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Sustainable Food Supply Chain Research

Edited by

Fred Amofa Yamoah and David Eshun Yawson

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About the Editors

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Fred A. Yamoah, PhD, is a Reader in Sustainability at Birkbeck, University of London, UK, with expertise in sustainability, marketing and agribusiness, sustainable supply chains, circularity, business ethics, sustainable consumption, and food security. He has published in world-ranked journals such as the *European Journal of Operational Research*; *Economic and Industrial Democracy*; the *International Journal of Production Economics*; *Technological Forecasting and Social Change*; *Resources, Conservation and Recycling*; *International Marketing Review*; the *Journal of Environmental Management*; *Environmental Management*; *The International Food and Agribusiness Management Review*; the *British Food Journal*; the *Journal of Business Ethics*; *Computers in Human Behaviour*; and the *Journal of Cleaner Production*.

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Preface to "Sustainable Food Supply Chain Research"

A sustainable food supply chain delivers value in terms of profit and promotes the well-being of people and the planet. However, achieving sustainable food supply chains remains a significant challenge despite efforts to ensure more efficient food production and distribution globally. In tandem with policies and practices ensuring sustainable food supply systems, scientific research in this discipline has employed organizational theories such as the resource-based view, institutional and transactional cost theory, dynamic capabilities theory, and stakeholder theory to understand drivers and inhibitors associated with achieving more sustainable food value chains around the world. The extant scholarship on the sustainable food supply chain has evolved in different directions as a response to different food industry dynamics. However, consistent catalysts to such an evolution have been environmental variability and shock events that manifest as extreme climatic changes and natural hazards that are felt to different degrees in various geographical areas. The effects of environmental variability on food supply chains can be experienced at the local, regional, national, and global scales, but the supply chain disruptions due to the current COVID-19 pandemic cut across global and local food supply chains, and recovery strategies are being explored. Behind this backdrop, this collection of scientific articles seeks to understand the dynamic ramifications of the environmental variability on sustainable food supply chains to improve resilience. Other objectives of this collection of scientific work include to map the state of the art of sustainable food supply chain research before and during the pandemic as an essential benchmark to enable sustainable food research academics, students, and practitioners to gauge the trajectory of sustainable food supply chain research following the COVID-19 pandemic and to provide a systematic view of current research on the sustainable food supply chain to serve as a useful seminar reference for future research following the COVID-19 pandemic.

Fred Amofa Yamoah and David Eshun Yawson
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Editorial

Special Issue: Sustainable Food Supply Chain Research

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The persistent advocacy for a sustainable food supply chain is to enable stakeholders to configure, promote, and maintain food supply systems that deliver value in terms of profit and the well-being of people [1] and the planet [2,3]. Despite efforts to ensure more efficient food production and distribution globally, achieving sustainable food supply chains remains a critical global challenge [4]. The extant scholarship on sustainable food supply chains has evolved in different directions as a response to different food industry dynamics, environmental variability, and incidences that manifest as extreme climatic changes and natural hazards in various geographical areas. The multidimensional nature of the field has proven to be a complex terrain for research. Therefore, research in sustainable food supply chains has received attention from a multidimensional scholarship [5]. In the sustainable supply chain literature, studies provided indicators, drivers, and barriers based on the stakeholder theory towards the attainment of a sustainable food supply chain [6], whereas others highlighted the persistent social and environmental challenges and the essence of stakeholder collaboration to develop a sustainable food supply chain [7]. Other strands of sustainable food supply chain research employed the resource-based view [3], systems theory for modelling sustainable food systems [2], actor-network theory, co-creation and collaboration on platforms for collaboration and co-creation [8], justice and fairness theory for food retailer–supplier relationships [9], and attitude–behaviour gap on sustainable food consumption [10].

This Special Issue "Sustainable Food Supply Chain Research" in *Sustainability*, therefore, received interesting articles with multidimensional theoretical perspectives such as logistics services quality, governance and power relationships, food quality, production and environmental challenges of the food supply chain, actor-network theory, co-creation, and collaboration on platforms for collaboration and co-creation, digitisation of sustainable food supply chains, and systems theory for modelling sustainable food systems.

In this Editorial for the Special Issue, we summarize the contents. The Johnson-Hall et al. (Contribution 1) paper developed and tested a novel product quality framework for food supply chains that addressed sustainability by including climate change, population growth, and resources required by industrialised agriculture, as well as changing consumer preferences using a natural resource-based view and convention theory. Mattsson et al.'s (Contribution 2) study identified causes of food waste at the grocery retail level to develop effective measures to reduce waste. They revealed different causes for different fruit and vegetable categories of waste and posited that generic descriptions of causes are not enough to use as bases for planning reduction measures, whereas the Yamoah et al. (Contribution 3) study examined the rationale behind consumers' vote for or against choice editing (reducing food choice) in favour of sustainable consumption to inform marketing communication strategies and sustainability policies in the UK. They reported that the majority of consumers disagreed with governments being allocated the right to minimize the food choice options available to consumers by requesting that food industry players supply only sustainable food products.

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From the governance and power relationships perspective, Schuster and Mossig's (Contribution 4) paper interrogated multi-stakeholder initiatives as formalised networks with member organisations from the private, public, and not-for-profit sectors. They reported that even though members interact to achieve sustainability goals, they cannot reach these alone; they are heterogeneous actors with their own and sometimes conflicting goals. Keller et al. (Contribution 5), examining sustainability in governance in a cocoa supply chain in a developing country, reported differentiation in terms of sustainability governance according to the different supply chain stages; they reported that sustainability is mainly improved using contracts, extensive and frequent knowledge sharing, and audits.

The Zoric et al. (Contribution 6) paper examined the importance of digitalisation for a sustainable food supply chain, with the aim of identifying the negative impact of indicators in the traditional supply chain impacting negatively on sustainability functions in the wholesale and retail segments. This proffers digitalisation to improve sustainability in business processes. Dovbischuk (Contribution 7) explored the attributes of logistics service quality in rural territories of the developing economy of Ukraine. The paper provides evidence that the perceived and expected quality of the social sustainability-related aspects of the logistics service quality is substantially different. Obour et al. (Contribution 8) interrogated crop failure in a developing African country, Ghana, of smallholder farmers of maize and reported a decline in maize yield due to the failure of the minor season rains and fall armyworms.

The Yawson and Yamoah (Contribution 9) paper reviewed strategic agility in the fresh produce supply chain to improve strategic agility and resilience to ensure sustainability. They posit the application of strategic agility to a developing country's fresh produce supply chain in the context of a rapidly chaining business environment due to disruptions such as COVID-19 and in stable conditions by conceptualizing a supply chain agility framework. The Csordás et al. (Contribution 10) paper provided a systematic review of who prefers regional products by focusing on the characteristics and attitudes of short food supply chain (SFSC) consumers.

The multidimensional nature of the field of study provides more room for the interrogation of sustainable supply chain research in various themes and provides opportunities for the application of diverse theoretical lenses to improve its development. The articles in this Special Issue contribute to the development of research in the sustainable food supply chain from different perspectives. However, some of the perspectives require further interrogation as Csordás et al. (Contribution 10) reported that though the number of short food supply chain (SFSC)-related empirical studies has risen in recent years, there is a lack of related data, even in developed countries (European Union) where a sustainable agriculture and food system must play a crucial role in the implementation of the Green Deal. This, we believe, will improve the sustainability field and agenda.

Conflicts of Interest: Both authors declare no conflicts of interest.

List of Contributions:

1. Johnson-Hall, T.D.; Hall, D.C. Redefining Quality in Food Supply Chains via the Natural Resource Based View and Convention Theory.
2. Mattsson, L.; Williams, H. Avoidance of Supermarket Food Waste—Employees' Perspective on Causes and Measures to Reduce Fruit and Vegetables Waste.
3. Yamoah, F.A.; Haque, A.u.; Yawson, D.E. Consumer Psychology on Food Choice Editing in Favor of Sustainability.
4. Schuster, D.; Mossig, I. Power Relations in Multistakeholder Initiatives—A Case Study of the German Initiative on Sustainable Cocoa (GISCO).
5. Keller, J.; Jung, M.; Lasch, R. Sustainability Governance: Insights from a Cocoa Supply Chain.
6. Zorić, N.; Marić, R.; Đurković-Marić, T.; Vukmirović, G. The Importance of Digitalization for the Sustainability of the Food Supply Chain.
7. Dovbischuk, I. Sustainability in Logistics Service Quality: Evidence from Agri-Food Supply Chain in Ukraine.

8. Obour, P.B.; Arthur, I.K.; Owusu, K. The 2020 Maize Production Failure in Ghana: A Case Study of Ejura-Sekyedumase Municipality.
9. Yawson, D.E.; Yamoah, F.A. Review of Strategic Agility: A Holistic Framework for Fresh Produce Supply Chain Disruptions.
10. Csordás, A.; Lengyel, P.; Füzesi, I. Who Prefers Regional Products? A Systematic Literature Review of Consumer Characteristics and Attitudes in Short Food Supply Chains.

References

1. Fearne, A.; Yawson, D.; Buxton, A.; Tait, J. *Measuring Fairness in Supply Chain Trading Relationships: A Methodology Guide*; International Institute of Environment and Development: London, UK, 2012; ISBN 978-1-84369-876-0.
2. Allen, T.; Prosperi, P. Modeling Sustainable Food Systems. *Environ. Manag.* **2016**, *57*, 956–975. [CrossRef] [PubMed]
3. Pullman, M.E.; Maloni, M.J.; Carter, C.R. Food for thought: Social versus environmental sustainability practices and performance outcomes. *J. Supply Chain. Manag.* **2009**, *45*, 38–54. [CrossRef]
4. Davis, K.F.; Downs, S.; Gephart, J.A. Towards food supply chain resilience to environmental shocks. *Nat. Food* **2021**, *2*, 54–65. [CrossRef]
5. Touboulic, A.; Walker, H. Theories in sustainable supply chain management: A structured literature review. *Int. J. Phys. Distrib. Logist. Manag.* **2015**, *45*, 16–42. [CrossRef]
6. Govindan, K. Sustainable consumption and production in the food supply chain: A conceptual framework. *Int. J. Prod. Econ.* **2018**, *195*, 419–431. [CrossRef]
7. Li, D.; Wang, X.; Chan, H.K.; Manzini, R. Sustainable food supply chain management. *Int. J. Prod. Econ.* **2014**, *152*, 1–8. [CrossRef]
8. Scandelius, C.; Cohen, G. Sustainability program brands: Platforms for collaboration and co-creation. *Ind. Mark. Manag.* **2016**, *57*, 166–176. [CrossRef]
9. Duffy, R.; Fearne, A.; Hornibrook, S.; Hutchinson, K.; Reid, A. Engaging suppliers in CRM: The role of justice in buyer–supplier relationships. *Int. J. Inf. Manag.* **2013**, *33*, 20–27. [CrossRef]
10. Yamoah, F.A.; Acquaye, A. Unravelling the attitude-behaviour gap paradox for sustainable food consumption: Insight from the UK apple market. *J. Clean. Prod.* **2019**, *217*, 172–184. [CrossRef]

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Article

Redefining Quality in Food Supply Chains via the Natural Resource Based View and Convention Theory

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Abstract: This study develops and tests a novel product quality framework for food supply chains (FSCs) that addresses sustainability. Issues including climate change, population growth, and the resources required by industrialized agriculture, as well as changing consumer preferences contribute to concerns about the social, ecological, and economic sustainability of FSCs. FSCs, therefore, need to be adapted to address changing supply and demand characteristics. We integrate the natural resource-based view (NRBV) with convention theory (CT) to develop a new set of quality dimensions. Placing social and ecological considerations within the domain of quality management advances theory in two ways. First, while social and ecological considerations are typically peripheral to business models, this framework allows social responsibility and the natural environment to occupy a central place within FSC operations. Second, the framework reflects the fundamentally socially embedded nature of FSCs, including the geographic, historical, and cultural associations of food quality. We then construct a typology of quality conventions and FSCs. We empirically test the typology using a case study methodology with cases from the United States of America (USA). The analysis explores how firms bundle quality conventions across FSCs for competitive advantage. We also find a set of paths through which FSCs transition via exploitation, exploration and organizational ambidexterity to generate competitive advantage, highlighting tradeoffs that may arise as FSCs evolve. These tradeoffs, which relate to maintaining or adapting quality conventions, are practically important because, if not managed appropriately, may result in lower performance and less sustainable FSCs.

Keywords: quality; sustainable food supply chains; food safety; natural resource-based view

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1. Introduction

We seek to redefine the dimensions of product quality by proposing a novel theoretical framework in the context of food supply chains (FSCs). We are motivated by the need to incorporate sustainability more directly into operations and supply chain management (OM/SCM) theory [1–4]. In addition, climate change, population growth, and the resources required by industrialized agriculture, as well as changing consumer preferences, contributing to concerns about the social, ecological, and economic sustainability of FSCs [5–11]. This research, therefore, contributes to the literature by developing and empirically validating a theoretical framework with social and ecological sustainability incorporated as dimensions of food product quality. The notion that quality addresses sustainability (i.e., social and environmental) issues has origins in practice as well as the OM/SCM literature [12–17]). Two rationales suggest sustainability may be embedded within quality. First, many quality management principles (e.g., defect and waste reduction) and tools (e.g., statistical process control and root cause analysis) can be extended to environmental management. Second, quality management emphasizes understanding customer requirements; by broadening the view of customers to include stakeholders, we can extend the definition of quality to encompass a variety of social issues (e.g., worker safety, working conditions, and community relations) as well as the natural environment [12].

We follow best practices for middle-range theory development, relying on a top-down approach to integrating extant theories within the context of FSCs [18,19]. Our theorization combines the lens of the natural resource-based view (NRBV), which prescribes the development of strategic capabilities related to social and ecological issues for long-term competitive advantage, with convention theory (CT) to reflect the broad and *socially embedded* nature of food quality attributes [20,21]. Integrating these theories into a novel product quality management framework places social and ecological issues in a central position within the OM/SCM function, which may enhance managers' ability to balance tradeoffs between performance attributes. We suggest that this could further advance the evaluation of quality performance from an input, rather than an output perspective, which is critical due to the limitations of testing and inspection, particularly in food [22]. Furthermore, this framework could reduce the need for *post hoc* monitoring because of the incorporation of sustainability in process and supply chain design. This is particularly relevant with respect to FSCs because of the acknowledged difficulty associated with measuring the outcomes of sustainability practices in this context [23].

