identified scores according to the opinions and perspectives of the decision-maker. Further, many scholars have adopted AHP approach to assess the performance of different systems. For example, Tyagi et al. (2015) adopted AHP and fuzzy AHP method to determine the priority weights and explore ranking for alternatives. Gupta and Vat (2019) applied AHP to rank the various alternatives and compare the findings acquired from the other pairwise comparison approaches for evaluating criterion priority weights. Longaray et al. (2015) used the AHP approach to build a model for assessing the quality of an outsource corporation's service level. Srivastava et al. (2019) applied the AHP approach to analyze the comparison criteria to improve the performance of Indian railway safety systems. Kumar, Tyagi, and Sachdeva (2022) adopted the AHP approach to analyze the performance evaluation factors of vaccine CSC.

The TOPSIS tool is the most well-liked and widely accepted approach when it comes to identifying a set of good practices rankings based on expert opinion because

of its inherent advantages over other methods, for example, simplicity and ability to address a vast variety indicators and good practices; recommend to prioritize good practice that is farthest away from a negative influence and closest to a positive influence on sustainability performance; pairwise comparisons and understandable iterations require less manual work; and easy to calculate and has good computing power. Govindan, Khodaverdi, and Jafarian (2013) adopted Fuzzy TOPSIS to find the ranking of suppliers.

On the basis of the above motivation, we used the AHP approach to identify the priority weights of the determining indicators and sub-indicators. In order to get the good practices ranking based on the opinions of experts, we used the fuzzy TOPSIS tool. In practice, gathering accurate judgments/opinions from experts in the domain can become a bit cumbersome since they vary from condition to condition. The present research aims to explore the impact of good practices on the sustainability performance of the fresh food CSC. Slight ambiguity or uncertainty in judgments regarding good practices may lead to wrong decisions in the sustainability performance system of fresh food CSC under consideration. Assessment by the TOPSIS tool in the fuzzy environment successfully deals with the ambiguity in the summary evaluation, making the analysis findings close to the real-life state. Therefore, the present research work found that the application of the AHP-Fuzzy TOPSIS hybrid approach appropriate for solving the current RQs.

5.3 Methodology: Fuzzy decision-making

The key issues involved in conducting this study in this chapter revolved around developing and validating scales for implementing sustainable fresh food CSC practices in organizations and the performance assessment of different measures of sustainable fresh food CSC. At the first stage, a list of eight good practices in improving

sustainability performance of the fresh food CSC was determined based on a literature review. The keywords were used to find good practices including four levels, and level one is "Cold chain" OR "cold supply chain" OR "cold supply chain logistics" OR "cold chain logistics" "sustainable" OR "sustainability" OR "sustainable development" OR "green" OR "environmental impact" OR "low carbon" OR "emissions" OR "social impact" OR "socioeconomic" OR "economic impact"; level two is "food" OR "perishable" OR "fresh product" OR "agriculture products"; level three is "performance" OR "practices"; level four is "nonperishable" OR "nonperishable." The keywords were selected based on the determined key research topics in various literature and reviews of the preliminary studies. Figure 11 describes the theoretical flow chart of this study work.

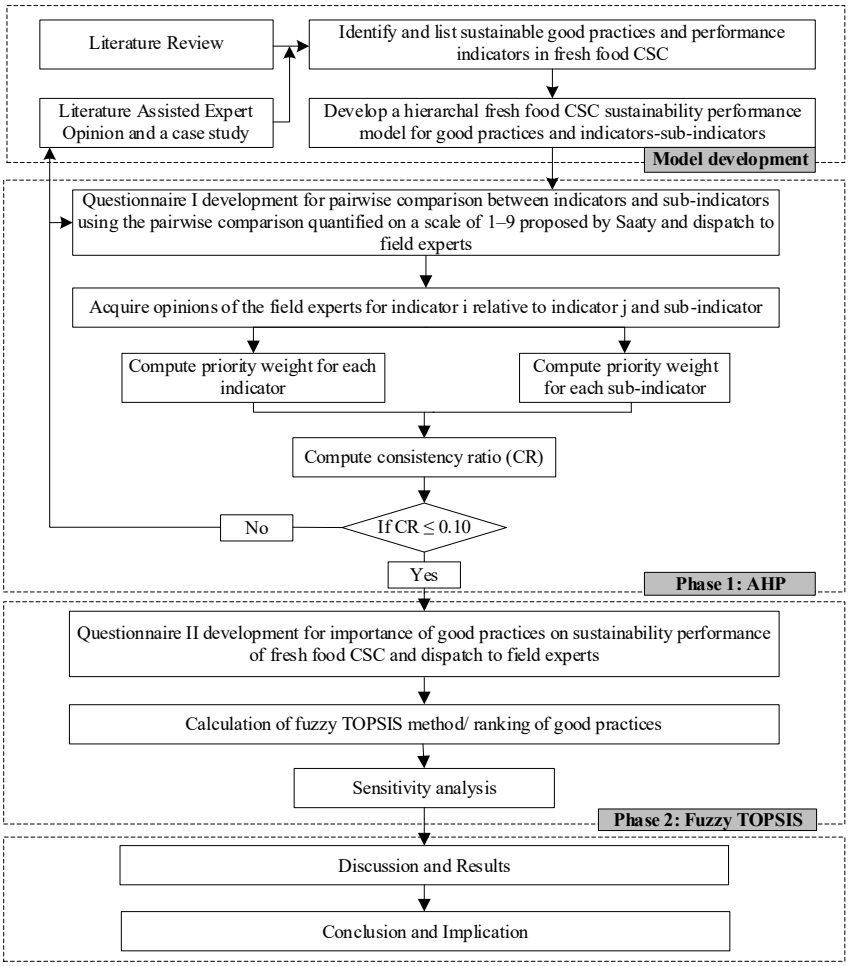

Figure 11. Theoretical flow chart of this study work

5.3.1 Conceptual framework model

An expert-assisted literature survey was used to determine good practices. Interviews with field experts helped to finalize eight good practices (Chapter III) in sustainable fresh food CSC in the Italian context, as well as classify the sustainability performance indicators (Chapter III, Table 5). These sustainability performance indicators were categorized into economic benefit, environmental impact, and social welfare. The domain experts are mainly practitioners in the fresh food CSC industry located in the cities of Guangzhou, Shanghai, Beijing, and Shenzhen and academics from food and management engineering institutions. To meet the study objectives, a hierarchy-based fresh food CSC sustainability performance assessment model containing three indicators and their sub-indicators and eight good practices have been developed, as shown in Figure 12.

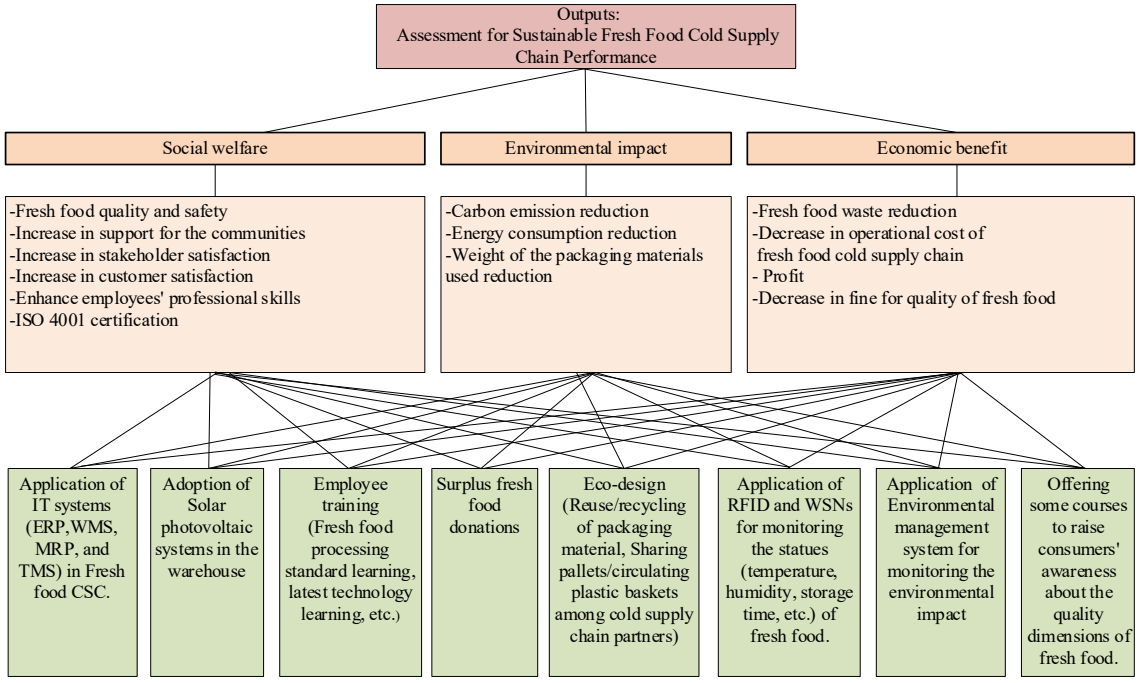

Figure 12. A conceptual sustainability performance structure

5.3.2 Analytic hierarchy process (AHP) approach

In 1980, Thomas Saaty introduced the AHP, which is a MCDM approach that

allows the decision-maker to assign priority to provided criteria before reaching a choice. In this present study, the AHP tool was used to determine a weight for each sustainability performance indicator based on the pairwise comparisons of decision-makers. Higher weight criteria mean these criteria are more important. Pairwise comparisons of elements can be made using a scale that indicates the strength of one element over another element to higher-level elements. In this present study, the AHP tool was used to determine a weight for each sustainability performance indicator based on the pairwise comparisons of decision-makers.

Saaty's (1980) proposed scales for pairwise comparison are quantified on a scale of 1–9, as shown in Table 11.

Table 11. The 1–9 fundamental scale

Definition	**Intensity of relative importance**
Equal importance/preferred	1
Weakly important/preferred	3
Strongly important/preferred	5
Very strongly important/preferred	7
Absolutely more important/preferred	9
Intermediate importance between two adjacent judgments	2,4,6,8

The AHP approach can be implemented as follows:

Step 1. Establish the indicators and sub-indicators pairwise comparison matrix according to the 1-9 scale provided by Saaty (1980).