Furthermore, while prior OM/SCM literature suggests quality dimensions (cf. [24]) including performance, features, conformance, etc., such frameworks do not address the socially embedded nature of economic markets and quality [1,25]. Consistent with the economic sociology literature and CT, our use of social embeddedness reflects aspects of product quality and economic decision-making which are grounded in social contexts and institutions including geographic, historical, and cultural associations. Incorporating social embeddedness into the definition of quality is particularly relevant for food products for several reasons. First, food is essential for human survival. The essential nature of food, therefore, dictates that the long-term sustainability of FSCs is of critical importance and that any holistic conceptualization of food quality needs to reflect the importance of ecological attributes. Second, food and consumer perceptions of food quality have strong associations with place, historical tradition, and culture [26]. Third, the for-profit food industry is intensely competitive, and, at the same, time, food products are typically low-margin items [7,27]. Fourth, firms compete, in part, with differentiated production and by marketing products with a wide array of quality attributes and claims [7]. Finally, FSCs involve a breadth of entities such as for-profit and non-profit operations, governmental organizations, and consumers. Each of these considerations suggests that quality frameworks need to address the socially embedded and complex nature of FSCs. From a practical perspective, food industry managers need to understand quality in order to interpret the voice of the customer into product attributes and to match supply with demand. We combine CT with the NRBV to develop the logic for how supply and demand characteristics influence the specification and *bundling* of quality conventions for competitive positioning [28].

Taken together, there are theoretical and practical motivations to reconsider definitions of quality for food products and within FSCs to incorporate sustainability [17]. Our study seeks to contribute by developing and testing a theoretical framework of food product quality that can simultaneously reflect the complexity and diversity of FSCs, as well as stakeholder perspectives, and which integrates dimensions of social, ecologic, and economic sustainability.

We organize the remainder of this manuscript as follows. First, we develop our theoretical framework by integrating the NRBV and CT to generate a food product/process typology with product exemplars [18]. Second, we explain our case methodology, including case selection strategy and analysis methods before moving on to an explanation of our case analysis and typology validation [29]. Finally, we conclude with a discussion of theoretical and managerial implications and directions for future research.

2. Literature Review and Theoretical Development

2.1. Natural Resource Based View

The NRBV extends resource-based theories of the firm by explicitly identifying the natural environment as a resource constraint, proposing that, in order to pursue competitive

advantage, firms must develop strategic capabilities in the areas of pollution prevention, product stewardship, and sustainable development [20]. Pollution prevention includes the substitution of processes and materials in order to reduce the environmental impact of products through continuous improvement. Product stewardship emphasizes the consideration of environmental impacts and costs of products throughout the entire product life cycle. NRBV's conceptualization of sustainable development originally included building markets in developing economies while simultaneously addressing the environmental impacts that result from serving these markets [30]. Since then, the NRBV has evolved with the sustainable development capability further subdivided into two dimensions: clean technology and serving the bottom of the pyramid (BoP) [20]. Following the original premise of sustainable development, clean technology consists of more radical innovations than pollution prevention or product stewardship. However, despite significant work in the areas of pollution prevention and, to a lesser extent, product stewardship capabilities, little work has focused on clean technology and even less on the intersection of clean technologies with serving the world's poorest populations [20]. Within the OM/SCM literature, research has largely examined how to make business processes less *unsustainable* rather than truly sustainable [2].

By integrating the NRBV into the development of food quality dimensions, we incorporate the relationship with the natural environment and societal impacts of FSCs directly into the operations function via product quality systems. Because quality is a critical dimension of OM/SCM performance, this integrated framework places social and ecological dimensions, traditionally considered ancillary performance dimensions, into a more central role. We argue that this framework has several benefits. First, by placing these issues within the realm of quality, managers have the opportunity to consider sustainability at the same time as other dimensions of quality, rather than *post hoc*. Sustainability may still be subordinate to other quality dimensions; however, including it in within the context of quality enables societal and ecological issues to be evaluated for potential order-winning characteristics. Second, as firms seek legitimacy in the eyes of their various stakeholders, embedding sustainability within the quality function combats the perception of symbolic rather than meaningful sustainability initiatives [31–33].

We conceptualize the NRBV as motivating our movement of social and environmental issues into the quality function within operations management. This is justified, in part, by the close relationship between the physical operations of a firm and its impact on society and the environment. Furthermore, reflecting sustainability within the operations function as a part of quality management makes sense because operations strategy and its implementation are critical for firm performance and because the NRBV dictates that sustainability capabilities can lead to long-term competitive advantage [20]. In addition, this conceptualization addresses calls from prior OM/SCM work to make sustainability issues central to OM/SCM research frameworks [2].

2.2. Convention Theory

To move from the high level of abstraction present within the NRBV in order to develop our quality framework, we propose to incorporate an additional theoretical perspective. We draw from CT, a theory that originates in "French pragmatic sociology" [34] (p. 12). CT attempts to reconcile how territorial, market, and production aspects of economic exchange can be coordinated when uncertainty exists, including the notion of embeddedness [35]. Within CT, embeddedness accounts for aspects of economic exchange that cannot be explained via purely rational economic decision-making [21]. CT incorporates the concept of embeddedness to describe how different sets of conventions are bundled within a specific product and its supply chain. In describing quality conventions as bundled, CT allows for the possibility of choosing to emphasize one particular convention over others, as well as the ability to reconfigure conventions when strategically necessary [36].

CT has been used extensively in the disciplines of economic geography, regional studies, and political economy, with specific applications in the agri-food context. These

studies apply CT to contrast quality conventions and justification of those conventions in different types of restaurants, and how wine makers specify different sets of conventions depending on the target market [37–39].

Storper and Salais [39] suggest that producers develop their offerings by positioning the selection and bundling of sets of quality conventions along the dimensions of supply and demand characteristics. Supply characteristics related to the level of specialization of the technology, methods, knowledge and skills used in production. Alternatively, demand characteristics relate to the extent to which the product is generic versus differentiated in terms of consumer requirements. These dimensions, when combined, yield what has been termed in the political economics literature as worlds of production [39]. Later work has applied CT in this way to demonstrate how firms move into different worlds or may occupy more than one world at a time depending on firm objectives [40]. From this literature, we adopt the terminology of standardized versus specialized for supply (i.e., process) characteristics, and generic versus differentiated when describing demand (i.e., product) characteristics. Accordingly, the worlds of production can be depicted as shown in Figure 1. In summary, the worlds of production combine "technologies and markets, product qualities, and practices of resource use," [34] (p. 15) to form a typology that can "formulate forms of organization, coordination and exchange specific to the nature of the product that is exchanged, and the means of justifying its quality claims," [34] (p. 15). The two dimensions yield the generic typology shown in Figure 1, with four quadrants corresponding to the pairing of the extreme endpoints of supply and demand characteristics.

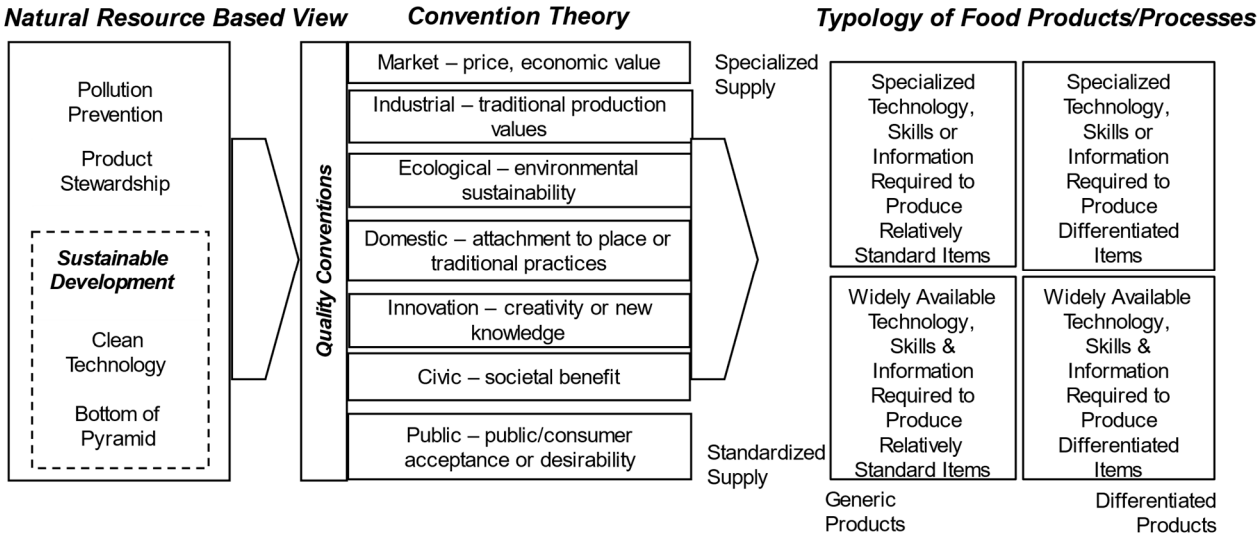

Figure 1. Theoretical framework: Natural Resource Based View (NRBV), Convention Theory (CT) and resulting typology.

2.2.1. Quality Conventions

CT proposes that a set of *conventions* define product quality; conventions are present (or absent) to varying degrees within specific products and their associated processes (Figure 1). By agreeing on the meaning of specific conventions, producers can regulate quality within their supply chain and customers can evaluate quality relative to a specific transaction. The product quality conventions include: (1) Market; (2) Industrial; (3) Ecological; (4) Domestic (5) Innovation; (6) Civic; and (7) Public [34,39] The *market convention* is characterized by attributes such as price or underlying economic value of the product. In the complete absence of uncertainty about product quality, the market convention is theorized as sufficient for assessing quality. The *industrial convention* is associated with traditional attributes such as efficiency and reliability of production, including the ability to produce at scale and to extend product scope or variety.

The *ecological convention* relates to the environmental sustainability of products and processes. The *domestic convention* relates to product attributes tied to specific locations or traditional production methods. The *innovation convention* reflects the novelty, creativity, or new knowledge associated with products and processes. The *civic convention* relates to societal benefit. The political economy literature sometimes subsumes the ecological convention into the civic convention because ecological sustainability is of benefit to society [34,41]. We have chosen to maintain ecological sustainability as a separate convention because we wish to emphasize the distinctive role of the natural environment in determining food quality, as well as the intensity of how FSCs are embedded in the environment.

The *public* convention has been represented in terms of consumer opinions; this type of convention is typically marked by public-facing attributes such as brand, trademarks, and advertised product claims. In this context, the public convention is also indicative of the extent to which consumers are accepting of the product as well as associated production characteristics and find those attributes desirable, or order-winning; this convention therefore would also be associated with any practice that supports one of those order-winning characteristics.

CT does not dictate how individual conventions are prioritized or valued and does not prescribe how conventions are bundled for competitive advantage. Our study contributes by empirically examining how organizations bundle and prioritize conventions for competitive advantage in FSCs. We begin by reviewing the CT and OM/SCM literature in the agri-food context to elaborate on a set of *attributes* associated with each quality convention (Table 1), as well as how quality conventions may be assigned and prioritized within the worlds of production framework. Each quality convention is associated with multiple attributes; a set of example *practices* within each attribute has been provided based on the literature review and examples observed in practice. Market, industrial, domestic, innovation, and public conventions were derived from the broader theoretical development of CT [39] and from agri-food applications of CT [42–45]. For aspects of ecological and civic conventions, we adapted existing sustainability frameworks [9,46] in addition to agri-food applications of CT [34,47].

Table 1. FSC quality conventions, convention attributes and examples.

Quality Convention	Convention Attributes	Examples
Market [42,46,48]	Price	Competitive price for volume
	Value-for-price	Competitive price for specific attribute (e.g., organic)
Industrial [34,39]	Economies of scale	High volume production Scaled processes
	Economies of scope	Product variety
	Emphasis on improving productivity & efficiency	Traditional productivity measures
	High reliability, low variation production	Uniform size and appearance
Ecological [46]	Resource conservation	Reduce use of water, refrigerants; land, energy, inputs Reducing plastic/changing packaging materials Eliminate use of sub-clinical antibiotics
	Waste reduction	Inventory management to reduce discards of perishables
	Total life cycle management	Life cycle analysis
	Recycling	Recycling packaging
	Recovery	Pick up of close to sale date food for distribution
	Reclamation	Waste converted to soil amendment or energy

Table 1. *Cont.*

Quality Convention	Convention Attributes	Examples
Domestic [26,34,42–45]	Ties to traditional production methods or practices	Seasonal local produce Wild-caught seafood "Small batch" production Heirloom varieties of produce or grains Feeding or foraging methods (e.g., jamón Ibérico)
	Ties to specific geographic region or location	Italian wine regions (e.g., DOCG) Washington apples Gulf shrimp Jamón Ibérico (Spain) or Texas Ibérico (Texas)
	Relationship between producer and customer	Direct-to-consumer retailing Events that bring producer and customer together Materials that share history, producer characteristics
Innovation [34,39]	Development of new categories of products and process technologies	New categories using plant-based protein Lab-grown protein Clean production technology [20]
Public [39]	Differentiated attribute that is either well-accepted by the public, or an order winner in the target market	Nutritional characteristics (protein, fiber, fat, etc.) Taste characteristics Convenience packaging Certified Human® Methods/conditions that promote natural behaviors More humane slaughter methods
Civic [46,47]	Societal/community benefits	Products developed for bottom of pyramid markets Charitable donations Community projects
	Working conditions/Supply chain practices	Workplace safety Worker's rights Living wage, competitive pay Fair treatment of suppliers Supplier codes of conduct

2.2.2. Worlds of Production and Quality Conventions in the FSC Context

To simplify our development of the FSC typology at the product/process level, we turn to common categorizations of foods developed by governmental agencies for the purpose of promoting public health. Such agencies typically define nutritious foods in the following general categories: (1) Grains; (2) Protein sources including meat, poultry, and eggs; (3) Dairy products; and (4) Fruits and vegetables [49]. We considered each of these categories, in combination with our search of the literature, to identify versions of similar categories of products that logically belong in different quadrants of the typology. By evaluating these categories against the convention attributes identified in Table 1, we were able to develop a list of quality conventions associated with each quadrant; our categorization is consistent with the limited literature that has assessed consumer perceptions of labeling that reflects sustainability across health and environmental dimensions [50]. We use the convention definitions and attributes identified in Table 1 to develop examples representative of food products and processes exhibiting the supply and demand characteristics that form the worlds of production (Figure 1). Based on the convention configurations, we tentatively labeled the four quadrants as: (1) Mainstream; (2) Future Emergent; (3) Growth; and (4) Niche (see Figure 2).

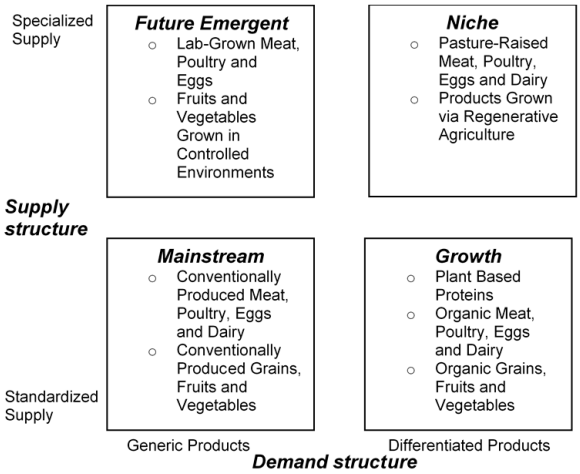

Figure 2. Food product/process typology with product exemplars.

3. Research Design and Methodology

We empirically investigate the typology using case study methods. These methods are appropriate because they allow us to collect rich data via semi-structured interviews as well as other primary sources for a breadth of cases that represent the diversity present in the food industry [29,51]. Because this work aims to elaborate and integrate extant theory to propose a new theoretical framework, it is, of necessity, somewhat exploratory in nature [18,29,52]. Case methods are particularly valuable in meeting our research objectives, which rely on the richness of data collected via interviews and triangulated with other sources. We have several objectives in conducting this study. First, we aim to uncover *patterns of how quality conventions are bundled and prioritized* for various food products and processes based on supply and demand characteristics. Second, we explore how *organizations participate in multiple quadrants of the typology to offer portfolios of products and to pursue competitive advantage*. Finally, we identify *patterns and drivers of transitions between quadrants of the typology* [50].

3.1. Case Selection

We confined our case selection to organizations that distribute, or plan to distribute, products in the US and sought to identify organizations of different sizes, those that operate across multiple supply chain stages, as well as those firms that concentrate within a particular level of the supply chain. To elaborate on and evaluate the typology shown in Figure 2 in context, we are interested in a diversity of supply and demand structures across FSCs [18,29,51]. To ensure that the sample includes firms across the typology quadrants, we specifically included cases that are pursuing technological innovations within the food industry, as well as firms that promote their operations as existing within the framework of alternative methods of agricultural production to reflect the diversity of supply characteristics [34]. We also included organizations that offer products that are more generic as well as those that offer a breadth of product variety that encompasses generic as well as more differentiated items to reflect variation in demand characteristics. For example, by including retailers of various sizes, we capture retail and distribution networks, as well as firms that offer products under their own brand (i.e., private label), and in some cases, own and operate manufacturing facilities. In order to explore the complexity of FSCs, we also included a number of cases that play a role in non-profit distribution of food, including food banks that act as aggregators and provide warehousing, and food pantries that distribute food directly to clients.

Table 2 describes the sample, including the product categories, the stage or stages of the FSC in which the firm operates, and the extent of downstream supply chain reach of the organization, as well as information about the firm size. FSC stages are categorized as producers, processors, distributors, retailers [53], food banks, and food pantries. We

define *producers* as agricultural operations that farm crops or raise animals for use as food. *Processors* include organizations that transform agricultural products into saleable items; such operations include washing, cleaning, and packaging, as well as a variety of processes that combine and transform ingredients. *Distributors* engage in the movement of products between production and points of sale. *Retailers* sell directly to consumers. *Food banks* include the approximately 200 organizations that operate within the Feeding America network of non-profit food distribution; their primary role is to aggregate and warehouse food for distribution through food pantries [54]. *Food pantries* include those organizations that operate to distribute groceries to clients, as well as feeding operations that provide meals to clients [54].

Table 2. Case study descriptions.

Case	Product Categories	Organization Type	FSC Stage	Downstream Supply Chain Reach	Sales ($)	Number of Employees
A	Various	For-profit	Retailer Processor	Multiple regions	>100 B	>200,000
B	Various	For-profit	Retailer Processor	Regional	>2 B	>50,000
C	Various	For-profit	Retailer	Local	~80 MM	~800
D	Produce Meat Poultry Eggs	For-profit	Producer Processor Distributor Retailer	Local (~200 miles)	~2 MM	~10
E	Eggs Dairy	For-profit	Producer Processor	Nationwide	~140 MM	~100
F	Eggs	For-profit	Producer Processor	Multiple regions	~2 MM	<20
G	Dairy	For-profit	Producer Processor Distributor Retailer	Local (~60 miles)	<1 MM	<20
H	Produce Meat Poultry Eggs	For-profit	Producer Processor Distributor	Local (~200 miles)	<1 MM	<10
I	Produce	For-profit	Retailer Grower	Local	<2 MM	<10
J	Various	Non-profit	Distributor	Regional	Not applicable	<50
K	Produce	For-profit	Producer Processor	Regional	<10 MM	<500
L	Various	Non-profit	Distributor	Local	Not applicable	Not applicable
M	Various	For-profit	Retailer	Regional	~500 MM	~3000
N	Various	For-profit	Retailer	Local	<50 MM	~300
O	Produce Dairy	For-profit	Producer Processor	Nationwide	>2 B	>5000
P	Various	Non-profit	Food bank	Regional	Not applicable	~40
Q	Various	Non-profit	Food bank	Regional	Not applicable	~20
R	Various	Non-profit	Food pantry	Local	Not applicable	~30
S	Various	Non-profit	Food pantry	Local	Not applicable	<20

Table 2. *Cont.*

Case	Product Categories	Organization Type	FSC Stage	Downstream Supply Chain Reach	Sales ($)	Number of Employees
T	Various	Non-profit	Food pantry	Local	Not applicable	<5
U	Eggs	For-profit	Producer Processor	Nationwide	~200 MM	~200
V	Plant-based protein	For-profit	Producer Processor	Nationwide	~300 MM	~500
W	Lab-grown meat	For-profit	Producer Processor	Not applicable	Not applicable	<100

Sales & number of employees are approximate to protect the identity of the case firms.

3.2. Data Collection and Analysis

Data were collected using semi-structured interviews with a series of open-ended questions at 23 separate case organizations. Interview protocols were prepared prior to initial interviews and modified for follow-up as dictated by new information [18,29,51]. Retrospective questions were asked about the following broad areas: (1) Business model; (2) Product portfolio; (3) Production methods and technologies; (4) Product development; (4) Quality management practices; (5) Marketing practices and claims; (6) Sustainability practices and initiatives; (7) Community involvement; (8) Charitable donations; and (9) Workplace and supply chain policies. To address validity and reliability, we triangulated data when possible using other data sources, including the organization's website, news articles, and governmental reports [29,50–52,55]. These open-ended areas of inquiry serve to elicit responses regarding supply and demand characteristics identify practices in support of and emphasizing particular quality conventions and understand competitive strategy. To ensure a complete record for each case, we collected and organized data by case; the data presented in this study are available in Tables 2 and 3.

Nineteen broad categories of attributes were identified from the literature as corresponding to the seven quality conventions (Table 1). We define FSC practices as actions that occur within the FSC that enable or support the attributes of quality conventions. We coded FSC practices associated with quality conventions using the categories of attributes identified in Table 1. In our analysis, we identified each of the literature-based attribute categories as present in at least one case; no additional unique attribute categories were identified. Specific practices associated with each attribute category and the relevant quality convention (e.g., Market, Industrial, Ecological, etc.) are shown in Table 3. In total, 73 unique convention-supporting practices were identified across cases.

In addition to the primary convention related to a specific practice, we also provide additional codes for conventions supported by that practice. For example, the primary convention associated with Case D's production of pastured meat is domestic (DOM) based on the highly specialized process and limited geographic distribution. However, market conventions are also supported by this practice, because the economic value per unit is a basis for competition in terms of the price premium earned. Case D's production methods also support order-winning qualities for the consumer, which are indicative of the public convention (PUB), as well as the ecological convention (ECO). The typology quadrant(s), dominant quadrant and practices identified by quality convention(s) are summarized for each case in Table 3. We present the results of our final analysis regarding the prioritization of quality conventions within each quadrant in Figure 3.

Table 3. Case study analysis: Typology validation.

Case	Product Categories	Organization Type	FSC Stage	Typology Quadrant [1]	Convention Practices
A	Various	For-profit	Retailer Processor	**Mainstream** Growth	(MKT/IND/PUB) Produces, distributes and retails food products created via industrialized processes at highly competitive prices. (MKT/IND/PUB/ECO) Produces, distributes and retails differentiated products created via industrialized processes at competitive prices (e.g., certified organic, Fair Trade). (ECO) Benchmarks, annual and long-term improvement targets for food waste recycling, recycling other types of waste and reducing packaging and making packaging more recyclable. Similar targets and planning for energy use reduction, water use reduction. (ECO) Benchmarks, annual and long-term improvement targets for responsible sourcing of seafood. (PUB/ECO) Animal welfare (e.g., transition to 100% cage-free eggs, elimination of gestation crates in pork production). (CIV) Sets targets for food and funds donated for hunger relief. (CIV) Donates close to sale date products (food recovery).
B	Various	For-profit	Retailer Processor	**Mainstream** Growth	(MKT/IND/PUB) Produces, distributes and retails food products created via industrialized processes at highly competitive prices. (MKT/IND/PUB/ECO) Produces, distributes and retails differentiated products created via industrialized processes at competitive prices (e.g., certified organic, Rainforest Alliance Certified®). (ECO) Benchmarks, annual and long-term improvement targets for food waste recycling, recycling other types of waste and reducing packaging and making packaging more recyclable. Similar targets and planning for energy use reduction (Energy Star Partner), water use reduction. (PUB/ECO) Animal welfare (e.g., transition to 100% cage-free eggs). (CIV) Donates close to sale date products (food recovery).
C	Various	For-profit	Retailer	**Mainstream** Growth Niche	(MKT/IND/PUB) Produces, distributes and retails food products created via industrialized processes at highly competitive prices. (MKT/IND/PUB/ECO) Produces, distributes and retails differentiated products created via industrialized processes at competitive prices (e.g., certified organic, Fair Trade). (MKT/DOM/PUB) Partners with specific local producers for seasonal items, conducts events with these producers, creates personalized advertising materials that tell the story of the producers. Direct-to-source relationships with suppliers for specific items and expedited shipping to increase freshness (e.g., seafood, which is air-freighted to stores). (DOM/PUB) Emphasis on trust developed with suppliers, customers. Marketing materials emphasize basis for trust, including supplier relationships and sourcing methods. (DOM/PUB) Holds cooking demonstrations for local/seasonal food and heavily promotes sale of limited stock of in-season items (e.g., Hatch chiles). (DOM/PUB) Emphasizes continuous family ownership, history, tradition, local (CIV) Donates close to sale date products (food recovery). (CIV) Charitable contributions to local organizations; includes customer participation.

Table 3. *Cont.*

Case	Product Categories	Organization Type	FSC Stage	Typology Quadrant [1]	Convention Practices
D	Produce Meat Poultry Eggs	For-profit	Producer Processor Distributor Retailer	**Niche**	(DOM/MKT/PUB/ECO) Produces pastured meat, poultry, eggs. Regenerative agriculture. (ECO/DOM/MKT/PUB) Longstanding practice of organic production (uncertified). (DOM) Direct to consumer model connects producer with customer personally. (DOM) On farm store, events, visiting policy. (DOM) Widespread communication of production methods. (DOM/ECO) Limits distribution area, seasonal retailing (e.g., limits sales to growing season). (DOM/ECO) Promotes sale of whole chickens, older chickens. (PUB/ECO) Practices that promote natural animal behavior. (PUB) Humane slaughter methods. (CIV) Donates surplus products to food banks.
E	Eggs Dairy	For-profit	Producer Processor	**Growth** Niche	(DOM/MKT/PUB/ECO) Produces pastured eggs and dairy. (PUB/ECO) Humane Certified® production. (MKT/ECO/PUB) Certified organic production, certified non-GMO. (IND) Production at scale. (IND) Expansion of scope of products offered, expansion of processing methods. (IND) Process improvements to reduce labor requirements and maximize productivity. (DOM) Transparency regarding production methods, including culling of male chicks, euthanization of hens, and COVID-19 at its facilities. (DOM/CIV/MKT) Partners with small farm owners. (CIV) Donates products to food banks. (CIV) Pledges reasonable income to farm partners.
F	Eggs	For-profit	Producer Processor	**Growth** Niche	(DOM/MKT/PUB/ECO) Produces pastured eggs. (MKT/ECO/PUB) Certified organic production, certified non-GMO. (IND) Increasing scale of production. (CIV) Donates products to food banks.
G	Dairy	For-profit	Producer Processor Distributor	**Niche**	(DOM/MKT/PUB/ECO) Cow-to-consumer production of dairy products for local markets. (DOM) Home delivery. (DOM) On farm store, events, visiting policy. (CIV) Donates surplus products.
H	Produce Meat Poultry Eggs	For-profit	Producer Processor Distributor	**Niche**	(DOM/MKT/PUB/ECO) Coordinates production, processing, and distribution for consortium of local poultry, meat, eggs, produce. Alternative methods of agriculture. (MKT/PUB/CIV) Partners with local retailer to distribute local products from small producers. (ECO/MKT/PUB/CIV) Partnered with regulatory agency and small producers to pursue streamlined form of organic certification. Certification allows producers to earn a premium. (DOM/MKT/PUB) Partners with local producers to sell through local retailers. (CIV) Partners to provide seasonal produce to urban food deserts and schools. (CIV) Donates surplus products.
I	Produce	For-profit	Producer Retailer	**Niche**	(DOM) Sells personally via two farmers' markets. (MKT/ECO/PUB) Longstanding use of organic methods to grow seasonal produce (uncertified). (CIV) Donates surplus products.