Let us consider that there are N indicators, when indicator i with indicator j are compared pairwise, the result is a square matrix $A1_{N\times N}$, where a_{ij} represents the relative importance of indicator i with regard to indicator j.

In the matrix;

$$a_{ij} = 1, \text{ When } i = j, \text{ and } a_{ji} = \frac{1}{a_{ij}} \quad (1)$$

Step 2. Find the relative normalized weight (W_i) for each indicator (both indicators and sub-indicators).

$$GM_i = \left(\prod_{j=1}^{n} a_{ij} \right)^{\frac{1}{n}}, \text{ and}$$
$$W_i = \frac{GM_i}{\sum_{j=1}^{n} GM_i} \tag{2}$$

Step 3. Assuming m judgments are inputted, Compute the average of weight AW_i for each criterion.

$$AW_i = \frac{W_i}{m} \tag{3}$$

Step 4. Compute matrix A_3 and A_4 such that $A_3=A_1\times A_2$ and $A_4 = \frac{A_3}{A_2}$,

$$\text{Where, } A_2 = \left[W_1,\ W_{2,}\ \ldots\ldots\ W_{i,}\ W_N \right]^T \tag{4}$$

Step 5. Determine the maximum eigenvalue λ_{max}, which is the average of matrix A_4.

Step 6. Compute the consistency index *CI*

$$CI = \frac{\lambda_{\max} - n}{n-1} \tag{5}$$

The lower the value of CI, the smaller the divergence from consistency.

Step 7: Compute the consistency ratio CR.

$$CR = \frac{CI}{RI} \tag{6}$$

where GM_i is the geometric mean of indicator i; RI is the random index (Table 12).

Table 12. Random indices from (Saaty 1977)

n	3	4	5	6	7	8	9	10
RI	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

5.3.3 Fuzzy TOPSIS

The TOPSIS method proposed by Hwang and Yoon (1981) is a multi-attribute decision analysis technique (MADM) that seeks the greatest potential alternative that is closest to the positive ideal solution and the farthest away from the negative ideal solution. In the traditional TOPSIS method, when the rating information is acquired in the form of numerical or quantifiable values, the relative importance of each alternative

with respect to each criterion can be acquired. But where experts or groups of individuals provide uncertainty in data or linguistic terms to make decisions, TOPSIS needs to be applied in a fuzzy environment to encounter these situations. Chen (2000) proposed an extended TOPSIS approach in a fuzzy environment. An extension of TOPSIS in a fuzzy environment is called fuzzy TOPSIS. In fuzzy TOPSIS, the importance of criteria and pairwise comparisons of alternatives are performed using fuzzy numbers rather than clear numbers. Here, this present research, it seeks the most impactful good practice in improving sustainability performance of the fresh food CSC. Our fuzzy TOPSIS method comprises the following steps (modified from Awasthi et al., 2010):

Step 1. Acquire decision-makers' linguistics ratings for each good practice and indicator

It is assumed in the present study work that k good practices Pi (i=1, 2,.., k) and N indicators C_j (j=1, 2,....., N), and "m" decision-makers (Ms) (m=1, 2,..., m), assigned average weights for each indicator are given by $A\tilde{w}_j$ (j=1, 2,.....,N). The importance of each good practice for each sub-indicator obtained from the groups of Ms can be represented as $\tilde{S}_K = \tilde{x}_{ijm}$ with a membership function $\mu_{\tilde{S}_m}(\chi)$.

Step 2. Calculate aggregated fuzzy decision matrix ($\tilde{A}$)

Before calculating the $\tilde{A}$, we used the five-point scale shown in Table 13 to replace Ms' linguistic opinions on the importance of each good practice to the sub-indicator.

Table 13. Linguistic terms for good practices ratings

Linguistic term	**Triangular fuzzy number**
Very poor	(1,1,3)
Poor	(1,3,5)
Fair	(3,5,7)
Good	(5,7,9)
Very good	(7,7,9)

If we assume triangular fuzzy number $\tilde{S}_m = (a_m, b_m, c_m),\ m = 1, 2, ...m,$ then combined fuzzy scores will be $\tilde{S} = (a, b, c)$

Where,

$$a = \min_m \{a_m\},\ b = \frac{1}{m}\sum_{m=1}^{m} b_m,\ c = \max_m \{c_m\} \tag{7}$$

If $\tilde{x}_{ijk}$ be the fuzzy rating and $\tilde{R}_{ijk}$ importance weight given by m^{th} M where $\tilde{x}_{ijk} = (a_{ijm}, b_{ijm}, c_{ijm})$ and $R_{ijm} = (R_{jm1}, R_{jm1}, R_{jm3}), i = 1, 2...\text{k};\ j = 1, 2...n,$ respectively, then aggregated fuzzy ratings $(\tilde{x}_{ij})$ of good practices can be represented as

$$\tilde{x} = (a_{ij}, b_{ij}, c_{ij})$$

Where,

$$a_{ij} = \min_m \{a_{ijm}\},\ b_{ij} = \frac{1}{m}\sum_{m=1}^{m} b_{ijm},\ c_{ij} = \max_m \{c_{ijm}\} \tag{8}$$

Follow the same procedure to assess fuzzy weights for each sub-indicator and then aggregate the decision matrix as follows

$$A = \begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \\ . \\ . \\ A_m \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & .... & C_n \end{array} \\ \begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} & .... & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & .... & \tilde{x}_{2n} \\ \tilde{x}_{31} & \tilde{x}_{31} & .... & \tilde{x}_{3n} \\ . & . & .... & . \\ . & . & .... & . \\ \tilde{x}_{m1} & \tilde{x}_{m2} & .... & \tilde{x}_{mn} \end{bmatrix} \end{array} \tag{9}$$

Step 3. Calculate the normalized fuzzy decision matrix

The raw data were normalized using a linear scale transformation to extract distinct sub-indicator scales into a comparable scale. The normalized fuzzy-decision matrix $\tilde{R}$ can be defined as:

$$\tilde{R} = \left\lfloor \tilde{r}_{ij} \right\rfloor_{\text{kxn}}, i = 1, 2...k; \quad j = 1, 2...n \tag{10}$$

Where

$$\tilde{r}_{ij} = \left(\frac{a_{ij}}{c_j^+}, \frac{b_{ij}}{c_j^+}, \frac{c_{ij}}{c_j^+} \right), \ and \ c_j^+ = \max\left\{ c_{ij} \right\} \ \text{(benifit indicator)} \tag{11}$$

$$\tilde{r}_{ij} = \left(\frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}} \right), \ and \ a_j^- = \min\left\{ a_{ij} \right\} \ \text{(cost indicator)} \tag{12}$$

Step 4. Calculate the normalized weighted fuzzy decision matrix

The weighted normalized matrix $\tilde{V} = [\tilde{v}_{ij}]$ is calculated by multiplying the average weights ($\tilde{w}_j$) of assessment indicators with the normalized fuzzy decision matrix $\tilde{r}_{ij}$.

$$\tilde{v}_{ij} = \tilde{r}_{ij} \times \tilde{w}_j \tag{13}$$

Step 5. The fuzzy positive-ideal solution (FPIS, S^+) and fuzzy negative-ideal solution (FNIS, S^-) can be represented as

$$S^+ = (\tilde{v}_1^+, \tilde{v}_2^+, .., \tilde{v}_n^+), \ \text{where} \ \tilde{v}_j^+ = \max_i \{v_{ij3}\}, \ i = 1,2,.,k; \ j = 1,2,.,n \tag{14}$$

$$S^- = (\tilde{v}_1^-, \tilde{v}_2^-, .., \tilde{v}_n^-), \ \text{where} \ \tilde{v}_j^- = \min_i \{v_{ij1}\}, \ i = 1,2,.,k; \ j = 1,2,.,n \tag{15}$$

Step 6: The distance of each good practice from the positive and negative ideal solution S^+, S^- can use formulas

$$D_i^+ = \sum_{j=1}^{n} d_v(\tilde{v}_{ij}\tilde{v}_j^+), \ \ i = 1,2...k \tag{16}$$

$$D_i^- = \sum_{j=1}^{n} d_v(\tilde{v}_{ij}\tilde{v}_j^-), \ \ i = 1,2...k \tag{17}$$

Where $d_v(\tilde{P},\tilde{Q})$ is the distance measurement between two fuzzy numbers $\tilde{P},\tilde{Q}$.

Step 7. Calculate relative closeness coefficient (CC_i^*) of each good practice

$$CC_i^* = \frac{D_i^-}{(D_i^+ + D_i^-)}, \ \ i = 1,2,.....,k \tag{18}$$

Step 8. Rank the good practices

As CC_i^* approaches 1, good practice Pi is closer to the FPIS (S^+) and farther away

from FNIS (S^-). We can identify the ranking order of all good practices and choose the most impactful good practice based on the descending order of CC_i^* .

5.4 Implementation of the study

The main goal of this study in this chapter is to provide a consistent performance measuring model that will help the fresh food CSC participants determine the good practices that have been successfully implemented in developed countries to improve the overall sustainability performance of the fresh food CSC. We have conducted semi-structured interviews with domain and academic experts to collect data. The domain experts were selected from the fresh food retail industry and logistics partners located in Guangzhou, Shenzhen, Shanghai, Beijing, China. And the academic experts were selected from the CSC industry, food industries, and management engineering in the southern region of China. The experts have been contacted through personal meetings. A hierarchy-based sustainability performance measurement model for fresh food CSC was constructed and assessed using the hybrid AHP-fuzzy TOPSIS method (as shown in Figure 12) after choosing the good practices for improving fresh food CSC sustainability performance and determining the indicators for fresh food CSC sustainability performance evaluation. The implementation of the study was divided into two phases, as follows.

5.4.1 Phase 1

In this phase, we first designed a questionnaire that used to ask participants to rate the severity of the indicators and sub-indicators on a scale of 1-9 (as shown in Table 11). After data collection, we use AHP method to identify the priority weights for indicators and sub-indicators relative to their respective indicators, as mentioned in Section 5.3.2. The designed questionnaire one was sent to 50 experts, and 30 replies were obtained, representing a 60 percent response rate. Two replies were deleted during

the relevance check of the received responses owing to missing information. As a result, the severity weights of the indicators and sub-indicators were analyzed using 28 pertinent responses. The Ms for the questionnaires shows in Table 14. Table 15 provides a pairwise comparison matrix between indicators and their computed priority weights for one of the Ms, while Table 16, Table 17, and Table 18 provide the matrices for pairwise comparison for sub-indicators of indicators for one of the Ms, respectively.

Likewise, the priority weights for other sub-indicators relative to their respective indicators are computed.

To check the consistency of pairwise comparisons between indicators and sub-indicators, a consistency test was performed. To test the consistency, the consistency ratio (CR) was computed for each pairwise comparison using formulas (4)-(6) and table 12. According to Saaty (1980), if the value of CR is less than 0.1, then weights for indicators and sub-indicators are consistent and acceptable for a provided pairwise comparison matrix. A value of CR ≤ 0.1 is known as Saaty's upper bound for the consistency of a given pairwise comparison matrix. The results of the consistency check for one of the Ms are shown in Table 19.

Likewise, consistency checks for other Ms are also tested. The CR results of all pairwise comparison matrices are less than 0.1, which shows that the pairwise comparisons of indicators and sub-indicators are consistent, and the priority weights are acceptable. The average priority weight for each indicator and sub-indicator was calculated using the formula (3) for all Ms' opinions. Compute the average global weights to identify the best representation of priority weights of sub-indicators relative to their respective indicators. The average global weight of sub-indicators is acquired by multiplying the average sub-indicators priority weight by the average priority weight of the respective indicators, as shown in Table 10.

Table 14. Questionnaire sections and respondents

Questionnaire sections	Title of the section	Examples of respondents	No. of respondents
I	Sustainability Performance Indicators Evaluation of Fresh Food Cold Supply Chain	CSC logistics manager	13
		Retailer	3
		Management engineering academic experts	1
		CSC academic experts	8
		SC academic experts	3
		Food engineering academic experts	2
TOTAL			30
II	Influence of company's Good Practice on Sustainability Performance of Fresh Food Cold Supply Chain	Cold storage officers	4
		CSC logistics manager	5
		Retailer	3
		CSC academic experts	3
TOTAL			15

Table 15. Calculation of priority weighs of indicators for M1

Indicators	So	En	Ec	Priority weightage
So	1	1	0.5	0.2611
En	1	1	1	0.3278
Ec	2	1	1	0.4111

Table 16. Calculation of priority weighs of sub-indicators So for M1

Indicators	So1	So2	So3	So4	So5	So6	Priority weightage
So1	1	1	9	1	7	1	0.2662
So2	1	1	7	0.5	7	1	0.2319
So3	0.1111	0.1429	1	0.5	1	2	0.0603
So4	1	2	2	1	3	1	0.2130
So5	0.1429	0.1429	1	0.3333	1	0.5	0.0551
So6	1	1	2	1	2	1	0.1735

Table 17. Calculation of priority weighs of sub-indicators En for M1

Indicators	En1	En2	En3	Priority weightage
En1	1	1	7	0.4761
En2	1	1	6	0.4523
En3	0.1429	0.16671	1	0.0717

Table 18. Calculation of priority weighs of sub-indicators Ec for M1

Indicators	Ec1	Ec1	Ec1	Ec4	Priority weightage
Ec1	1	1	1	1	0.2374
Ec2	1	1	0.3333	2	0.2106
Ec3	1	3	1	3	0.3998
Ec4	1	0.5	0.3333	1	0.1522

Table 19. The results for consistency check for M1

Test for (indicators and sub-indicators)	λ_{max}	*C.I.*	*R.I.*	*C.R.*
For pairwise comparison between indicators	3.0537	0.02685	0.58	0.0463
For pairwise comparison between sub-indicators of social indicator	6.5115	0.1023	1.24	0.0825
For pairwise comparison between sub-indicators of environmental indicator	3.0026	0.0013	0.58	0.0022
For pairwise comparison between sub-indicators of economic indicator	4.2153	0.07177	0.90	0.0797

Table 20. Calculation of average priority weights and average global weights for all Ms

Indicators	Average eigen value	Sub-indicators	Average weight of sub-indicators	Average global weight
		So1	0.3098	0.084
		So2	0.1183	0.032
		So3	0.1165	0.031
So	0.2707	So4	0.2103	0.057
		So5	0.1406	0.038
		So6	0.1045	0.028
		En1	0.4088	0.134
En	0.3275	En2	0.3601	0.118
		En3	0.2311	0.076
		Ec1	0.2978	0.120
		Ec2	0.2096	0.084
Ec	0.4081	Ec3	0.3029	0.122
		Ec4	0.1897	0.076

5.4.2 Phase 2

The average priority weights for each indicator and sub-indicator obtained in the first phase were used as input to the fuzzy TOPSIS method together with the questionnaire II to gain the good practices ranking. To acquire the relative importance of the good practices concerning to sub-indicators, the designed questionnaire 2 was sent to 15 experts, and 15 replies were obtained. 1 reply was deleted owing to missing information. As a result, the relative closeness coefficient (CC_i^*) was analyzed using 14 pertinent responses (see Table 14). The Ms were asked about the importance of good practices relative to each sub-indicator. As shown in Table 14, we used a five-point scale to gather the linguistic opinions on relative importance of good practice from Ms. There are only two Ms' opinions summarized in Table 21 due to space constraints. Follow the fuzzy TOPSIS approach provided in Section 5.3.3 to compute the CC_i^*.

Table 21. Evaluation of good practices on each sub-indicator by two Ms

Sub-indicators	Good practices															
	P1		P2		P3		P4		P5		P6		P7		P8	
	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2
So1	G	G	G	G	F	F	F	G	F	G	F	G	F	VG	G	P
So2	F	G	F	F	F	G	F	G	F	G	F	F	F	VG	F	P
So3	G	G	G	F	G	G	G	G	G	G	G	G	G	G	G	P
So4	G	VG	G	G	G	G	G	G	G	G	G	G	G	G	G	P
So5	G	VG	G	G	G	F	G	F	G	F	G	VG	G	G	G	P
So6	F	F	F	F	F	F	F	G	F	G	F	F	F	F	F	P
En1	G	G	G	VG	G	G	G	G	G	VG	G	G	G	VG	F	F
En2	VG	G	VG	VG	VG	G	VG	G	VG	G	VG	G	VG	VG	G	F
En3	VG	G	VG	G	VG	F	VG	G	VG	G	VG	F	VG	G	VG	F
Ec1	G	VG	G	G	F	G	G	G	G	G	G	G	G	VG	G	F
Ec2	G	VG	G	G	F	VG	F	G	F	G	G	G	G	G	G	F
Ec3	VG	VG	G	G	F	G	F	G	G	G	VG	F	VG	G	G	P
Ec4	VG	VG	G	G	F	F	F	G	G	F	VG	F	VG	G	G	P

Before using formulas (8) and (9) to form combined or aggregated fuzzy decision matrices (see Table 22), we first replace the linguistic opinions obtained from Ms with corresponding triangular fuzzy numbers. The aggregated fuzzy decision matrix shows the overall relative strength of each group' good practice associated with each sub-indicator. Then, use formulas (10)-(12) to compute the normalized fuzzy decision matrix. By eliminating heterogeneity from the aggregated fuzzy decision matrix, a dimensionless unit that offers a ranking for good practices is created.

Table 22. Combined fuzzy decision matrix for good practices

Sub-indicators	Good practices							
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**
So1	3,7.571,9	5,7.714,9	1,5,9	1,6.714,9	1,6.286,9	3,7.429,9	3,6.533,9	1,5.286,9
So2	3,6.429,9	1,5.857,9	1,5.571,9	1,5.857,9	1,5.857,9	3,5.857,9	1,6.286,9	1,6.143,9
So3	3,7,9	1,6.429,9	1,5.714,9	1,5.857,9	1,5.571,9	3,6.857,9	1,6,9	1,5,9
So4	3,6.857,9	3,6.429,9	1,5.143,9	1,5.571,9	1,6.143,9	3,7.143,9	3,7.143,9	1,5.571,9
So5	1,6.143,9	3,6.143,9	1,5.143,9	1,5.714,9	1,6,9	5,8.286,9	1,6.429,9	1,4.286,9
So6	1,6.286,9	3,6.429,9	3.6.714,9	3,7,9	3,7.286,9	3,6.714,9	1,5.429,9	1,5.143,9
En1	1,6.143,9	3,6.429,9	5,8.143,9	3,7.429,9	5,7.571,9	1,6,9	1,6.143,9	1,6.429,9
En2	1,6.429,9	3,6.429,9	5,8.286,9	3,7.429,9	3,7.286,9	1,6.286,9	1,6.429,9	1,6.143,9
En3	1,6.143,9	1,5.143,9	1.4.571,9	3,6.857,9	1,6.143,9	3,6.429,9	1,6.429,9	1,5.571,9
Ec1	3,7.429,9	3,7.714,9	1,4.571,9	1,6.429,9	1,6.429,9	3,7.429,9	3,7.429,9	1,7.571,9
Ec2	3,7.571,9	1,7,9	1,7,9	3,6.714,9	1,5.286,9	5,7.286,9	1,5.286,9	1,5,9
Ec3	3,7.714,9	3,6.714,9	1,6.571,9	3,6.571,9	1,5.429,9	3,7,9	1,5.714,9	1,4.286,9
Ec4	3,7.429,9	3,7.286,9	1,4.143,9	1,5.714,9	1,6.143,9	3,7,9	1,5.143,9	1,4.429,9

Then, use the formula (13) to form a weighted normalized fuzzy decision matrix (as shown in Table 23). And use formulas (14) and (15) to calculate the FPIS (S^{+}) and FNIS (S^{-}) for the good practices relative to each sub-indicator (as shown in Table 24). The primary purpose of this study in this chapter effort is to prioritize the determining indicators and provide the most impactful good practice closet to FPIS and farthest away from FNIS.