Table 3. *Cont.*

Case	Product Categories	Organization Type	FSC Stage	Typology Quadrant [1]	Convention Practices
J	Various	Non-profit [2]	Distributor	**Niche**	(DOM/MKT/PUB/ECO) Distributes food from local sustainable producers. Provides processing capabilities to small producers. (DOM/MKT/ECO/PUB) Sets standards for sustainable production (certification not required). (DOM/CIV) Transparency regarding production methods. Emphasizes building community and trust, improving food security, access to fresh food, community health. (DOM/MKT/PUB/ECO) Connects small local producers to wholesalers and retailers. (CIV) Connects small local producers to institutions to improve access to nutritious food in vulnerable communities. (CIV) Discounts for qualifying non-profits.
K	Produce	For-profit	Producer Processor	**Growth**	(MKT/IND/PUB/ECO) Produces differentiated products created via industrialized processes at competitive prices (e.g., certified organic). (IND) Traceability—barcoding to greenhouse & date of harvest. (IND/ECO) Closed loop water system with sterilization. (IND/ECO/PUB) Optimized climate control in greenhouse. (IND/ECO/PUB) Biomass hot water boilers used for heating greenhouses. (ECO/PUB) Greenhouse production with insulation to reduce heat loss. (ECO/PUB) Vertical growing. (ECO/PUB) Sustainable growth medium. (PUB/ECO) Non-GMO seeds. (ECO/PUB) Integrated pest management. (ECO/PUB) Limited use of plastic. (CIV) Donates surplus products.
L	Various	Non-profit [2]	Distributor	**Mainstream** Growth	(CIV) Provides technology to enable food recovery. (CIV) Connects food donors with volunteers and food pantry operations.
M	Various	For-profit	Distributor Retailer	**Mainstream** Growth Niche	(MKT/IND/PUB) Produces, distributes and retails food products created via industrialized processes at highly competitive prices. (MKT/IND/PUB/ECO) Produces, distributes and retails differentiated products created via industrialized processes at competitive prices (e.g., certified organic). (DOM) Partnership with local aggregator for local seasonal products. (DOM) Holds farmers market within/outside stores. (DOM) Holds events within store to meet local producers. (CIV) Donates close to sale date items (food recovery).

Table 3. *Cont.*

Case	Product Categories	Organization Type	FSC Stage	Typology Quadrant [1]	Convention Practices
N	Various	For-profit	Retailer	**Niche**	(DOM/MKT/PUB/ECO) Emphasizes local production, small businesses, seasonal produce, freshness, and sustainable production methods including regenerative agriculture, renewable energy, and biodiversity. (MKT/PUB/ECO) Retails differentiated products created via smaller scale processes at premium prices (e.g., certified organic, fair trade). (MKT/PUB) Inventory systems allow customers to order products that are still at farms. (DOM/ECO/PUB) Sources the majority of produce within ~150 miles of service area. (DOM/PUB) Commits to transparency to customers regarding production methods and sources. (CIV/PUB) Supplier standards for working conditions and wages. (CIV) Donates close to sale date items.
O	Produce Dairy	For-profit	Producer Processor Distributor	**Mainstream** Growth	(MKT/IND/PUB) Produces, processes and distributes food products created via industrialized processes at highly competitive prices. (MKT/IND/PUB/ECO) Produces differentiated products created via industrialized processes at competitive prices (e.g., certified organic). (CIV) Donates products to food banks.
P	Various	Non-profit [2]	Food bank	**Mainstream** Growth	(CIV/ECO) Coordinates food recovery among participating donors and food pantries. (CIV) Warehouses and distributes food from USDA, corporate donors, and private donors to food pantries.
Q	Various	Non-profit [2]	Food bank	**Mainstream** Growth	(CIV/ECO) Coordinates food recovery among participating donors and food pantries (CIV) Warehouses and distributes food from USDA, corporate donors, and private donors to food pantries.
R	Various	Non-profit [2]	Food pantry	**Mainstream** Growth	(CIV/ECO) Conducts food recovery from local grocery stores to increase fresh content for pantry clients. (CIV) Stores and distributes food to pantry clients.
S	Various	Non-profit [2]	Food pantry	**Mainstream** Growth	(CIV/ECO) Conducts food recovery from local grocery stores to increase fresh content for pantry clients. (CIV) Stores and distributes food to pantry clients.
T	Various	Non-profit [2]	Food pantry	**Mainstream** Growth	(CIV/ECO) Conducts food recovery from local grocery stores to increase fresh content for pantry clients. (CIV) Stores and distributes food to pantry clients.
U	Eggs	For-profit	Producer Processor	**Growth** Niche	(DOM/MKT/PUB/ECO) Produces free-range eggs. (PUB/ECO) Humane Certified® production. (MKT/PUB/ECO) Certified organic production, certified non-GMO. (IND) Production at scale. (DOM) Transparent communication regarding production methods, including culling of male chicks, euthanization of hens. (PUB/ECO) Humane Certified® production. (CIV) Donates products to food banks.

Table 3. *Cont.*

Case	Product Categories	Organization Type	FSC Stage	Typology Quadrant [1]	Convention Practices
V	Plant-based meat substitutes	For-profit	Producer Processor	**Growth**	(MKT/IND/PUB) Produces, distributes and retails food products created via industrialized processes at competitive prices. (MKT/ECO/PUB) Plant-based protein source (animal welfare, climate change, human health, natural resources). (MKT/CIV) Minimizes potential for safety issues as compared to animal-based proteins. (CIV) Donates products to food banks.
W	Lab grown beef and poultry	For-profit	Producer Processor	**Future Emergent**	(INN/MKT) Novel technology being developed to grow meat cells and to form those cells into products that look, feel, and taste like animal-based meat. (IND/INN) Actively pursuing manufacturing at scale; development of new process technology. (IND/INN) Expanding product scope. (ECO) Use of animal cells to create meat; (animal welfare, climate change, human health, natural resources). (MKT/CIV) Lab grown meat will have a favorable nutritional profile and minimizes food safety issues because the environment is controlled.

[1] Primary quadrant is listed first in **bold**. [2] Non-profit organizations are not producers; the quadrant is indicative of the type of food that they distribute.

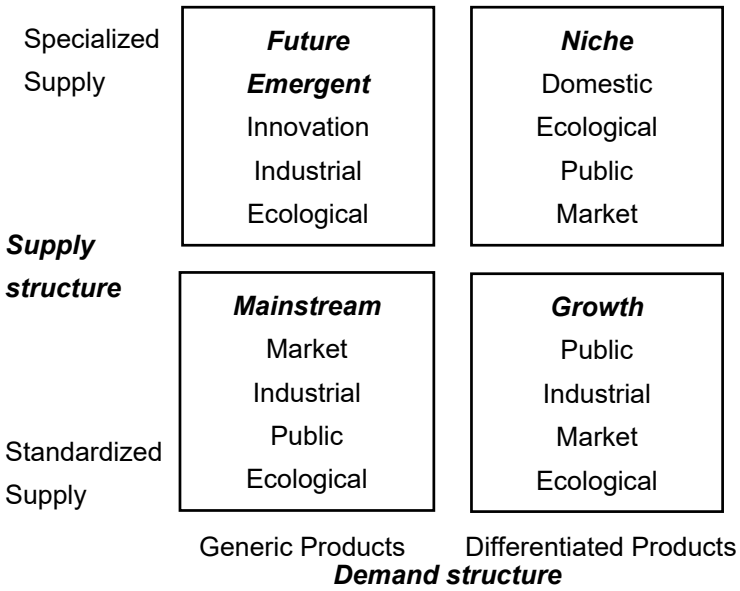

Figure 3. Typology of embedded quality conventions.

Consistent with the prescribed practice for case study methods, we assigned cases and developed the typology through iterative examination of the data [18,29,50–52]. We first tentatively assigned cases to one or more quadrants within the typology (i.e., Mainstream, Future Emergent, Growth, or Niche) based on the configuration of conventions that emerged from the data (Figure 4). Of the 23 organizational cases, nine occupied a single quadrant with their food products and FSCs. In contrast, 14 cases offered products and operate FSCs in more than one quadrant. We then finalized the assignments of cases with the second iteration of analysis. We analyzed practices within each quadrant of the typology to assess consistency between cases, consistency of the dominant conven-

tion within each quadrant, patterns of practices, as well as any inconsistencies or notable findings within a particular bundle of quality conventions. We then compared practices a third time, across quadrants of the typology, assessing similarities and differences, as well as characteristics of conventions that could enable movement between quadrants. Two researchers independently coded data and follow-up discussions were used to resolve any discrepancies.

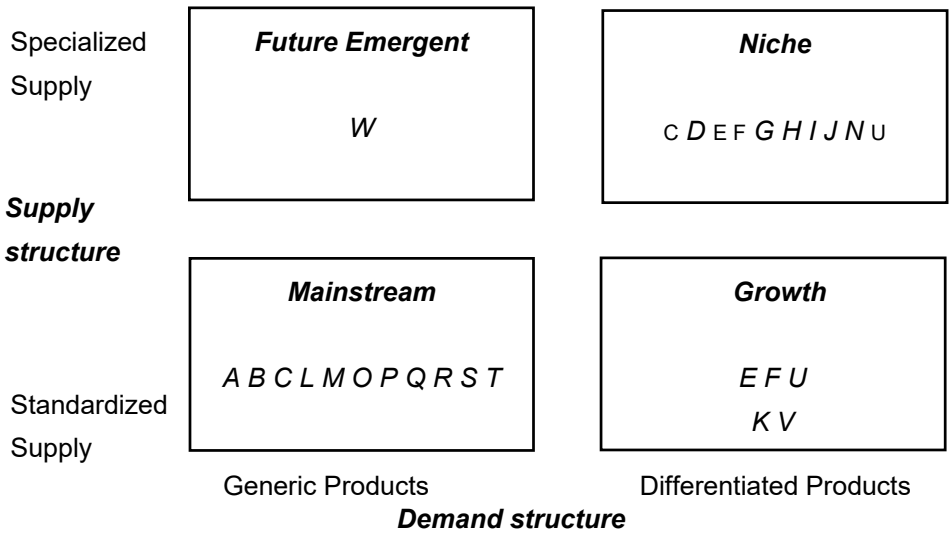

Figure 4. Case placement within typology. 1. All quadrants occupied by an organization indicated by letter. Primary focus indicated with larger/italicized font. 2. Cases L, P, Q, R, S, and T are non-profits providing food assistance; their placement within the typology indicates the types of products that they distribute; they are not food producers.

4. Findings

4.1. Bundling of Quality Conventions and Competitive Advantage

We first examined generic products with standardized supply (Mainstream). Mainstream emphasizes providing economic value. Market conventions are closely followed by the industrial convention (IND), which supports the ability to produce conforming items at high volumes and relatively low prices [48]. In contrast, Growth products must exhibit some level of differentiation, which, in turn, makes them fit for use or desired by customers (i.e., satisfying demand characteristics). Certified organic processes operating with scale and scope are one example of Growth, applying standardized supply processes. This would suggest the prioritization of public conventions to achieve order-winning characteristics such as organic certification, followed by industrial conventions, which enable high volume at a relatively lower cost than more specialized supply (i.e., Niche). Using similar logic, we found innovation in distinguishing Future Emergent, and the domestic convention for Niche.

4.1.1. Mainstream

The Mainstream type of food supply chain applies widely available production techniques to create relatively undifferentiated food products (some differentiation may occur as Mainstream ingredients are further processed, combined, and comingled to take on various quality attributes. However, compared to Growth and Niche products, Mainstream products have little differentiation). The skills and information required for farming, animal husbandry, harvesting, slaughter, processing, and packaging of these products are widely available and well understood; Mainstream FSCs therefore engage in exploitation as defined by March [56]. Because these products involve mature technologies, processes are conducted with an emphasis on increasing efficiency at the process level (we refer to efficiency at the process level, not reflecting total inputs of energy, fertilizers, and the resources

associated with those inputs). The differentiation of products is relatively low, although branding may be used to convey quality and value to the consumer. Price competition is intense. Accordingly, market conventions are a priority for competitive advantage, supported by industrial conventions that enable efficiency and scale, followed by widespread public acceptance of this type of food product, and by inference, acceptance of this type of FSC.

4.1.2. Future Emergent

The Future Emergent quadrant of the typology is characterized primarily by innovation beyond incremental processes or technological improvements (i.e., exploration [56]). While it may not be a stated goal of firms within this space, the successful commercialization of these products and processes has the potential to disrupt the industry. Future Emergent products are substitutes for existing, relatively standardized products. Laboratory-grown meat, for example, strives to be a replacement for meat produced through Mainstream, Growth, or Niche methods. In contrast with Growth's plant-based protein substitutes (e.g., soy-based nuggets or plant-based ground beef substitutes), these processes aim to create products that, at a cellular level, are identical to animal cells, and which replicate the texture and appearance of meat. We deduce that industrial conventions are aspirational for Future Emergent products; in order to commercialize their relatively generic products, Future Emergent production needs to be at an industrial scale to compete successfully with comparable Mainstream products. As long as products in this space remain undifferentiated, it is unlikely that they will compete directly with Niche or Growth products. Ecological sustainability is also a part of the value proposition for Future Emergent; however, the technologies within this quadrant are still maturing and their relative ecologic sustainability compared to other quadrants are uncertain. Similarly, these products and processes have not yet fulfilled the market convention in terms of being commercially viable.

4.1.3. Growth

Growth FSCs apply widely available skills, technology and information to create differentiated products, in addition to leveraging economies of scale and scope. Consumers pay a premium for differentiated products, but there is price-based competition in this category. Product differentiation is achieved through following procedures required to establish one or more product/process attributions, such as certified organic, non-GMO, fair trade, etc. Firms that occupy this quadrant exploit existing industrial technologies and skills to produce differentiated products efficiently [56]. In some respects, products in this space may be labeled with attributes that also appear to differentiate the Niche quadrant (e.g., local, pasture-raised). What distinguishes Growth from Niche in this respect is the ability to achieve industrial scale and efficiency. What is striking, in comparing the bundle of quality conventions present in Mainstream with those in Growth, is that each quadrant applies the same set of conventions; the distinguishing feature is the *prioritization* of conventions. As conveyed by its name, the Growth quadrant competes by offering one or more product claims or attributes that are highly desirable by consumers and therefore fulfill the public convention. Such differentiation, however, must occur at industrial scale in order to be competitive. The essential tradeoff associated with the Growth quadrant is between the level of product differentiation and industrial scale in widely available and well-understood processes. In other words, there may be an upper limit to the firm's ability to create differentiated attributes without moving into specialized processes, which require the firm to explore rather than exploit.

4.1.4. Niche

Niche FSCs differentiate their products via processes and methods that are highly specialized. Growing and production methods may (or may not) be externally certified or recognized by an institution or body of experts. The practice of organic growing methods, for example, may pre-date development of governmental organic standards. Niche

producers engage in some level of exploitation as well as exploration. While the balance of exploitation and exploration varies between cases, this organizational ambidexterity is necessary for Niche producers to exploit and incrementally improve existing production methods while exploring demand characteristics [57,58]. For example, depending on the exact type of forage available, pastured eggs may have a more favorable nutritional profile than eggs from Mainstream FSCs [59]. This nutritional advantage is less widely recognized than other attributes of pasturing, but represents a potential additional competitive advantage for firms than can maintain this convention.