Table 23. Weighted normalized fuzzy decision matrix

Sub-indicators	Good practices							
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**
So1	0.028,0.071,0.084	0.047,0.072,0.084	0.009,0.047,0.084	0.009,0.063,0.084	0.009,0.059,0.084	0.028,0.069,0.084	0.028,0.061,0.084	0.009,0.049,0.084
So2	0.011,0.023,0.032	0.004,0.021,0.032	0.004,0.02,0.032	0.004,0.021,0.032	0.004,0.021,0.032	0.011,0.021,0.032	0.004,0.022,0.032	0.004,0.022,0.032
So3	0.010,0.024,0.031	0.003,0.022,0.031	0.003,0.02,0.031	0.003,0.020,0.031	0.003,0.019,0.031	0.010,0.024,0.031	0.003,0.021,0.031	0.003,0.017,0.031
So4	0.019,0.043,0.057	0.019,0.041,0.057	0.006,0.033,0.057	0.006,0.035,0.057	0.006,0.039,0.057	0.019,0.045,0.057	0.019,0.045,0.057	0.006,0.035,0.057
So5	0.004,0.026,0.038	0.013,0.026,0.038	0.004,0.022,0.038	0.004,0.024,0.038	0.004,0.025,0.038	0.021,0.035,0.038	0.004,0.027,0.038	0.004,0.018,0.038
So6	0.003,0.020,0.028	0.009,0.020,0.028	0.009,0.021,0.028	0.009,0.022,0.028	0.009,0.023.0.028	0.009,0.021,0.028	0.003,0.017,0.028	0.003,0.016,0.028
En1	0.015,0.091,0.134	0.045,0.096,0.134	0.074,0.121,0.134	0.045,0.111,0.134	0.074,0.113,0.134	0.015,0.089,0.134	0.015,0.091,0.134	0.015,0.096,0.134
En2	0.013,0.084,0.118	0.039,0.084,0.118	0.066,0.109,0.118	0.039,0.097,0.118	0.039,0.096,0.118	0.013,0.082,0.118	0.013,0.084,0.118	0.013,0.081,0.118
En3	0.008,0.052,0.076	0.008,0.043,0.076	0.008,0.039,0.076	0.025,0.058,0.076	0.008,0.052,0.076	0.025,0.054,0.076	0.008,0.054,0.076	0.008,0.047,0.076
Ec1	0.04,0.099,0.12	0.040,0.103,0.12	0.013,0.061,0.12	0.013,0.086,0.120	0.013,0.086,0.120	0.040,0.099,0.120	0.040,0.099,0.120	0.013,0.101,0.120
Ec2	0.028,0.071,0.084	0.009,0.065,0.084	0.009,0.065,0.084	0.028,0.063,0.084	0.009,0.049,0.084	0.047,0.068,0.084	0.009,0.049,0.084	0.009,0.047,0.084
Ec3	0.041,0.105,0.122	0.041,0.091,0.122	0.014,0.089,0.122	0.041,0.089,0.122	0.014,0.074,0.122	0.041,0.095,0.122	0.014,0.077,0.122	0.014,0.058,0.122
Ec4	0.025,0.063,0.076	0.025,0.062,0.076	0.008,0.035,0.076	0.008,0.048,0.076	0.008,0.052,0.076	0.025,0.059,0.076	0.008,0.043,0.076	0.008,0.037,0.076

Thus, the distance of each good practice from the FPIS and FNIS is necessary to be determined in order to have a clear estimate of the good practice for the issue that fulfilled the requirements of most indicator and sub-indicator. We used formulas (16) and (17) to compute the distance of each good practice from the FPIS and FNIS. For example, compute the distance of P1 relative to its sub-indicators and aggregate the distance for P1 (D_1^+) will be the sum of all distance of P1 associated with each sub-indicator. Similarly, the distance for other good practices is computed in the same way

(as shown in Table 25).

Table 24. Summary of FPIS and FNIS for the practices to each sub-indicator

Sub-indicators	FPIS(A^+)	FPIS(A^-)
So1	0.047,0.072,0.084	0.009,0.047,0.084
So2	0.011,0.023,0.032	0.004,0.02,0.032
So3	0.01,0.024,0.031	0.003,0.017,0.031
So4	0.019,0.045,0.057	0.006,0.033,0.057
So5	0.021,0.035,0.038	0.004,0.018,0.038
So6	0.009,0.023,0.028	0.003,0.016,0.028
En1	0.074,0.121,0.134	0.015,0.089,0.134
En2	0.066,0.109,0.118	0.013,0.081,0.118
En3	0.025,0.058,0.076	0.008,0.039,0.076
Ec1	0.04,0.103,0.12	0.013,0.061,0.12
Ec2	0.047,0.071,0.084	0.009,0.047,0.084
Ec3	0.041,0.105,0.122	0.014,0.058,0.122
Ec4	0.025,0.063,0.076	0.008,0.035,0.076

Since the ranking of good practices depends on the CC_i^*, the CC_i^* of good practice has been calculated by formula (18) (as shown in Table 26).

Table 25. Calculations of according to formulas (16) and (17)

Sub-indicators	Good practices															
	P1		P2		P3		P4		P5		P6		P7		P8	
	d_1^+	d_1^-	d_2^+	d_2^-	d_3^+	d_3^-	d_4^+	d_4^-	d_5^+	d_5^-	d_6^+	d_6^-	d_7^+	d_7^-	d_8^+	d_8^-
So1	0.01098	0.01767	0.00000	0.02626	0.02626	0.00000	0.02255	0.00924	0.02319	0.00693	0.01111	0.01678	0.01268	0.01363	0.02565	0.00115
So2	0.00000	0.0044	0.0042	0.00058	0.0044	0.00000	0.0042	0.00058	0.0042	0.00058	0.00115	0.00408	0.00408	0.00115	0.00408	0.00115
So3	0.00000	0.00572	0.0042	0.00289	0.00465	0.00173	0.00465	0.00173	0.00497	0.00115	0.00000	0.00572	0.0044	0.00231	0.00572	0.00000
So4	0.00115	0.00947	0.00231	0.00881	0.01021	0.00000	0.00947	0.00115	0.00827	0.00346	0.00000	0.01021	0.00000	0.01021	0.00947	0.00115
So5	0.01111	0.00462	0.00695	0.00695	0.01236	0.00231	0.01169	0.00346	0.01139	0.00404	0.00000	0.01388	0.01085	0.0052	0.01388	0.00000
So6	0.00387	0.00231	0.00173	0.00416	0.00115	0.00451	0.00058	0.0049	0.00000	0.00532	0.00115	0.00451	0.0049	0.00058	0.00532	0.00000
En1	0.03821	0.00115	0.02211	0.01779	0.00000	0.03875	0.01771	0.02148	0.00462	0.03677	0.03875	0.00000	0.03821	0.00115	0.037	0.00404
En2	0.03383	0.00173	0.02124	0.01511	0.00000	0.03461	0.01706	0.01763	0.0173	0.01733	0.03434	0.00058	0.03383	0.00173	0.03461	0.00000
En3	0.01041	0.00751	0.01309	0.00231	0.01472	0.00000	0.00000	0.01472	0.01041	0.00751	0.00231	0.01309	0.01008	0.00866	0.01169	0.00462
Ec1	0.00231	0.02691	0.00000	0.02883	0.02883	0.00000	0.01842	0.01443	0.01842	0.01443	0.00231	0.02691	0.00231	0.02691	0.01563	0.02309
Ec2	0.01097	0.01767	0.02221	0.01039	0.02221	0.01039	0.0119	0.01434	0.02535	0.00115	0.00173	0.02507	0.02535	0.00115	0.02595	0.00000
Ec3	0.00000	0.03129	0.00808	0.02462	0.01812	0.0179	0.00924	0.02373	0.02373	0.00924	0.00577	0.02644	0.02246	0.01097	0.03129	0.00000
Ec4	0.00000	0.01891	0.00058	0.01842	0.01891	0.00000	0.01309	0.00751	0.01169	0.00981	0.00231	0.01698	0.01515	0.00462	0.01794	0.00115
D_i^+	0.12284		0.10670		0.16182		0.14056		0.16354		0.10093		0.18430		0.23823	
D_i^-	0.14936		0.16712		0.11020		0.13490		0.11772		0.16425		0.08827		0.03635	

Table 26. Calculations of according to formulas (18)

Good practices	CC_i^*
P1 (Application of IT systems (ERP, WMS, MRP, and TMS) in fresh food CSC)	0.54871
P2 (Application of RFID and WSNs for monitoring the storage temperature of fresh food)	0.61033
P3 (Adoption of Solar photovoltaic systems in the warehouse)	0.40512
P4 (Eco-design)	0.48973
P5 (Application of Environmental management system for monitoring the environmental impact)	0.41855
P6 (Employee training)	0.61939
P7 (Offering some courses to raise consumers' awareness about the quality dimensions of fresh food)	0.32384
P8 (Surplus fresh food donations)	0.13238

5.4.3 Results

From Table 17, it is obvious that the good practice P6 has the highest CC_i^*, and the good practice P8 is the least. The ranking order of eight good practices according to the sustainability performance is P6>P2> P1> P4 > P5> P3> P7> P8.

Hence, we can conclude that good practice P6 has the most impact on the sustainability performance of fresh food CSC according to the opinion of the experts. We have just presented the result of an analysis of good practices given a condition where takes into account all sustainability indicators. In the next section, we examine several conditions to determine the sensitivity of good practices when the dimension of sustainability performance is altered.

5.4.4 Sensitivity analysis

The goal of a sensitivity analysis is to see how the outcomes change when the sustainability performance dimension change as more researchers focusses on environmental and economic aspects and less on the social aspect. This investigation is important when there is uncertainty in the definition of the materiality of different aspects. Table 27 shows the specifics of six additional conditions, and Figure 13 is a graphical illustration of these findings. For instance, condition 1 only takes social indicators (So1, So2, So3, So4, So5, So6) into consideration.

According to the sensitivity analysis test, it is obvious that in 3 of 6 conditions, the

good practice P6 (Employee training) reached the highest CC_i^* value and hence ranked first. In 2 conditions and 1 condition, practice P2 (Application of RFID and WSNs for monitoring the status (temperature, humidity, storage time, etc.) of fresh food) gains the highest and the second-highest CC_i^* value respectively and therefore ranked second. In 2 conditions and 1 condition, practice P1 (Application of IT systems (ERP, WMS, MRP, and TMS) in fresh food CSC) attains the second-highest and third-highest CC_i^* value respectively and hence ranked third. In 1 condition, 1 condition, and 3 conditions, practice P4 (Eco-design) attains the second, third-highest, and fourth-highest CC_i^* value, respectively, and hence ranked fourth. To justify the minimum ranking of good practices, the tests showed that under 6 conditions, good practice P8 (Surplus fresh food donations) attains the least rank. During the sensitivity analysis, good practice P7 (Offering some courses to raise consumers' awareness about the quality dimensions of fresh food) has the highest incidence in the seventh position, and hence it ranked as seven; the occurrence of the sixth rank for the good practice P3 (Adoption of Solar photovoltaic systems in the warehouse) is maximums, and therefore it ranked as six.

Table 27. Summary of sensitivity analysis

Condition	**Sub indicators**	**Practices ranking (Respectively)**
Initial condition	So1, So2, So3, So4, So5, So6, En1, En2, En3, Ec1, Ec2, Ec3, Ec4	P6, P2, P1, P4, P5, P3, P7, P8
Condition 1	So1, So2, So3, So4, So5, So6	P6, P2, P1, P7, P5, P4, P3, P8
Condition 2	En1, En2, En3	P3, P5, P4, P2, P6, P7, P1, P8
Condition 3	Ec1, Ec2, Ec3, Ec4	P6, P1, P2, P4, P7, P5, P3, P8
Condition 4	So1, So2, So3, So4, So5, So6, En1, En2, En3	P2, P3, P5, P4, P6, P1, P7, P8
Condition 5	So1, So2, So3, So4, So5, So6, Ec1, Ec2, Ec3, Ec4	P6, P1, P2, P4, P7, P5, P3, P8
Condition 6	En1, En2, En3, Ec1, Ec2, Ec3, Ec4	P2, P4, P6, P1, P3, P5, P7, P8

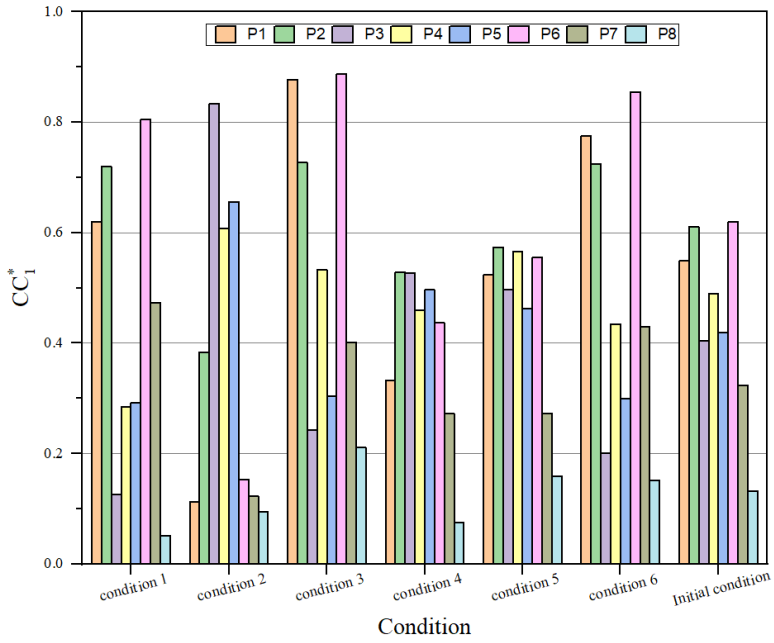

Figure 13. Results of sensitivity analysis

The ranking order attained from the study work is formed as P6>P2>P1>P4>P5>P3>P7>P8. Hence, the outcomes of the sensitivity analysis strongly support for the findings attained from the proposed method. Therefore, arguably, the present study provides a precise rank order of suggested good practices to improve the sustainability performance of fresh food CSC.

5.5 Conclusions

5.5.1 Discussion of the results

An in-depth review of prior study works linked to the sustainable fresh food CSC was undertaken in the initial stage of the study work, as well as brainstorming meetings with experts. On the basis of the literature analysis and the opinions of experts, the three most essential indicators and 13 sub-indicators for fresh food CSC sustainability performance evaluation were selected. To address the influence of the indicators and improve sustainability performance, the study work offered eight good practices. The good practices were chosen based on a case study of an Italian market-leading company and an extensive analysis of previous studies. After that, we developed a hierarchical

model (shown in Figure 12) to show the interrelationship among the indicators, sub-indicators, and good practices. AHP was utilized to identify the relative priority weight for each indicator and sub-indicator. AHP was utilized to determine the relative weights of the indicators and sub-indicators. To check the consistency of the pairwise comparisons, a consistency test was performed for each pairwise comparison.

Table 19 shows that the values of consistency ratio (*CR*) for all the pairwise comparisons are less than Saaty's upper limit, which is 0.1. As a result, the comparison matrices are consistent and hence the priority weights of indicators and sub-indicators were accepted.

Table 20 illustrates a summary of the average priority weights of the considered indicators. It can be seen that the indicator Ec (Economic benefits) with an eigenvalue of 0.4018 has the greatest average priority weight and is the most valued indicator for measuring the sustainability performance of fresh food CSCs, while So (Social welfare) gets the smallest eigenvalue of 0.2707, which is currently the least valued indicator in measuring the sustainability performance of fresh food CSCs. Therefore, in order to improve the fresh food CSC sustainability performance, the indicator Ec is the most important indicator, and the economic sustainability performance of fresh food CSC should be prioritized. Generally, economic benefits consider cost and profit indicators (Ahmad, Wong, and Rajoo, 2019). However, as we all know, one of the characteristics of the CSC is high cost and low-profit margins, which makes discourage related companies from investing in high-cost CSC infrastructure, which may further diminish company profits or even lead to going bankrupt (Han et al., 2021). Lindberg et al. (2020) have demonstrated that reducing refrigeration operation costs (i.e., electricity, refrigeration infrastructure input) is a challenging technical issue for retailers that has a direct impact on their economic returns. Hence, the decision-makers and fresh food

CSC management must take these indicators into consideration at first so that the operation cost of fresh food CSC in its various stages can be diminished.

Following the economic benefits, the indicator En (Environmental impact) is the second most important indicator to measure the sustainability performance of fresh food CSCs. Hence, after emphasizing the indicator "economic benefit", the "environmental impact" of sustainable fresh food CSC must be emphasized. The high energy consumption of fresh food CSC poses a serious challenge to sustainable development. CSC activities are projected to consume around 30% of global energy (Hu et al., 2019; Ghorbani and Mehrpooya 2020; Shamayleh et al. 2019). As a result, minimizing unnecessary energy consumption at the entire stages of fresh food CSC can not only improve the overall economic benefits of fresh food CSC but also help decrease the use of fossil fuel, therefore mitigating some related environmental issues (especially in developing countries, coal-fired power plants in these countries provide the majority of electricity.) (Azmi et al., 2017). The policy-makers and managers of fresh food CSC have to concentrate on good practices that can improve fresh food quality and safety, reduce fresh food waste and losses, reduce energy consumption, carbon emission, and environmental impact to optimize overall sustainability performance. The least important indicator for sustainability performance of fresh food CSC is So (social welfare; having eigenvalue 0.2707). The sequence of priorities for indicators can be obtained as Ec>En>So (see Figure 14).

As can be seen from Table 20, for the indicator So, among the six sub-indicators related to So, the sub-indicator So1 (fresh food quality and safety) having an average global weight of 0.084 is regarded as the most critical indicator for measuring economic sustainability performance of fresh food CSCs. Similarly, for indicators En and Ec, the most important indicator for evaluating environmental and social sustainability

performance of fresh food CSCs is En1 (carbon emission reduction, 0.134) and Ec3 (increase in profit, 0.122), respectively.

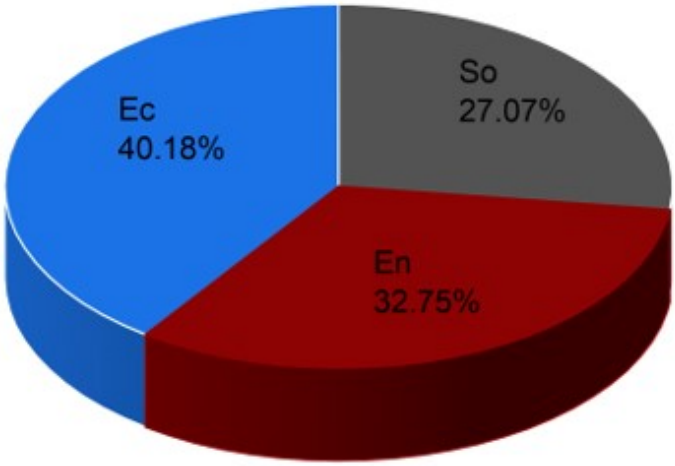

Figure 14. Pie chart for indicators average priority weights

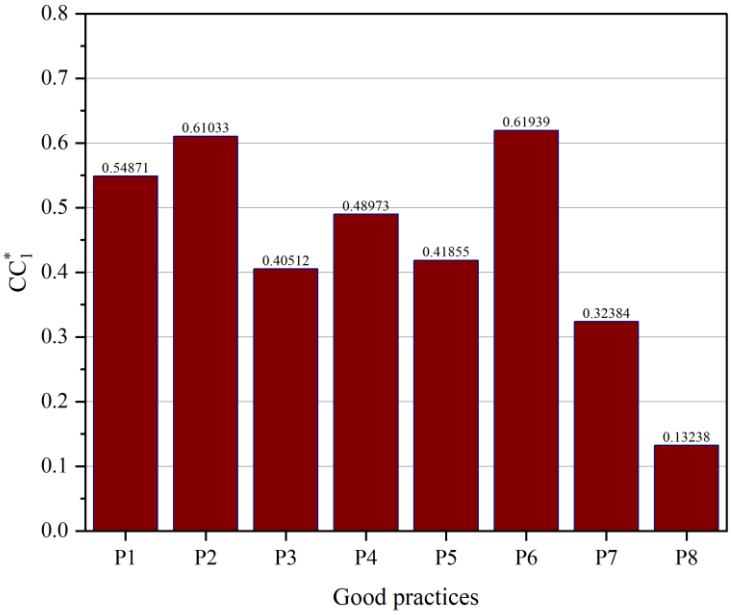

Figure 15. Bar diagram for relative closeness coefficients for practices

The TOPSIS technique was applied in a fuzzy environment to derive the preference order of the proposed good practices removing any ambiguity, imprecision or

uncertainty in the data. Calculate the relative CC_i^* for each good practice based on the algorithm of the Fuzzy-TOPSIS method described above (see Figure 14).