Conventions of place or tradition may be codified by external bodies, or may be less formal (e.g., Washington State apples versus Denominazione di Origine Controllata e Garantita [DOCG] for Italian wine). Domestic conventions can be rooted in traditional methods and location (e.g., Spanish jamón Ibérico), however firms may seek to transfer the methods to different locations (e.g., ham produced in Texas using the same cerdo Ibérico species, and the same feeding, slaughter, and curing methods as in Spain). Attachment to place can be very specific to *terroir* in that the underlying characteristics of that location are considered non-substitutable (e.g., DOCG Italian wine). Alternatively, attachment to place can be associated with a claim of *local* production and distribution.

Specific elements of Niche methods may limit the ability to scale production, keeping prices relatively high. Pasturing of hens to produce pastured eggs, for example, is not formally defined by any regulatory agency, but Certified Humane (among others) sets a standard and conducts facility certification [60]. Because this standard requires at least 108 square feet of pasture availability versus the two square foot certification standard applied to free range eggs, pasture raised eggs under this standard require greater resource inputs and sell at higher prices.

4.2. Cases Competing Based on a Single Quadrant

Our analysis indicates that some firms occupy and compete based on a single quadrant of the typology. This is more readily observable for Future Emergent and Niche. Future Emergent production, as characterized from practice anecdotally and our single Future Emergent case (see Figure 4), is conducted by start-up organizations, some of which claim to be on the verge of commercialization. The phenomenon of competing within a single quadrant is also observed in Niche production when firms prioritize some form or combination of domestic conventions as a basis of competition. Seven of our 23 cases occupy a single quadrant.

Case D, for example is a producer that operates all levels of the supply chain, encompassing production through retail. Cultivation and animal husbandry techniques are more labor intensive than industrial farming and meat production methods, but are beneficial in terms of minimizing off-farm inputs such as pesticide and fertilizer as well as promoting carbon sequestration, soil quality, and animal welfare. In addition, the producer conducts their own slaughter, packaging, and distribution of products in a direct-to-consumer model, limiting distribution to a several hour drive from the farm. Our analysis of this case suggests two particularly interesting findings. First, products are characterized and marketed as *local* food. Second, this producer strongly asserts that scaling operations would destroy core capabilities and quality conventions.

When asked to define *local* food, the consensus of Case D responses indicated that in this context the term denotes more than geographical proximity between producer and consumer. Two main themes emerged related to their conceptualization of local food. First, local food offers the opportunity to develop a connection between the producer and the customer. Second, the term indicates a type of proximity that allows transparency regarding production methods and quality attributes [61]. In addition to limiting how far products travel, their distribution and retailing model maximizes direct contact between the producer and the customer. In addition to their production methods, this connection was reported to be an important, order-winning attribute for their products. Customers are encouraged to visit the farm and facilities, the producer regularly holds open on-site events, operates

an on-site store, and maintains an extensive website explaining their values, production methods, and quality attributes. The producer charges a substantial premium as compared to similar products available in specialty grocery stores or farmers' markets. Domestic and ecological quality conventions are intrinsic in product marketing, and justify the price premium (e.g., public and market). Because of relatively high prices and the method of distribution, these products are largely unavailable to socio-economically disadvantaged consumers. As a result, there is a tradeoff for this producer with respect to achieving market, ecological and public conventions versus the civic convention.

Conventional business logic suggests that where a premium can be earned, expansion and greater production scale are desirable. However, our interviews at Case D reflected strong resistance to the idea of scaling production up to higher volumes. Interviewees expressed serious doubt regarding the potential for achieving economies of scale with these practices. The producer firmly rejected the idea that a large firm could successfully undertake similar agricultural practices. The rationale behind this assertion was twofold: (1) Loss of the relational aspect of small volume production with direct-to-consumer sales would erode consumer trust in quality attributes; and (2) Perception that larger firms, because they rely heavily on external investment, would be unable to balance potential tradeoffs between sustainable practices and seeking higher efficiency.

Cases concentrating on Niche tend to be smaller firms with highly specific target markets. Cases D, G, H, I, and N serve relatively small geographic areas, reinforcing their branding as local food. The domestic convention as evidenced by these firms does not necessarily rely on external validation by certifying bodies or other institutions. Instead, Niche producers may develop and rely on their own definitions of practices that fulfill the domestic conventions. In this sense, this type of producer is particularly vulnerable to encroachment by Growth products, which may have more obvious and externally validated quality attributes and are more competitively priced than their Niche counterparts. To defend their competitive advantage, producers concentrating solely on Niche must therefore consistently deliver products that are perceived by customers as fulfilling domestic conventions with attributes that justify price premiums (public, market). We observed multiple instances of Niche producers implementing practices to defend their domestic convention, including direction connection to consumers (Cases D, G, and H) and high levels of transparency regarding production methods (Cases D, E, G, N, and U). In each case, demonstrating authenticity to customers appears to be central to domestic convention, conveying producer trustworthiness and maintaining socially embedded attributes of transactions [45,61–63].

Firms that compete in one quadrant face potential tradeoffs. Niche firms, for example exploit existing capabilities and accept lower productivity to earn a price premium. By forgoing entry into Growth, for example, such firms are trading off access to volume demand with avoiding investment in industrial conventions. For some Niche producers, this choice is philosophical (Case D, G, I), however, multiple producers indicated that they were more interested in, and believed their skills and resources were more suited for, incremental growth, including expansion of scope, within Niche. Firms may not have the resources to compete in multiple quadrants, or may decide that focusing on single set of quality conventions is more efficient. Finally, as explained by multiple respondents at Case D, there may be a perceived quality risk associated with expanding to different supply or demand characteristics.

4.3. Cases Competing Based on Multiple Quadrants

Thirteen cases occupy two quadrants and a single case occupies three quadrants of the typology. Our analysis indicates that there are several motivations for competing in this manner. First, with respect to demand characteristics, consumer preferences are changing. Increasingly, US consumers express interest in food safety, nutrition, as well as social and environmental issues around how food is produced [64]. Recent surveys of US consumers suggest that food purchase decisions have shifted from traditional drivers of

price, convenience, and taste towards evolving drivers such as health and wellness, safety, social impact, personal engagement, and transparency [27]. However, at the same time a majority of global consumers express doubts about the validity of food label claims [64] and for several decades, US consumers have expressed distrust in the food industry, and more specifically, large food corporations [65].

Our analysis finds that the majority of firms occupying multiple quadrants appear to do so in order to address consumer preferences and to ensure long-term firm survival. Cases A, B, C, M, and O each compete within the Mainstream quadrant as well as Growth. This combination reflects what appears to be a nearly complete intertwining of Mainstream and Growth FSCs via exploitation of industrial conventions. While this offers potential competitive advantage for firms and choice for consumers, it also presents challenges for managers attempting to manage FSCs with different sets of quality conventions. Furthermore, the pressure to achieve efficiency and scale could strain the ability of Growth FSCs, operating in combination with Mainstream FSCs, to maintain differentiating characteristics. One example of these challenges has arisen in the dairy industry, where a series of allegations have been made that large organic milk producers do not fulfill the pasturing requirements of certified organic dairy production [66]. Even if such allegations remain unsubstantiated, such issues could erode consumer trust and compromise the ability of Growth dairy to earn a premium. Organic certification currently relies on achieving and maintaining standards of practice with up-front certification and infrequent auditing rather than testing, however, evolution of testing capabilities may eventually enable routine discrimination between compliant and non-compliant organic dairy [67].

Changing supply characteristics provide a second driver for competing in multiple quadrants. Mainstream producers may be interested in hedging against future supply uncertainty for a variety of reasons. Natural resource depletion associated with Mainstream agriculture, as well as climate change may render inputs to existing processes more costly and outputs less productive [68]. In the long term, current global production capacity is insufficient to support projected population growth [6].

If successful, Future Emergent technologies have the potential to minimize resources required to satisfy future demand, as well as to reduce risk associated with contamination [69]. Despite advances in production, monitoring, and testing methods, food safety continues to be a problem, even in developed economies with mature regulatory systems such as the US [70]. The interconnectedness, global reach, as well as a relative lack of transparency and traceability in FSCs contribute to food safety risk [22,71]; in addition, aspects of industrialized agriculture may contribute to the incidence of such failures [72,73].

Finally, firms may expand to multiple quadrants in order to explore and exploit simultaneously, implementing a strategy of operational ambidexterity [56,74,75]. Food industry firms face both high levels of competition as well as high levels of dynamism [74]; as a result, a combination of exploration and exploitation may be advantageous if the firm can balance both activities [69,75,76].

4.4. Movement between Quadrants

Due to external threats such as climate change, which may affect supply, Mainstream firms may be motivated to look outside this quadrant. Transition to Growth most closely resembles exploitation, as articulated by March [56] because the firm is applying well-known practices to extend itself into a different set of demand characteristics. Alternatively, Mainstream firms may pursue exploration via transition to Future Emergent. While we did not directly observe this in our sample, we have observed anecdotal examples of firms investing in Future Emergent startups as a hedge against future supply and demand shifts. A number of firms that engage in industrialized meat production, for example, have invested in one or more lab-grown meat startups, which could be considered a form of exploration [56]. These firms arguably are engaging in the exploration of both supply (e.g., production technology development) and demand (e.g., consumer perceptions, public conventions) characteristics. We have also observed firms in these situations exploiting

existing capabilities and differentiated demand by offering different varieties of plant-based proteins [77]. By engaging in transitions toward both Growth and Future Emergent FSCs, a firm is exhibiting a form of organizational ambidexterity [56,74]. This orientation is the potentially effective use of resources and a hedge against an uncertain future, however, this approach requires the firm to balance exploitation and exploration; imbalance or misfit with the external environment can threaten firm survival [57,58].

Mainstream FSCs are likely to pursue exploitation by adding Growth to their portfolio as a source of differentiation. Five cases (A, B, C, M, and O) operate in both Mainstream and Growth quadrants, maintaining a dominant orientation toward Mainstream products. These firms exploit existing industrial capabilities to produce differentiated products at high volumes and relatively low prices. To defend their differentiation, Growth FSCs need to align with and maintain appropriate quality conventions, which may be challenging when pursuing a competitive advantage in two different quadrants.

Niche FSCs appear to either be entrenched (Cases D, G, H, I, J, and N), or poised to attempt to transition to Growth, which will require a level of ambidexterity. We identified three cases (E, F, and U) that exist in both the Niche and the Growth quadrants. Each of these cases concerned egg products. As indicated in Figure 4, E, F, and U each compete as *alternative* FSCs within the Niche quadrant; these producers' methods are associated with aspects of the domestic, and ecological conventions, both of which are order winners and therefore suggest the public convention. We have also indicated that these firms occupy Growth for these cases and have shown Growth as the predominant positioning. This is based on our observation that these producers increasingly apply quality conventions that are more consistent with the Growth quadrant including increasing scale, scope, and process improvements for efficiency.

As shown in Figure 4, the typology predicts that firms transitioning from Niche to Growth FSCs must take on the associated industrial convention. In reviewing the practices that these cases employ to support the domestic convention, we note that the authenticity and transparency differentiating these FSCs as they occupy the Niche quadrant will necessarily be difficult, if not impossible, to maintain as their operations expand. Each of these egg producers relies on a network of smaller producers and the resource requirements (e.g., labor and land). As production volumes increase, the number of suppliers qualified, contracted, and managed, and therefore the level of resources and supply chain maturity required to successfully maintain consistency of quality conventions will grow as complexity increases [78,79]. Furthermore, increases in scale are likely to require substantial capital investments; as these producers take on debt, they will be under intense pressure to service debt, further increasing the potential for efficiency to drive prioritization of the industrial convention. These insights are supported by evidence from entrenched Niche producers (e.g., Case D); it remains to be seen how the transitioning firms will span both Niche and Growth, transition to Growth and associated conventions and priorities, or, alternatively, generate a new configuration of quality conventions.

While we did not observe Future Emergent transitions in our sample, the typology predicts that they have two likely future paths. If Future Emergent firms develop industrial conventions and produce high volume, relatively commoditized products at low prices, they will need to convert their exploratory efforts into exploitative capabilities and transition into the Mainstream quadrant. Alternatively, they may transition to Growth by developing differentiated products; this transition will also require industrial conventions. For example, if lab-grown protein can achieve differentiation via ecological conventions, or by being nutritionally superior to animal protein, a Future Emergent product could mature into a Growth product.

We identify a single firm (Case C) that occupies three quadrants (Mainstream, Growth, and Niche). This firm is a small family-owned grocer with a few locations. The paths through which Case C traveled to its current position is distinct from other retailers than occupy both Mainstream and Growth. Case C included Niche products relatively early in its history; such early introductions included wine, cheese, and condiments associated

with particular locations and traditional processes (e.g., Italian balsamic vinegar). In addition, Case C developed relationships with local producers of seasonal produce early in their history. As consumer interest in place associations of food increased, the retailer expanded the marketing of its sourcing practices. These practices include developing direct relationships with specialized, high quality providers; whether local or distant (e.g., locally grown corn and air-freighted lobsters are both promoted on the basis of the social and ecologically embedded characteristics of the producer). Later, as opportunities arose in terms of both supply and demand, this retailer added Growth products. Neither Niche nor Growth products dominate Case C's offerings; therefore, they are classified as predominately Mainstream.

While our limited sample cannot guarantee exhaustive identification of potential movement between quadrants, however, from a theoretical and practical perspective, as well as based on our empirical evidence, we find specific paths to be unlikely. Mainstream and Growth supply and demand characteristics, as well as their associated quality conventions, do not lend themselves to transitioning toward Niche production. While Case C is a notable exception, this firm spans both Mainstream and Niche quadrants, enabled, in part by its small size and position as a retailer. As a small retailer, Case C can accomplish Niche offerings with a select number of key procurement decisions. In contrast, a producer or processor would need to master entirely different capabilities to occupy the Niche space. While it might be attractive, to some extent, for a Mainstream or Growth firm to acquire a Niche producer, profound barriers to maintaining Niche conventions exist. As a result, we speculate that such acquisitions of Niche producers are likely to result in Niche products fully transitioning away from domestic conventions and occupying Mainstream or Growth quadrants. Theoretically and practically, the chief barrier to occupying combining Mainstream, Growth and Niche at the producer level is the absence of the domestic convention in Mainstream and Growth quadrants, and the corresponding absence of industrial conventions in the Niche quadrant. Similarly, we see little support for transitions from Niche or Growth to Future Emergent.