Based on the relative closeness of the good practices to improve the sustainability performance of fresh food CSC. The good practices ranking is provided. A good practice with the greatest relative closeness, given the highest rating, can be considered as the most impactful good practice for improving the sustainability performance of the fresh food CSC compared to other good practices. Conversely, if the rating or priority is the lowest, the relative closeness is minimum for this good practice, that is, this good practice can be considered to have less impact on improving the sustainability performance of the fresh food CSC compared to other good practices. From table 17 and Figure 15, it can be concluded that the good practice P6 "employee training" attained the highest relative closeness (CC_i^* =0.61939), hence given the highest rating and is considered as the most impactful good practice for improving the sustainability performance of the fresh food CSC compared to other good practices. In developing countries, one of factors hindering the sustainable development of fresh food CSC is the lack of expertise in fresh food CSC (Grigor et al., 2018). Since CSC handles a complicated series of activities in the fresh food industry, including harvesting, collecting, pre-cooling, packaging, processing, distribution, storage, and marketing (Katina, 2013). Furthermore, the fresh food CSC industry has evolved rapid evolution in terms of management procedures, technology-based operations, and customer expectations (Joshi and Joshi, 2016). These factors result in multiple ever-changing demands that necessitate more complicated professional abilities. In this case, adequate employee training at the operational level is critical. For example, training warehouse operators can not only reduce fresh food loss and waste by improving their professional processing skills but also successfully comply with strict environmental regulations by

helping them gain specialized knowledge.

From Figure 14, it is obvious that the Chinese value more economical performance. Good practice P6 "employee training" attained the highest relative closeness (CC_i^* =0.88728) under condition 3 (considering only economic indicators) over the other conditions (see Figure 16). According to the previous discussion and the findings of the sensitivity analysis, it is obvious that employee training can not only improves employees' professional skills in fresh food CSC processing, but also ensures the environmentally friendly emission from fresh food CSC with the highest profit. Hence, in order to improve sustainability performance, the decision-makers must focus on "employee training".

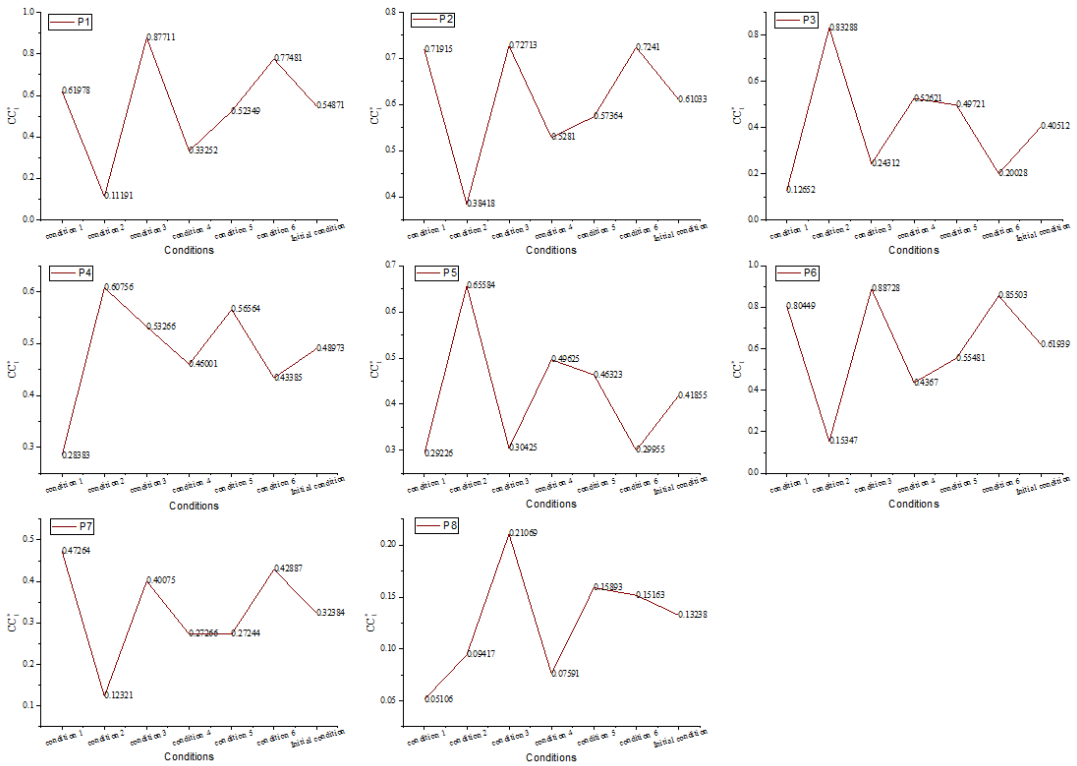

Figure 16. Results of sensitivity analysis for each practice under different conditions

Following by the good practice P6 "employee training," the good practice P2 "application of RFID and WSNs for monitoring the storage temperature of fresh food" comes out as the second-highest value of CC_i^* (0.61033), and hence ranks second and

is regarded the second-good practice for improving the sustainability performance of fresh food CSCs. In a fresh food CSC, real-time monitoring of fresh food status (such as temperature, humidity, time, and place) is a challenging task. Due to insufficient food monitoring and data tracking capabilities, a large amount of post-harvest fresh food is wasted in the circulation process, especially in developing countries where refrigeration facilities are scarce (Han et al., 2021). The application of RFID and WSNs in fresh food CSC allows decision-makers and management to track the status of the fresh food in real time, helping the company meet customer demands and ensure quality-oriented fresh food delivery. In addition, the application of RFID and WSNs in fresh food CSC can also reduce related risks, for example over procurement, risk of fresh food loss, and waste during transportation and storage. Moreover, it can also be seen from Figure 16 that the good practice P2 achieves the highest relative closeness coefficient (CC_i^* =0.72713) under condition 3 (considering only economic indicators) over the other conditions. Hence, in order to improve the sustainability performance of the fresh food CSC, "application of RFID and WSNs in fresh food CSC" can be regarded as the second most impactful good practice.

After analyzing the first two most impactful good practice P6 "employee training" and P2 "Application of RFID and WSNs for monitoring the status (temperature, humidity, storage time, etc.) of fresh food", the other good practices P1 (application of IT systems (ERP, WMS, MRP, and TMS) in fresh food CSC), P3 (adoption of Solar photovoltaic systems in the warehouse), P4 (eco-design), P5 (application of Environmental management system for monitoring the environmental impact), P7 (offering some courses to raise consumers' awareness about the quality dimensions of fresh food), P8 (Surplus fresh food donations) have CC_i^* 0.54871, 0.40512, 0.48973, 0.41855, 0.32384, and 0.13238 respectively. Hence, the other good practices, P1, P3,

P4, P5, P7, and P8, are provided rank 3, 6, 4, 5, 7, and 8, respectively. The good practices ranking can be obtained as P6>P2> P1> P4 > P5> P3> P7> P8.

Sensitivity analysis tests were performed to assess the sensitivity of the findings as obtained from the proposed method. From Figure 16, it can be seen that P1, P2, P6, and P8 attain the maximum relative CC_i^* under condition 3 (considering only economic indicators) over the other conditions, that is, P1, P2, P6, and P8 have a greater influence on improving economic performance than on improving social and environmental performance. With no doubt that P3, P4, P5 attain the maximum relative CC_i^* under condition 2 (considering only environmental indicators) over the other conditions. P3, P4, and P5 have a greater influence on improving environmental performance than on improving social and economic performance. P7 attains the maximum relative CC_i^* under condition 1 (considering only social indicators) the other conditions, that is, P7 has a more significant influence on improving social performance than on improving environmental and economic performance. Table 27 and Figure 13 show that for good practice P6, the height of the bar displaying the value of the CC_i^* is maximum. Meanwhile, the bar heights for good practice P1 are the lowest and almost constant in most of the conditions, which justified the results of the study work. Hence, the findings of the present study are robust and may be used by fresh food CSC industry to improve its sustainability performance.

On the other hand, these results can contribute confirmation and supplementary evidence for Proposition 2 (in Chapter IV), that is, in the stage when China is more concerned about economic performance, all three Chinese companies implement P1, P2, and P6, but rarely implement the good practices for improving environmental performance (only implement one environmental performance improvement good practice (P3) has been implemented in case R2 and case R4).

5.5.2 Managerial implications and future research

The major contribution of the presented study was to develop a sustainability performance assessment model for fresh food CSC and to explore what good practices can improve the sustainability performance of the fresh food CSC. An attempt was made to explore the impact of good practices on sustainability performance indicators of fresh food CSC and identify the priority weights among them. Good employee training practice (P6) plays a critical role in improving the sustainability performance of the fresh food CSC of a company, while the good practice of surplus fresh food donations (P8) has the most negligible impact on improving the sustainability performance of fresh food CSC. That is, to improve a company's sustainability performance of fresh food CSC, people are the most critical factor.

The present study guides the decision-makers and the management of fresh food CSC in evaluating and analyzing the factors impact the sustainability performance of the fresh food CSC. In addition, according to the implementation of sustainability performance measurement, organizations can determine and prioritize good practices to improve the sustainability performance which could result in economic improvement and reduce the negative impact on environment and society. Furthermore, this study in this chapter can also assist policy-makers to have a better understanding of the current focus of sustainable fresh food CSC companies to develop targeted sustainability policies/laws.