Three Niche cases (E, F, and U) are in currently in period of transition from Niche to Growth; we coded these firms as emphasizing Growth over Niche, based on the observed direction of this transition. Considering the evidence of some firms transitioning between or occupying both Niche and Growth (e.g., Cases E, F, and U), it remains to be determined if Niche and Growth can be maintained simultaneously at the producer level. Should such firms transition away from Niche into Growth, it is possible that eventually a transition could be made from Growth to Mainstream. The transition, currently under way, at McDonald's and Walmart from cage-raised eggs to cage-free eggs could represent an opportunity for this type of transition [80,81]. Several factors suggest this possibility. First, the transition from Growth to Mainstream could occur if consumers no longer widely accept or demand cage raised eggs consumers (i.e., loss of public convention). Second, from a technological perspective, both types of egg production share strong ties to the industrial convention. Practically speaking, cage-free eggs represent a small evolution in terms of resources required as compared to cage-raised eggs; industrial conventions ensure a focus on productivity improvements, increasing the likelihood of production at a relatively low cost [82]. Notably, the most rigorous standards for egg production that certify the humane treatment of animals do not certify cage-free facilities [60]. Finally, such a transition may be possible given that some of the largest commercial buyers of eggs are driving demand for cage-free eggs. In comparison, a similar transition to pasturing under the most rigorous standard is estimated to require roughly the same amount of land as Rhode Island in order to supply pastured eggs at current volumes of US demand, making such a transition substantially more difficult [82].

5. Discussion and Conclusions

5.1. Research Contributions

From a theoretical perspective, this study contributes by explicitly incorporating the elements of sustainable strategies suggested by the NRBV with CT to develop a novel and comprehensive quality convention framework for FSCs. This is theoretically relevant because of the complexity of evaluating quality in food products, and because of the diversity present in and dynamic nature of different FSC configurations [75]. Furthermore, the proposed framework allows issues that have formerly been considered peripheral to operational performance (e.g., ecological and civic conventions) to be reflected under the umbrella of quality management.

To our knowledge, this is the first use of CT in the OM/SCM discipline. Given CT's long history in geographic sociology and political economy as well as its tradition of explaining socially embedded quality conventions in agri-food systems, we believe that there is substantial potential for further application of CT to FSCs, as well as to other industry contexts.

5.2. Managerial Implications

Managers within the food industry must handle high levels of competition, relatively low-profit margins and increasing levels of governmental regulation, in addition to supply chain complexity. In navigating this environment, these managers need to match operational capabilities with evolving consumer preferences [27,64]. One of the contributions of this study is to provide clarity by developing a robust, theoretically grounded and empirically validated framework for the product, process, and FSC quality. This clarity is important because prior quality frameworks (e.g., Garvin's [24]) do not capture the socially embedded nature of food products. Accurate and comprehensive quality dimensions allow managers at all levels to assess the ability of their enterprise to deliver on product claims, and, in turn, to satisfy consumer demand and expectations. In addition, Tables 1 and 3 identify general convention attributes as well as specific examples of practices that managers may consider adopting in order to support their selected quality conventions.

In addition, we highlight the need to manage a number of tradeoffs in order to reduce the potential for quality failures. In particular, our findings suggest that firms that attempt to move from Niche to Growth positions and from Mainstream to Growth are vulnerable to systemic quality failures. We find that firms in these transitions may be particularly susceptible to allowing the pressures of achieving scale and scope to detract from or erode important quality conventions. Quality failures for conventions that are sources of differentiation and order winners (e.g., organic production methods or pasture-raised eggs), the potential for damage to the firm in terms of reputation and market share is severe. Our analysis of cases across the typology suggests that firms seeking differentiation through Niche or Growth must compete with possible substitute products that make similar claims (e.g., *local* claims for what is objectively a Mainstream product). The value, therefore, of a quality convention, may be diminished by: (1) Spurious use of similar claims by the competition; (2) Lack of transparency across competing FSCs; (3) Limited consumer ability to evaluate the authenticity of quality conventions; and (4) Lack of regulatory definitions for quality claims. It is therefore critical for managers to understand the quality conventions attached to various products, to develop and maintain alignment between operations and marketing functions, and to monitor and remedy quality issues throughout the FSC. Furthermore, for firms choosing to transition between quadrants, or choosing to occupy more than one quadrant, managers should consider the resource requirements necessary for pursuing an ambidextrous strategy [56,58,74]. In addition, managers need to be particularly careful when spanning quadrants where one convention may trade off with another (e.g., Niche and Growth). Where these tradeoffs exist at the quality convention level, managers should consider the extent to which resources need to be duplicated rather than shared to avoid conflicts between conventions.

Given the lack of standard definitions and regulatory protections for some methods, particularly within the Niche quadrant, managers make seek to defend their quality claims by developing local or regional institutions and branding [75,83]. In addition to the potential to develop a collective and visible presence via such institutions, we have observed at least one case within our sample where a cooperative institution allowed producers to share resources and reduced the cost of valuable certifications and infrastructure. While conducted at a national level, the Origin Green/Bord Bia program of Ireland is a best practice exemplar for collaboration between policy-making institutions and industry to develop shared sustainability standards, share resources, and develop branding to support increasing demand [83].

One potential value-add for managers adopting a quality conventions framework is that it can be used to decide and convey how social and ecological sustainability concerns are integrated into firm and supply chain strategy. We suggest that the quality conventions approach enables FSC strategy to be set, communicated, and implemented with greater authenticity than more narrow approaches. Placing sustainability under the umbrella of quality management renders these formerly ancillary considerations central to the operations management function.

We acknowledge that it is unlikely that a for-profit firm will make civic conventions their first priority. However, incorporating this dimension, to the extent deemed appropriate, directly into the quality management and supply chain strategy enables firms to articulate their social sustainability in a manner that minimizes the potential for to be perceived as engaging in impression management rather than making an actual civic contribution.

5.3. Limitations, Future Research, and Conclusions

Our research is subject to several limitations. First, the use of case methods and the accompanying limited sample could limit the generalizability of our findings. Future research using other methods such as surveys could more easily collect larger samples, confirm our exploratory findings, and provide broader generalizability. Further, we suggest that future studies should consider how to reliably measure FSC quality conventions and examine the role of firm positioning and performance against quality conventions in terms of sustainability, financial performance, and market share. More particular to supply chain management, the typology could be used to examine how firms that operate in multiple quadrants and across multiple supply chain stages balance the different types of network configurations and quality management systems required to fulfill multiple sets of quality conventions. The second limitation is that our sample is limited to FSC cases from the US. We suggest, however, that the use of quality conventions, consistent with its application in other disciplines, can be adapted to other industries. As such, we suggest that future work extend this framework to FSCs in other countries and industries.

In conclusion, the criticality of FSCs, as well as the extent to which they are embedded in social and ecological conventions demands a comprehensive and flexible quality framework. This study lays the foundation for future work and for managers to consider FSC quality in a different and more holistic manner. Looking ahead, we believe that there is potential for the integration of NRBV and CT to advance theory and practice beyond the food industry context.

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organization. Each individual spoke on the conditions of: (1) anonymity in the primary interview data; and (2) individual statements were not made on behalf of the case study organization. Additional sources of data (i.e., websites, advertisements, public press) were derived from publically available sources accessed by the authors. Individual names were not recorded in the primary data, therefore individuals cannot be identified based on their statements. In addition, information on identifying organizational characteristics was limited to the data provided in Table 2.

Informed Consent Statement: All subjects gave their informed consent for inclusion before they participated in the study.

Data Availability Statement: The data presented in this study are available in Tables 2 and 3 of this article.

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References

1. Markman, G.; Krause, D. Theory building surrounding sustainable supply chain management: Assessing what we know, exploring where to go. *J. Supply Chain Manag.* **2016**, *52*, 3–10. [CrossRef]
2. Montabon, F.; Pagell, M.; Wu, Z. Making sustainability sustainable. *J. Supply Chain Manag.* **2016**, *52*, 11–27. [CrossRef]
3. Pagell, M.; Shevchenko, A. Why research in sustainable supply chain management should have no future. *J. Supply Chain Manag.* **2014**, *50*, 44–55. [CrossRef]
4. Samson, D. Operations/supply chain management in a new world context. *Oper. Manag. Res.* **2020**, *13*, 1–3. [CrossRef]
5. Food and Agriculture Organization of the United Nations. *The State of Food Security and Nutrition in the World 2018. Building Climate Resilience for Food Security and Nutrition*; Food and Agriculture Organization of the United Nations: Rome, Italy, 2018.
6. Food and Agriculture Organization of the United Nations. *The Future of Food and Agriculture—Alternative Pathways to 2050*; Food and Agriculture Organization of the United Nations: Rome, Italy, 2018.
7. Food Marketing Institute. US Grocery Shopper Trends. 2017. Available online: https://www.fmi.org/our-research/research-reports/u-s-grocery-shopper-trends (accessed on 24 August 2020).
8. Lappé, F.; Collins, J. *World Hunger: Ten Myths*; Grove Press: New York, NY, USA, 2015.
9. Maloni, M.; Brown, M. Corporate social responsibility in the supply chain: An application in the food industry. *J. Bus. Ethics* **2006**, *68*, 35–52. [CrossRef]
10. McWilliams, J. *Just Food: Where Locavores Get It Wrong and How We Can Truly Eat Responsibly*; Little, Brown and Company: New York, NY, USA, 2009.
11. Norwood, F.; Calvo-Lorenzo, M.; Lancaster, S.; Oltenacu, P. *Agricultural and Food Controversies: What Everyone Needs to Know*; Oxford University Press: New York, NY, USA, 2015.
12. Corbett, C.; Klassen, R. Extending the horizons: Environmental excellence as key to improving operations. *Manuf. Serv. Oper. Manag.* **2006**, *8*, 5–22. [CrossRef]
13. Curkovic, S.; Melnyk, S.; Handfield, R.; Calantone, R. Investigating the linkage between total quality management and environmentally responsible manufacturing. *IEEE Trans. Eng. Manag.* **2000**, *47*, 444–464. [CrossRef]
14. Curkovic, S.; Sroufe, R.; Landeros, R. Measuring TQEM returns from the application of quality frameworks. *Bus. Strategy Environ.* **2008**, *17*, 93–106. [CrossRef]
15. Rusinko, C. Using quality management as a bridge to environmental sustainability in organizations. *SAM Adv. Manag. J.* **2005**, *70*, 54–61.
16. Wiengarten, F.; Pagell, M. The importance of quality management for the success of environmental management initiatives. *Int. J. Prod. Econ.* **2012**, *140*, 407–415. [CrossRef]
17. Roth, A.; Zheng, Y. A tale of two food chains: The duality of practices on well-being. *Prod. Oper. Manag.* **2021**, *30*, 783–801. [CrossRef]
18. Craighead, C.W.; Ketchen, D.J., Jr.; Cheng, L. "Goldilocks" theorizing in supply chain research: Balancing scientific and practical utility via middle-range theory. *Trans. J.* **2016**, *55*, 241–257. [CrossRef]
19. Wowak, K.D.; Craighead, C.W.; Ketchen, D.J., Jr.; Connelly, B.L. Food for thought: Recalls and outcomes. *J. Bus. Logist.* **2022**, *43*, 9–35. [CrossRef]
20. Hart, S.; Dowell, G. A natural-resource-based-view of the firm: Fifteen years after. *J. Manag.* **2011**, *37*, 1464–1479.
21. Granovetter, M. Economic action and social structure: The problem of embeddedness. *Am. J. Soc.* **1985**, *91*, 481–510. [CrossRef]
22. Roth, A.; Tsay, A.; Pullman, M.; Gray, J. Unraveling the food supply chain: Strategic insights from China and the 2007 recalls. *J. Supply Chain Manag.* **2008**, *44*, 22–39. [CrossRef]
23. Pullman, M.; Maloni, M.; Carter, C. Food for thought: Social versus environmental sustainability practices and performance outcomes. *J. Supply Chain Manag.* **2009**, *45*, 38–54. [CrossRef]
24. Garvin, D. Competing on the eight dimensions of quality. *Harvard Bus. Rev.* **1987**, *65*, 101–109.
25. Raynolds, L. Re-embedding global agriculture: The international organic and fair trade movements. *Agric. Hum. Values* **2000**, *17*, 297–309. [CrossRef]