As this is the first research to investigate the impact of good practices on the sustainability performance of fresh food CSC, it is important to use a quantitative approach to assess the sustainability performance of good practices implemented by Chinese companies. In order to help decision-makers and management of fresh food CSC have a better understanding of the benefit of implementing these good practices

in their companies. It is important to explore what good practices have been implemented by Chinese companies first so far, as well as the reasons for the implementation of the good practice

5.5.3 Limitations of the study

Although the sustainability performance indicators determined in the current research take into account the Chinese context, the sustainability performance assessment framework proposed in this study in this chapter might be applicable to other developing countries. The good practice and sustainability performance indicators determined were modeled from the subjective knowledge of domain experts, which might provide a challenge to the judge. Furthermore, for China, as one of the world's fastest growing economies, the sustainability performance of fresh food CSC that may seem to value more economical performance today might not be the most valued in the future. The emphasis on environmental performance is specifically true as the Chinese government actively promotes investment and innovation in low-carbon infrastructure and new energy usage. The results and implications of the AHP-Fuzzy TOPSIS method need to be validated in terms of organizational theory perspective, and further empirical research is needed. In addition, identifying good practices implemented by companies in developing countries through empirical study and exploring the reasons for the implementation of the good practices is another critical question that may become a new research trend in the future.

Chapter VI: Discussions and Conclusions

Once the third phase of this thesis has been concluded, it is time to summarize several findings obtained from the three phases and then explain their theoretical contributions and practical implications in the first two sections; describe limitations encountered in the third section, which were the; and finally, based on these limitations, future research opportunities are presented in the last section.

To advance the existing knowledge in the research stream on the implementation of the good practices in fresh food CSC (technology and management), and contributing to the debate on sustainable fresh food CSC, we conduct a systematic literature review. Then based on the findings of the literature review, we first determined five motivations for this research: 1) Despite the growing awareness of the importance of adopting sustainability in fresh food CSC, research on the sustainability of fresh food CSC is still at the nascent stage, fragmented; 2) Rigorous empirical research is needed to investigate the drivers/enablers of implementing good practices in sustainable fresh food CSC; 3) Rigorous empirical research is needed to explore the impact of good practices that have been successfully implemented in developed countries on sustainability performance in developing countries; 4) There is a scarcity of real-world case-studies related to the implementation of good practices in sustainable fresh food CSC; 5) Decision-makers lack empirical evidence to understand how companies successfully implement good practices and how those good practices affect sustainability performance.

With these research motivations, according to the objectives and gaps of knowledge identified by the preliminary exploration of the research field described in Chapter II, the following RQs were proposed and solved in this thesis:

- RQ1: What are the good practices available/ used in the sustainable fresh food CSC in developed countries?
- RQ2: What differences exist in the good practices available/ used in the sustainable fresh food CSC in a developing country? Why these differences, if any?
- RQ3: What are the impacts of the implementation of good practices in developed countries on the sustainability performance of developing countries?

In order to answer these three RQs, we divided our research into three phases. In the first phase, we first defined good practices, which are conceptualization groups or organized activities to improve the company's triple bottom line (TBL) performance (economic, social, and environmental), which can result in more environmentally friendly and ecologically responsible behaviors and lifestyles, according to the concepts of sustainable fresh food CSC and TBL. Then, we identified the eight good practices which an Italian market-leading company has successfully implemented through a systematic literature review, experts' interviews, and a case study. We also identified the sustainability performance indicators in this phase based on the systematic literature review and expert interviews.

In the second phase, based on the eight good practices identified in the first phase, we focused on exploring the differences and the reasons for sustainable fresh food CSC good practices implementation by companies in developing countries. In this phase, we adopted multiple case studies of 3 Chinese companies and 1 Italian market-leading company (as a reference case). The four cases were examined in aggregate to determine

the characteristics of different types of existing good practices implemented in the reference case (an Italian market-leading company) and three Chinese companies. Finally, based on the evidence we gathered from this phase; we developed four propositions to explain the reasons for companies implementing good practices in sustainable fresh food CSC.

In the last phase, based on the eight good practices and sustainability performance indicators identified in the first phase, we focused on exploring the impacts of the implementation of good practices in developed countries on the sustainability performance of developing countries. In this phase, we adopted a survey research method consisting of two stages, and a questionnaire was designed for each stage. We developed a hybrid AHP-Fuzzy TOSIS tool to analyze the data we collected from the survey research. The results we obtained at this phase not only provide a precise ranking order of proposed good practices for improving the sustainability performance of the fresh food CSC but also can contribute to confirming and adding evidence for why companies are implementing good practices.

That is, based on the AHP analysis, we know that the Chinese value more economic sustainability performance at least initially, and if some good practices have a greater impact on economic sustainability performance than the other two dimensions (environmental, and social), this could explain why some Chinese companies implement these good practices. For example, since we know that case R3 only implement good practice P1, P2, and P6, from Figure 16, it can be observed that these three good practices have a more significant impact on economic sustainability performance than the other two dimensions (environmental, social). That is, under this context (the Chinese value more economic sustainability performance at least initially), due to the higher operating costs of the fresh food CSC (Sharma, Abbas, and Siddiqui,

2021), in order to survive, R3 tends to implement more good practices oriented towards operational efficiency to improve its economic sustainability performance.

The following subsections present the theoretical contributions, practical implications, main limitations, and main future research directions of this thesis.

6.1 Theoretical contributions

The main scopes of this thesis were to explore what good practices have been successfully implemented in the sustainable fresh food CSCs by companies and what factors influence companies to implement good practices to improve the sustainability performance of the fresh food CSCs; first analyze the relevant literature in this domain from a theoretical and broad perspective, to then conduct empirical studies aimed to identify that 8 good practices (i.e. application of IT systems (ERP, WMS, MRP, and TMS) in fresh food CSC, application of RFID and WSNs for monitoring the status (temperature, humidity, storage time, etc.) of fresh food, adoption of solar photovoltaic systems in the warehouse, eco-design, application of environmental management system for monitoring the environmental impact, employee training, offering some courses to raise consumers' awareness about the quality dimensions of fresh food, surplus fresh food donations) have been successfully implemented by one Italian market-leading company and well these 8 good practices were implemented by three Chinese companies, and to explore that 5 factors (i.e. government regulation, customer's sustainability awareness, dependence, top management support, laws/policies support) influence the implementation of these 8 good practices in the sustainable fresh food CSC by these 4 companies, and finally to discuss that the impact of these 8 good practices on sustainability performance (i.e. economic benefit, social welfare, and environmental impact).

The findings obtained in this thesis fill previously identified research gaps in

Chapter II and extends existing knowledge in the sustainability and fresh food CSC field by:

- Exploring and providing a better understanding of the list of good practices that have been successfully implemented in the sustainable fresh food CSC.
- This thesis provides theoretical reasoning and empirical evidence for companies to implement good practices in sustainable fresh food CSCs.
- It reveals the mechanisms by which buyer-supplier dependence on their buyers influences the implementation of good practices for sustainable fresh food CSC, thereby enhancing existing knowledge of the impact of dependence on buyer-supplier relationships.
- It also reveals that government regulations play a key role in implementing good practices for sustainable fresh food CSC, improving existing knowledge on how to implement good practices in developing countries.
- This theoretical reasoning and empirical evidence are summed up through a set of propositional, explanatory theories that explain why China or other developing countries are not able to implement the good practices that have been successfully implemented by developed countries. For example, due to the high costs associated with implementing good practices, fresh food CSC companies will not proactively adopt these good practices without strict government regulation, even with laws/policies support (at least initially).
- It advances existing research on the antecedents of sustainable fresh food CSC in developing countries
- Providing insights into how the Chinese value the sustainability dimension. This thesis reveals that in the context of the current development of fresh food CSC in China, the Chinese value more economic benefits than the other two

dimensions of sustainability (environmental and social).

- Ranking good practices according to sustainability performance indicators and providing evidences of what should and should not be sustainable. Moreover, this thesis provides insights into which good practices are more likely to improve a company's sustainability performance. For instance, employee training is considered the most impactful good practice for improving sustainability performance (overall, including both economic, social and environmental).

Because of the theoretical nature of this thesis, relevant results were obtained, making significant contributions to the sustainability and fresh food CSC field of knowledge. Furthermore, the practical implications of this thesis are numerous due to its empirical focus, as described in the following section.

6.2 Managerial/practical implications

The findings of this thesis raise several practical implications for policymakers and corporate management who aim to get a better understanding of the factors that influence companies to achieve sustainable development in the fresh food CSC industry.

Firstly, this research enablers companies to develop sustainable strategies that address cost, ecological, and social issues for fresh food CSC firm decision-makers in developing countries (Govindan, 2018). That is, we suggest that companies classify good practices that have been successfully implemented by companies into different categories based on the objectives of good practices implementation when designing new sustainability strategies draw on the experience of companies that have successfully developed and implemented sustainability strategies (Matzembacher and Meira, 2018; Bravo, Moretto, and Caniato, 2021).

Secondly, this research forwards the theoretical basis of the fresh food CSC

expansion and provides suggestions for decision-makers and policy makers to support fresh food industry towards a sustainable fresh food CSC. In particular, we warn policy-makers to not only consider the formulation of sustainability policies, but also to take strict action to supervise companies' compliance with these issued polices (Darnall, 2003; Delmas and Toffel, 2004; Darnall et al., 2008b; Vo and Arato, 2020). Specifically, the government should also popularize and attach importance to environmental management systems certification (e.g., ISO 4001). Top management of retail companies should develop a code of conduct and establish a system to record past experience of implementing good practices to improve sustainability performance.

Thirdly, the government and industry decision-maker need to be aware that pressure from all stakeholders remains a fundamental factor in the implementation of environmental/social good practices in the sustainable fresh food CSC (Varsei et al, 2014). Hence, we suggest that raising awareness of sustainability among top management of companies, employees and customers are critical and urgent to help companies proactively comply with relevant sustainability policies. Specifically, we suggest that the sustainable development education of customers, employees and top management should be strengthen from various channel such as government, companies, or institutions.

Fourthly, we also suggest that retail companies establish long-term relationships with their suppliers to enhance the level of dependence with suppliers, thereby facilitating the implementation of inter-organizational good practices throughout the sustainable fresh food CSC (Wolf, 2011; Lee, 2015).

Fifthly, the present study guides the policy-makers and the management of fresh food CSC to assess and analyze the factors impacting the sustainability performance of fresh food CSC. Based on the implementation of sustainability performance evaluation,

organizations can determine and prioritize good practices for improving their sustainability performance which may lead to economic improvement and reduce the negative environmental and social impacts.