26. Hinrichs, C. Embeddedness and local food systems: Notes on two types of direct agricultural market. *J. Rural. Stud.* **2000**, *16*, 295–303. [CrossRef]
27. Deloitte. Capitalizing on the Shifting Consumer Food Value Equation. 2016. Available online: https://www2.deloitte.com/content/dam/Deloitte/us/Documents/consumer-business/us-fmi-gma-report.pdf (accessed on 23 August 2020).
28. Murdoch, J.; Marsden, T.; Banks, J. Quality, nature, and embeddedness: Some theoretical considerations in the context of the food sector. *Econ. Geo.* **2000**, *76*, 107–125. [CrossRef]
29. Eisenhardt, K.M. Building theories from case study research. *Acad. Manag. Rev.* **1989**, *14*, 532–550. [CrossRef]
30. Hart, S. A natural-resource-based-view of the firm. *Acad. Manag.* **1995**, *20*, 986–1014.
31. Clarkson, P.; Li, Y.; Richardson, G.; Vasvari, F. Revisiting the relation between environmental performance and environmental disclosure: An empirical analysis. *Account. Org. Soc.* **2008**, *33*, 303–327. [CrossRef]
32. Holder-Webb, L.; Cohen, J.; Nath, L.; Wood, D. The supply of corporate social responsibility disclosures among US firms. *J. Bus. Ethics* **2009**, *84*, 497–527. [CrossRef]
33. Mueller, M.; Dos Santos, V.; Seuring, S. The contribution of environmental and social standards towards ensuring legitimacy in supply chain governance. *J. Bus. Ethics* **2009**, *89*, 509–523. [CrossRef]
34. Ponte, S. Convention theory in the Anglophone agro-food literature: Past, present and future. *J. Rural. Stud.* **2016**, *44*, 12–23. [CrossRef]
35. Boltanski, L.; Thévenot, L. *De la Justification. Les Économies de la Grandeur. 2006 English Translation by C Porter: On Justification: Economies of Worth*; Princeton University Press: Princeton, NJ, USA, 1991.
36. Diaz-Bone, R. Convention theory, classification and quantification. *Hist. Soc. Res.* **2016**, *42*, 48–71.
37. Murdoch, J.; Miele, M. Culinary networks and cultural connections: A conventions perspective. In *Geographies of Commodity Chains*; Hughes, A., Reimer, S., Eds.; Routledge: London, UK, 2004; pp. 102–119.
38. Ponte, S. Governing through quality: Conventions and supply relations in the value chain for South African wine. *Sociol. Rural.* **2009**, *49*, 236–257. [CrossRef]
39. Storper, M.; Salais, R. *Worlds of Production: The Action Frameworks of the Economy*; Harvard University Press: Cambridge, MA, USA, 1997.
40. Trabalzi, F. Crossing conventions in localized food networks: Insights from southern Italy. *Environ. Plan A* **2007**, *39*, 283–300. [CrossRef]
41. Gibbon, P.; Riisgaard, L. A new system of labour management in African large-scale agriculture? *J. Agrar. Chang.* **2014**, *14*, 94–128. [CrossRef]
42. Feagan, R. The place of food: Mapping out the 'local' in local food systems. *Prog. Hum. Geog.* **2007**, *31*, 23–42. [CrossRef]
43. Hinrichs, C. The practice and politics of food system localization. *J. Rural. Stud.* **2003**, *19*, 33–45. [CrossRef]
44. Renting, H.; Marsden, T.; Banks, J. Understanding alternative food networks: Exploring the role of short food supply chains in rural development. *Environ. Plan A* **2003**, *35*, 393–411. [CrossRef]
45. Winter, M. Embeddedness, the new food economy and defensive localism. *J. Rural. Stud.* **2003**, *19*, 23–32. [CrossRef]
46. León-Bravo, V.; Caniato, F.; Caridi, M. Sustainability in multiple stages of the food supply chain in Italy: Practices, performance and reputation. *Oper. Manag. Res.* **2019**, *12*, 40–61. [CrossRef]
47. Bloemhof, J.; van der Vorst, J.; Bastl, M.; Allaoui, H. Sustainability assessment of food chain logistics. *Int. J. Logist.* **2015**, *18*, 101–117. [CrossRef]
48. Miller, S.; Tait, P.; Saunders, C.; Dalziel, P.; Rutherford, P.; Abell, W. Estimation of consumer willingness-to-pay for social responsibility in fruit and vegetable products: A cross-country comparison using a choice experiment. *J. Consum. Behav.* **2017**, *16*, 13–25. [CrossRef]
49. Tobi, R.C.; Harris, F.; Rana, R.; Brown, K.A.; Quaife, M.; Green, R. Sustainable diet dimensions. Comparing consumer preference for nutrition, environmental and social responsibility food labelling: A systematic review. *Sustainability* **2019**, *11*, 6575. [CrossRef]
50. Voss, C.; Tsikriktsis, N.; Frohlich, M. Case research in operations management. *Int. J. Oper. Prod. Manag.* **2002**, *22*, 195–219. [CrossRef]
51. Meredith, J. Building operations management theory through case and field research. *J. Oper. Manag.* **1998**, *16*, 441–454. [CrossRef]
52. Hoffman, A.J.; Ocasio, W. Not all events are attended equally: Toward a middle-range theory of industry attention to external events. *Org. Sci.* **2001**, *12*, 414–434. [CrossRef]
53. United States Department of Agriculture. ChooseMyPlate. 2010. Available online: https://www.myplate.gov/ (accessed on 29 August 2020).
54. Feeding America. What Is a Food Bank? 2020. Available online: https://www.feedingamerica.org/our-work/food-bank-network (accessed on 27 August 2020).
55. Marsden, T.; Flynn, A.; Harrison, M. *Consuming Interests: The Social Provision of Foods*; UCL Press: London, UK, 2000.
56. March, J. Exploration and exploitation in organizational learning. *Org. Sci.* **1991**, *2*, 71–87. [CrossRef]
57. Gupta, A.; Smith, K.; Shalley, C. The interplay between exploration and exploitation. *Acad. Manag. J.* **2006**, *49*, 693–706. [CrossRef]
58. Zimmermann, A.; Raisch, S.; Cardinal, L. Managing persistent tensions on the frontline: A configurational perspective on ambidexterity. *J. Manag. Stud.* **2018**, *55*, 739–769. [CrossRef]
59. Karsten, H.; Patterson, P.; Stout, R.; Crews, G. Vitamins A, E and fatty acid composition of the eggs of caged hens and pastured hens. *Renew Agri. Food Sys.* **2010**, *25*, 45–54. [CrossRef]

60. Certified Humane. Our standards. 2020. Available online: https://certifiedhumane.org/how-we-work/our-standards/ (accessed on 20 August 2020).
61. Chaudhuri, A.; Holbrook, M. The chain of effects from brand trust and brand affect to brand performance: The role of brand loyalty. *J. Mark.* **2001**, *65*, 81–93. [CrossRef]
62. Cheshire, C.; Gerbasi, A.; Cook, K. Trust and transitions in modes of exchange. *Soc. Psychol. Q.* **2010**, *73*, 176–195. [CrossRef]
63. Kirwan, J.; Maye, D.; Brunori, G. Acknowledging complexity in food supply chains when assessing their performance and sustainability. *J. Rural. Stud.* **2017**, *52*, 21–32. [CrossRef]
64. Nielsen. Nielsen Global Health and Wellness Survey. 2015. Available online: https://www.nielsen.com/wp-content/uploads/sites/3/2019/04/Nielsen20Global20Health20and20Wellness20Report20-20January202015-1.pdf (accessed on 1 August 2022).
65. Center for Food Integrity. *Cracking the Code on Food Issues: Insights from Moms, Millennials and Foodies*; Funded Research for the Foundation for Food Integrity: Gladstone, MO, USA, 2014.
66. Whoriskey, P. Why your "organic" milk may not be organic. *The Washington Post*, 1 May 2017.
67. Chung, I.; Park, I.; Yoon, J.Y.; Yang, Y.S.; Kim, S.H. Determination of organic milk authenticity using carbon and nitrogen natural isotopes. *Food Chem.* **2014**, *160*, 214–218. [CrossRef]
68. Hoffman, M. The social foundation of sustainable agriculture in southeastern Vermont. In *Remaking the North American Food System*; Hinrichs, C., Lyson, T., Eds.; University of Nebraska Press: Lincoln, NE, USA, 2007; pp. 315–331.
69. Tuomisto, H. Vertical farming and cultured meat: Immature technologies for urgent problems. *One Earth* **2019**, *1*, 275–277. [CrossRef]
70. Osterholm, M. Foodborne disease in 2011: The rest of the story. *N. Engl. J. Med.* **2011**, *364*, 889–891. [CrossRef] [PubMed]
71. Hall, D.; Johnson-Hall, T. The value of downstream traceability in food safety management systems: An empirical examination of product recalls. *Oper. Manag. Res.* **2021**, *14*, 61–77. [CrossRef]
72. Roberts, P. *The End of Food*; First Mariner Books: New York, NY, USA, 2008.
73. Russell, J.; Rychilik, J. Factors that alter rumen microbial ecology. *Science* **2001**, *292*, 1119–1122. [CrossRef]
74. Patel, P.; Terjesen, S.; Li, D. Enhancing effects of manufacturing flexibility through operational absorptive capacity and operational ambidexterity. *J. Oper. Manag.* **2012**, *30*, 201–220. [CrossRef]
75. Beske, P.; Seuring, S. Sustainable supply chain management practices and dynamic capabilities in the food industry: A critical analysis of the literature. *Int. J. Prod. Econ.* **2014**, *152*, 131–143. [CrossRef]
76. Jansen, J.; Van Den Bosch, F.; Volberda, H. Exploratory innovation, exploitative innovation, and performance: Effects of organizational antecedents and environmental moderators. *Manag. Sci.* **2006**, *52*, 1661–1674. [CrossRef]
77. Fassler, J. After Backing Out of Beyond Meat, Tyson Foods Announces a New Plant-Based Brand of Its Own. 2019. Available online: https://thecounter.org/after-backing-out-of-beyond-meat-tyson-foods-announces-a-new-plant-based-brand-of-its-own/ (accessed on 25 August 2020).
78. Choi, T.; Dooley, K.; Rungtusanatham, M. Supply networks and complex adaptive systems: Control versus emergence. *J. Oper. Manag.* **2001**, *19*, 351–366. [CrossRef]
79. Choi, T.; Krause, D. The supply base and its complexity: Implications for transaction costs, risks, responsiveness, and innovation. *J. Oper. Manag.* **2006**, *24*, 637–652. [CrossRef]
80. McDonald's. Sharing Progress on Our Cage-Free Egg Commitment. 2020. Available online: https://news.mcdonalds.com/stories/using-our-scale-for-good/cage-free-farmer (accessed on 29 August 2020).
81. Walmart. Walmart 2017 Global Responsibility Report. 2016. Available online: https://corporate.walmart.com/media-library/document/wmt-2017-grr-report-pdf-download (accessed on 1 August 2022).
82. Fassler, J. What Are "Pasture-Raised Eggs," Really? 2016. Available online: https://thecounter.org/pasture-raised-eggs-part-one/ (accessed on 20 August 2020).
83. Shelman, M.; McLoughlin, D.; Pagell, M. Origin green: When your brand is your supply chain. In *Supply Chain Processes for Sustainable Innovation in the Agri-Food Industry*; Cagliano, R., Caniato, F., Worley, C., Eds.; Emerald Publishing Group Limited: Bingley, UK, 2016.

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Avoidance of Supermarket Food Waste—Employees' Perspective on Causes and Measures to Reduce Fruit and Vegetables Waste

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Abstract: Identifying causes of food waste at grocery retail level is crucial for the development of effective measures to reduce waste. Frontline employees manage food waste in their day-to-day operations; however, there is a paucity of research that draws attention to their knowledge of and approach to causes and measures to reduce food waste. In this empirical study, a mixed methods approach is adopted, using multiple interviews and participatory observations with employees, and primary quantitative data on fruit and vegetable waste for one year from the supermarkets. The results illuminate the fact that the role of employees is central for reducing food waste, and from their perspective, the causes and measures can be divided into four different main themes covering policy, practice, people and product. The analysis involves 73 different fruit and vegetables categories, and the fruit and vegetables waste at the three supermarkets is 60 tonnes. The results also reveal different causes for different fruit and vegetables categories, implying that generic descriptions of causes are not enough to use as bases for planning reduction measures. The paper provides a base for planning and implementing reduction measures for the grocery retail sector, which contribute to a sustainable food supply chain.

Keywords: food waste; fruit and vegetables; retail; supermarket; causes; measures; employee; packaging; organic; store operations

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1. Introduction

Food waste is a huge global environmental problem creating about 10 percent of the annual carbon dioxide emissions [1]. Avoidance and reduction of food waste should be prioritised to reduce the associated environmental, economic and social burdens [2–4]. Food retailers have an important role to play in efforts to implement reduction measures for food waste due to their central position in the food system [5,6], since they can influence both upstream suppliers and downstream consumers [7,8]. Studies have quantified food waste and suggested reduction measures in the entire food supply chain [9–11], mapped and recommended improved routines for recording retail food waste [10], and mapped and suggested preventive measures on a general retail level [11].

In a grocery store, the fresh fruit and vegetables (FV) department is where a large part of the food waste within the store occurs [12–17]. The waste quotas for FV range from 3 to 9% [12–16]. Additionally, the FV department has a special position, as many customers tend to choose a retail store based on their perception and experience of the department [18]. Therefore, management and maintenance of the FV department is important for many stores and retail chains. Nevertheless, managing an FV department is difficult and complex, as many of the products are perishable with a limited shelf-life, have sensitive logistical characteristics, and involve erratic demand patterns [19]. Investigations of retail store operations in relation to food waste carried out through interviews of store managers and managers at regional and headquarter levels have shown that the absence of proper work routines has a negative effect on food waste [19–23]. The employees are often portrayed

as a negative factor in this regard, for instance, due to lack of training, knowledge and commitment, and incorrect handling [14,24,25]. However, a cost benefit analysis has shown that it can be cost-effective to spend more personnel time on waste management activities to accomplish waste reduction [26], and retail staff are considered to be a suitable group of informants for further examining causes of food waste [20]. Extant literature on food waste from the perspective of frontline employees is limited, and to the best of the knowledge of the authors of this paper, thus far, no research has been carried out to explore the contributions employees can make to the reduction of food waste. Previous studies have focused on the perspective of managers and there is a scarcity of research that draws attention to the knowledge and approach of employees, and how food waste is actually managed in their day-to-day operations. Since employees and their perspectives have been overlooked, some important aspects may not have been covered, and consequently, focusing on frontline employees will provide additional insights.

General causes of food waste at a retail level have been addressed in the literature [11,15,27,28], including appearance and shape, lack of coordination, lack of waste measurement, inadequate demand forecasting, and customers' behaviour and demands. Inadequate packaging has also been identified as a cause of food waste, including damage during transportation, improper handling, and confusion regarding labelling of dates [29,30]. Within meat and dairy categories, organic products have a higher percentage waste vis-à-vis their conventional counterparts, and low turnover, short shelf-life and large wholesale packaging size were identified as the main reasons [31]. Many studies have examined causes of food waste in stores on an aggregated level [24], but nonetheless, general descriptions of causes are not necessarily applicable to all departments within a store and there is a paucity of specific knowledge about what is valid in each department. Furthermore, supplementary in-depth information on causes for different products and descriptions of the impact on food waste of different packaging solutions are absent [25].

Food waste at retail store level is a multifaceted research area with a multiplicity of influencing factors [24,32]. To gain a better understanding of the complexities involved in the occurrence and management of retail food waste, both qualitative and quantitative sources of data are needed, and the combination of these different data sources is often lacking in previous research [24,25]. There is also a need for empirical work with primary data collection, as well as more in-depth analyses of food waste at the retail level [33,34]. In this paper, a mixed methods approach is adopted, the perspectives of frontline employees are gleaned and first-hand data on food waste are analysed. This research aims to: (1) examine and categorise causes of and measures to reduce food waste from the perspective of frontline employees; (2) collect, compile and calculate the amount of food waste and waste quota for all FV categories, and create a top list with the products that cause 80% of the retail FV waste; (3) compile and calculate the amounts of food waste for both packaged and unpackaged products as well as for organic and conventional products on the top list; (4) use both quantitative and qualitative data to identify and explain product-specific causes of FV waste.

The paper makes two original contributions to the research literature on retail food waste. First, the findings cover the perspectives of the frontline employees and highlight the importance of their knowledge and practices since they prevent and reduce food waste on a daily basis. Second, the paper contributes to research literature by showing the product-specific differences and that different practices should be adapted for different products. The findings provide a better understanding of general and product-specific causes of food waste, and can thus support the planning and implementation of effective waste reduction strategies. Reduction of food waste at supermarkets saves resources and obviates financial losses, and is in accordance with the first and second steps of EU waste hierarchy [35]. Additionally, the findings can support food retailers' work in addressing the UN Agenda 2030 SDGs [36] and the EU Action Plan for circular economy [37].

2. Materials and Methods

To answer the research questions in a comprehensive manner, a mixed-methods sequential explanatory design [38] was considered to be suitable to generate in-depth insights about the causes of food waste and measures to reduce food waste.