Finally, since implementation of these good practices across different industry sectors requires government' intervention (Krishnan et al., 2020), this study can help policy-makers to have a better understanding of the current focus of sustainable fresh food CSC companies to develop targeted sustainability policies/laws. For example, due to some of the eight good practices still suffer from higher costs (Toffaletti and Soldatos, 2010; Hong et al., 2011; Ghaani et al., 2016), that is, there are positive externalities in implementing these costly good practices, the governments can incentivize the implementation of environmental/social sustainability good practices in companies by providing them with economic incentives to reduce the cost of these good practices. Likewise, since there are significant positive externality existing in the implementation of these good practices in sustainable fresh food CSC by companies, it may risk the competitive in the market if these companies could not gain supports from the governments. Likewise, since there are significant positive externalities for firms to implement these high-cost good practices in sustainable fresh food CSC, if these companies are unable to obtain government support to implement these costly good practices, they may face the risk of a decline in market competitiveness, or worse, they may go bankrupt.

6.3 Main limitations and future research

Some limitations limiting the scope of this study were encountered during the development of this study, which must be acknowledged. Future research should consider these to determine the agenda for future research.

Firstly, the good practice and sustainability performance indicators determined

were modeled based on the domain experts' subjective knowledge, which might challenge the judge.

Secondly, this study considers only one Italian market-leading company as a reference case study and three Chinese cases in the sample. Hence, the generalizability of the findings is limited. Hence, large-scale surveys can be carried out in the future to empirically test and validate the propositions. Moreover, this study did not consider the impact of the stages of industrial development on the implementation of more good practices oriented towards operational efficiency by companies in developing countries. Future research could investigate at what stage industrial development companies in developing countries would begin implementing environmental/social good practices. In addition, it is clear that this study has provided evidence that government regulations play a key role in implementing good practices for sustainable fresh CSCs, but based on the evidence we gathered in this study, it is impossible to explain how government regulations affect the implementation of the practice in sustainable fresh food CSC. Therefore, future studies could explore how the implementation of good practices in sustainable fresh food CSC are affected by government regulations. Finally, since this study considers three Chinese cases with different target customers, we only consider the impact of government and customer pressure on implementing good practices. Although the target customers are different, competitive market pressure may also influence the implementation of good practices in sustainable fresh food CSC. Future research could investigate the impact of competitive market pressure on the implementation of good practices.

Thirdly, the results and implications of the AHP-Fuzzy TOPSIS method need to be validated from the organizational theory perspective, and further empirical investigations are needed. Furthermore, as this is the first research to explore the impact

of good practices on the sustainability performance of fresh food CSC, it is important to use a quantitative approach to assess the sustainability performance of good practices implemented by Chinese companies.

In addition to this, some difficulties were found during the data collection phase, including:

- Due to the coronavirus outbreak, it was difficult to contact more managers of the Italian market-leading company for interviews, so some difficulties were found in collecting factors affecting the implementation of good practices in the Italian market-leading company.
- In order to contact senior experts in this field in China, some difficulties were encountered in distributing and collecting questionnaires.

In all in, all these limitations have been overcome during the development of this thesis, but they are considered important because they constitute an important opportunity to investigate them in depth in further research.

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Appendix 1 - Interview protocol

Introduction	– Presentation of the research team, research motivations, and objectives – Confidentiality, research consent, and permission for recording
Interviewee general information	– Could you describe your role, responsibilities, and years of experience within the organization?
Company information	– Could you describe the company's history? – What is the size, turnover, and annual sales volume? – How is the company positioned in the retail market? – What is your company's market share? – How many stores does your company have? – How many employees does your company have? – Who are your main customers? – How much fresh food is wasted/lost each year? – Could you provide a description of the company's operations? – What are the main selling channels used by the company? – Does the company have a team to learn government regulations and laws relevant to your industry? – Does the company conduct real-time temperature monitoring of fresh food throughout the entire CSC network? – How are this fresh food positioned in the market in terms of price segment? – How important is it for the company to assure the fresh food quality and safety to final consumers? – How important is it for the company to improve the satisfaction of customer and employee? – How important is it for the company to improve the professional skills of employees? – How important is it for the company to raise consumers' awareness about the quality dimensions of fresh food?
Fresh food CSC characteristics	– Could you describe the company's fresh food cold supply chain network? – Who are your main fresh food suppliers and where are they located? – How to place orders with your suppliers?

	- What types of warehouses (Fruit and Vegetables WH, Cured Meat and Cheese WH, Freeze Goods WH) does your company has? Where are these warehouses? How big are these warehouses? - How much fresh food (fruits and vegetables) will be stored in the cold warehouse each cycle? - How long is fresh food (fruits and vegetables) stored in the cold warehouse? - What does your cold supply chain belong to? (Proprietary logistics, third-party logistics, fourth-party logistics, etc.) - How does the company handle fresh food that is about to expire? - How to deal with damaged (rotted, broken, expired) fresh food (fruits and vegetables)? (Such as, landfill, return or incineration)
Good practices implementation in the sustainable fresh food CSC	- What is the sustainability strategy of the company? - When did your company start voluntarily developing a sustainability strategy? - On which good practices are implemented? - What are the expected results? - Could you describe the implementation process, the processes involved, the required changes in the current activities, roles, responsibilities, etc.? - What costs has the company incurred to implement and maintain the good practices? - How long did it take to implement the good practices?
Factors affecting the implementation of good practices	- How important is obtaining laws/polices support for company to implement good practices? - Will your company be penalized for not complying with relevant environmental protection laws/policies? - Are your customers demanding sustainable products? - Dose your company have long-term relationships with suppliers and how? - Does top management support the company to implement these good practices?
Personal questions	- Do you have any other remarks or questions? - Could you provide us additional documentation related to the project?

Appendix 2 - Measurement scales of the sustainability performance indicators

Indicators-Triple bottom line performance indicator

Please rank the importance of the following evaluation indicators in the sustainability performance. (Nine-point scale: 1=equally important; 3=Weakly important; 5= Strongly important; 7=Very strongly important; 9=Absolutely more important; 2,4,6,8= Intermediate importance between two adjacent judgments)

- Environmental impact
- Social welfare
- Economic benefit

Sub-indicators-Social welfare

Please rank the importance of the following evaluation indicators in the social sustainability performance. (Nine-point scale: 1=equally important; 3=Weakly important; 5= Strongly important; 7=Very strongly important; 9=Absolutely more important; 2,4,6,8= Intermediate importance between two adjacent judgments)

- Fresh food quality and safety
- Increase in support for the communities
- Increase in stakeholder satisfaction
- Increase in customer satisfaction
- Enhance employees' professional skills
- ISO 4001 certification

Sub-indicators-Environmental impact

Please rank the importance of the following evaluation indicators in the environmental sustainability performance. (Nine-point scale: 1=equally important; 3=Weakly important; 5= Strongly important; 7=Very strongly important; 9=Absolutely more important; 2,4,6,8= Intermediate importance between two adjacent judgments)

- Carbon emission reduction
- Energy consumption reduction
- Weight of the packaging materials used reduction

Sub-indicators-Economic benefit

Please rank the importance of the following evaluation indicators in the economic sustainability performance. (Nine-point scale: 1=equally important; 3=Weakly important; 5= Strongly important; 7=Very strongly important; 9=Absolutely more important; 2,4,6,8= Intermediate importance between two adjacent judgments)

- Fresh food waste reduction
- Decrease in operational cost of fresh food cold supply chain
- Profit
- Decrease in fine for quality of fresh food

Appendix 3 - Measurement scales of the influence of company's good practice on sustainability performance

Social sustainability performance

Please rate each of the following good practices in improving social sustainability performance. (Five-point scale: 1=Very poor; 2=Poor; 3= Fair; 4=Good; 5=Very good)

	Fresh food quality and safety	Increase in support for the communities	Increase in stakeholder satisfaction	Increase in customer satisfaction	Enhance employees' professional skills	ISO 4001 certification
Application of IT systems (ERP, WMS, MRP, and TMS) in Fresh food CSC.						
Adoption of Solar photovoltaic systems in the warehouse						
Employee training (Fresh food processing standard learning, latest technology learning, etc.)						
Surplus fresh food donations						
Eco-design (Reuse/recycling of packaging material, sharing pallets/circulating plastic baskets among cold supply chain partners)						
Application of RFID and WSNs for monitoring the status (temperature, humidity, storage time, etc.) of fresh food.						
Application of Environmental management						

system for monitoring the environmental impact						
Offering some courses to raise consumers' awareness about the quality dimensions of fresh food.						

Environmental performance

Please rate each of the following good practices in improving environmental sustainability performance. (Five-point scale: 1=Very poor; 2=Poor; 3= Fair; 4=Good; 5=Very good)

	Carbon emission reduction	Energy consumption reduction	Weight of the packaging materials used reduction
Application of IT systems (ERP, WMS, MRP, and TMS) in Fresh food CSC.			
Adoption of Solar photovoltaic systems in the warehouse			
Employee training (Fresh food processing standard learning, latest technology learning, etc.)			
Surplus fresh food donations			
Eco-design (Reuse/recycling of packaging material, sharing pallets/circulating plastic baskets among cold supply chain partners)			
Application of RFID and WSNs for monitoring the status (temperature, humidity, storage time, etc.) of fresh food.			
Application of Environmental management system for monitoring the environmental impact			
Offering some courses to raise consumers' awareness about the quality dimensions of fresh food.			

Economic sustainability performance

Please rate each of the following good practices in improving economic sustainability performance. (Five-point scale: 1=Very poor; 2=Poor; 3= Fair; 4=Good; 5=Very good)

	Fresh food waste reduction	Decrease in operational cost of fresh food cold supply chain	Profit	Decrease in fine for quality of fresh food
Application of IT systems (ERP, WMS, MRP, and TMS) in Fresh food CSC.				
Adoption of Solar photovoltaic systems in the warehouse				
Employee training (Fresh food processing standard learning, latest technology learning, etc.)				
Surplus fresh food donations				
Eco-design (Reuse/recycling of packaging material, sharing pallets/circulating plastic baskets among cold supply chain partners)				
Application of RFID and WSNs for monitoring the status (temperature, humidity, storage time, etc.) of fresh food.				
Application of Environmental management system for monitoring the environmental impact				
Offering some courses to raise consumers' awareness about the quality dimensions of fresh food.				