2.1. Mixed Methods Research Design

To understand the store environment and comprehend how food waste occurs, three different methods were used. The research design was based on mixed methods [38,39] and the design was uniform for all stores. Information about the employees' daily work routines and waste management was gathered by conducting semi-structured interviews [40] with staff, and through participatory observation [41] during the work in the FV department. The authors obtained existing quantitative data from databases on food waste for one year that each store keeps. The methods complemented each other, and methodological triangulation [42] gave a more diverse description of the research problem.

2.2. Descriptions of the Stores

The three stores included in the study are located in different municipalities in Central Sweden. The sales area range between 4050 and 7000 square meters and the stores belonged to the hypermarket segment [43]. Two of the stores are proximal to the respective city centres, and the third store is adjacent to an external shopping centre. The stores are part of the same retail chain, called ICA, and the franchise is owned by different individuals. The ICA Group is one of the Nordic region's leading retail companies and the largest player in the Swedish food retail market, with a market share of 36% [44]. At the time of this study, the three stores had the same main supplier of FV, had similar product ranges, used the same computerised ordering tool, had similar storage and cooling facilities, and received similar support from the retail chain's headquarter. The waste that was generated in the stores was collected by a waste company and used for biogas production or was incinerated for energy recovery. In cases of food donation, it occurred after the food had been registered as in-store waste, meaning that there was no unrecorded food waste [45].

Each storeowner selected a contact person in their FV department, and in all the three stores, the employee responsible for the department was chosen. Those persons were also the most experienced among the personnel, and were considered specialists. One or two more employee/s from the FV departments from each store was/were involved on site for participatory observations.

2.3. Data Collection

On-site investigations were made at the supermarkets in their FV departments. The work in the FV departments was conducted independently of this study, in the sense that the work was performed before the study started and continued after the study ended. Before the main study commenced, an exploratory series of semi-structured interviews and participating observations with employees at one supermarket was executed. Based on the gleanings, an interview guide and a protocol for participating observations were developed.

2.3.1. Field Visits

With the intention of not disturbing the work routines, the store visits were planned in collaboration with the employees, and they were asked not to change their daily work routines for the visits. During the store visits, days and times were chosen to cover all parts of the work in each store, and each visit lasted for half-a–work-day. Seven employees from the FV departments (2–3 from each store) were interviewed and/or observed. Moreover, telephone conversations to follow up on the field visits were conducted, and respondent validations were executed. In total, 9 interviews, 19 observations, 3 follow-up calls and 3 respondent validations were performed. For more information about the respondents and data collection, see Table 1.

Table 1. Information about respondents at the supermarkets and data collection.

Respondent	Store	Gender	Years of Work Experience at FV Department	Interview (Approx. Min)	Observation (Approx. Min)	Follow-Up Call (Approx. Min)	Respondent Validation (Approx. Min)
Employee A1	A	F	33	90, 120, 30	60, 60, 90, 90	30	70
Employee A2	A	F	10	-	60, 60, 90, 90	-	-
Employee B1	B	F	22	60, 60, 60	60, 90, 90	60	45
Employee B2	B	F	6	-	30	-	-
Employee B3	B	M	4	-	30	-	-
Employee C1	C	M	20	90, 90, 30	60, 90, 90	30	60
Employee C2	C	F	1	-	30, 45, 45	-	-

Sequence of conducting field visits and data collection at each store:

1. Store visit 1: interview in the back office of the store (1 employee), participating observations in the FV department (2 employees), field notes and photos on site, compiling memory notes;
2. Store visit 2: interview in the back office of the store (1 employee), participating observations in the FV department (2 employees), interview in the FV department (1 employee), field notes and photos on site, compiling memory notes;
3. Collecting data from the database on food waste kept by the store;
4. Follow-up telephone call (1 employee), compiling memory notes;
5. Processing and analysis of qualitative data (interviews and observations);
6. Processing and analysis of quantitative data (waste data from the stores);
7. Respondent validation: presentation and discussion of results (1 employee), compiling memory notes.

The first author conducted all interviews and observations, and in at least one of the visits to each store, the second author attended. To control for any distortion caused by the influence of any of the researchers, the findings were compared and discussed after the field visits.

2.3.2. Semi-Structured Interviews

The interviews were conducted face-to-face, and a semi-structured interview guide [41] was employed to ensure that the same questions were asked in all three stores. The main questions in the interview guide covered daily work routines, detailed questions about general and product-specific causes of waste, measures to prevent and reduce waste, and the decision-making process in each store. During the interviews, the employees gave both descriptions and interpretations of their work. When the interview was completed, the employee and the researchers jointly went to the FV department and the employee had the opportunity to demonstrate examples of practices that were touched on during the interview, especially if something was difficult to describe only by words. During the second and third interview, follow-up questions were sometimes asked to clarify parts of the previous interview, and elements from the preceding participating observation could also be brought up.

2.3.3. Participatory Observations

Participatory observations were carried out when the employees performed daily work routines. The observations were based on an observation protocol [41] and this approach ensured uniformity across all three stores, and to control and confirm what was stated during the interviews. Participatory observations took place together with the employee that was interviewed and with one or two more employees from the FV departments. During the observations, the researchers participated in all store operations, and photographs were taken to support the field notes. The observations revealed aspects of the work that had not been dwelt upon earlier during the interview, and enabled acquisition

of detailed information about specific issues for each product. At times, it was possible to ask something directly during the work, and in other cases, the question was raised in a subsequent interview. To deepen the insights about the employees and what they were doing and why, the researchers spent many hours interacting with the employees in the supermarkets with the observation protocol but also with a high degree of flexibility in order to follow the employees, inspired by the Gioia method [46]. The Gioia method emphasises the importance of "get in there and get your hands dirty-research—madly making notes on what the informants are telling us, conscientiously trying to use their terms, not ours, to help us understand their lived experience". During the field visits, the researchers also participated in internal store meetings where figures on food waste were presented and discussed among all departments.

In the pre-study, the authors sensed some reservations and anxiety from the employees during the interviews and observations, as well as around sharing sensitive information about food waste figures. Existing literature shows that interviewees can experience an interview as an inconvenient situation [47]. To reduce the inconvenience and distance between the interviewer and the interviewee, and consequently create data with larger nuances [48], the interviews and participating observations were carried out without any audio recordings. As a result, it was necessary to document the facts regularly and smaller breaks during the field visits were planned to reconsolidate and write down facts, comments and reflections from the interviews. All interviews and observations were documented through field notes the same day as the field visits. There was also a mutual agreement with the employees regarding follow-up telephone calls to confirm and seek clarification if anything from the visits was unclear. The extensive field notes with photos and follow-up calls reduced the need for audio recording.

2.3.4. Waste Data from the Stores

Data of in-store food waste were provided by each store for one year, from 1 December 2018 to 30 November 2019, in the form of records from the databases maintained by the stores. The staff registered all items that were unsaleable and were removed from the FV department. This procedure has been used for many years by the stores for internal follow-up and was performed independently of this study. In waste data, different types of information were registered such as what type of fruit or vegetable, information on whether it was sold in bulk, packaged or in pieces, the weight or amount, and the purchase price. In total, for all three stores, data from 43,137 waste registrations were analysed for this study.

2.4. Data Analyses

The data analyses were divided into three different main steps. At first, the qualitative analyses were performed, followed by the quantitative analyses, and lastly both qualitative and quantitative analyses were conducted. Analyses were made in an iterative process; moving back and forth between different data, a schematic figure of the different steps in the analysis process is presented in Figure 1.

The qualitative data consisted of memory notes of interviews, observations and telephone conversations as well as photographs. Initially, the memory notes were examined in detail on several occasions to create familiarity with the content. Subsequently, the analytical coding and categorisation were inspired by the analysis in grounded theory [49]. A direct content analysis approach was applied as a preliminary coding scheme [50]. The themes were organised in two different tracks; the first track followed various activities and factors related to food waste management at the department, and the second track followed the different FV categories and their causes of waste. The qualitative data were reviewed several times before reaching a stage of saturation, at which no further themes emerged from the processes [51].

The quantitative data were processed and analysed using Excel spreadsheets. In the data processing, the same type of fruit or vegetable constituted one category; for example, all different varieties of apples became an apple category. The same procedure was per-

formed with all types of fruits and vegetables. For each category, data about waste weight and waste quota were calculated. The waste quota was defined as the waste in store in relation to the sold quantity and was calculated with the equation: *Waste quota = Waste weight/(Waste weight + Sold weight)*. Before detailed analysis of the waste data was conducted, the information was checked manually, and any errors and inconsistencies were followed up. Whenever possible, data were corrected and in other cases, the inaccurate data were excluded from further analysis. The waste weight of the excluded products corresponded to 0.01% of the total waste weight and none of the FV categories were overrepresented. When calculations were completed for all FV categories, the top categories that together corresponded to 80% of the total amount of waste were identified. For each FV category at the top list, special attention was paid to the differences of waste between packaged/unpackaged and organic/conventional products. If the share of packaged or organic products was less than 5% for any of the FV categories, no figures were reported since the proportion was considered to be too small to warrant an analysis.

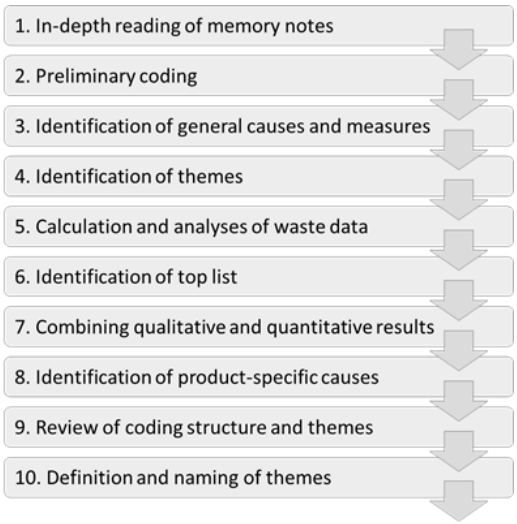

Figure 1. Schematic overview of the analysis process.

In the final phase, both qualitative and quantitative results were analysed in order to identify product-specific causes of waste. For every FV category on the top list, data pertaining to food waste were examined in relation to qualitative data about the specific product. The process was iterative and new themes related to general and product-specific causes of waste emerged until saturation was reached.

2.5. Delimitations

Only fresh fruits and vegetables were included in the study. Preserved, dried or frozen products were excluded. No distinction was made between edible or non-edible food waste since the products, including the peel and haulm, were sold as whole products and the weight of the whole products was reported as waste by the stores. Only in-store waste was studied, so pre-store waste [52], take-back agreements [53] and other in-store operations for unsaleable products [54] are beyond the scope of this study.

2.6. Ethical Considerations

The respective storeowners agreed that their store would be included in the study; they facilitated interviews and observations in the FV department, gave access to the waste data, and consented to the publication of the results. All the respondents gave their consent to use their answers in this paper, on the condition of anonymity. The study has been communicated to the stores in an open and transparent manner. The outcome has been presented to and discussed with the storeowners and employees.

3. Results

Food waste in the FV departments was not a result of a single cause, but rather combinations and interactions of multiple causes. Based on the employees' perspective from semi-structured interviews and participating observations, and data on waste, provided by the stores, four main themes emerged that describe different aspects of causes and measures of food waste at supermarkets. The themes were policy, practice, people, and product. No hierarchy has been detected among these four main themes, but they were all connected and dependent on each other, and sometimes the themes partially overlapped each other. Each theme consists of several sub-themes, and the themes will be elaborated in sections further down. An illustration of all themes and sub-themes is presented in Figure 2.

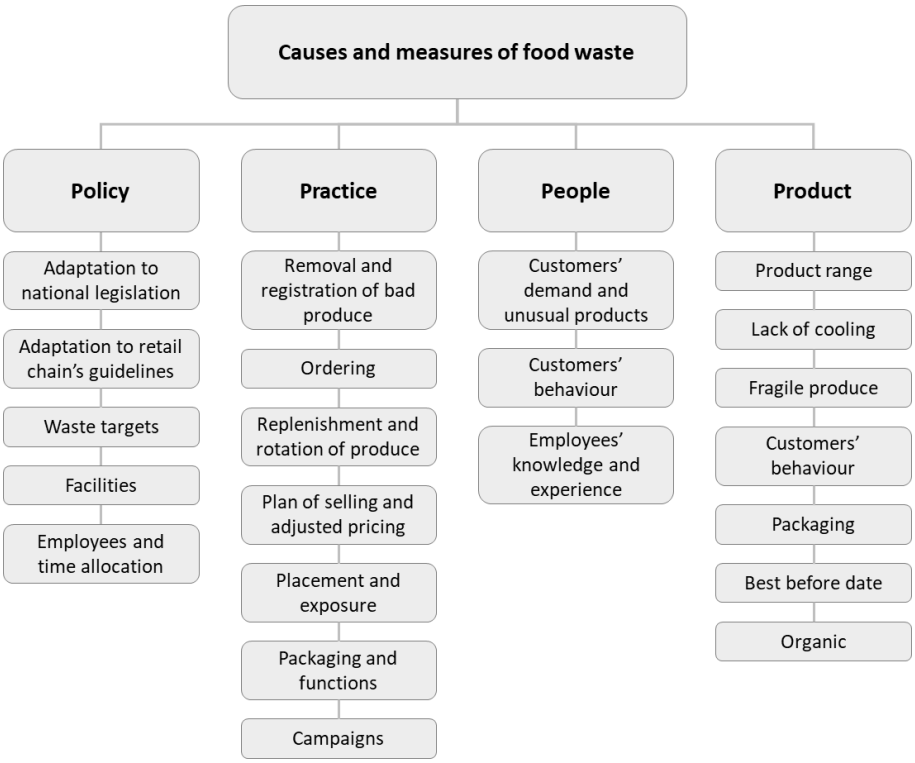

Figure 2. Causes of and measures to reduce food waste at supermarkets' fruit and vegetables department from the employees' perspective, categorised thematically.

3.1. Policy

Based on the employees' perspective, one theme that influenced the causes of and measures to reduce food waste was policy. It includes guidelines describing how the employees should deal with different areas; adaptation of national legislation, adaptation of the retail chain's guidelines, internal waste targets, waste information feedback, size of storage and cooling facilities, design of FV department and display units, participation in campaigns, number of staff and time allocation. The employees did not make any decisions about these areas, since it was rather the responsibility of the managers. Nevertheless, the employees had been delegated the responsibility to operate the FV department, and had a pronounced mandate to execute daily work routines and make their own decisions within the framework of the policies.

3.2. Practice

The theme of practice, which also emerged from the employees' perspective, contained well-defined and agreed-upon in-store operations. The practices among the three supermarkets were uniform since they belong to the same retail chain following the same guidelines. According to the staff, certain tasks and handling of different situations were

directly decisive for food waste, and they considered the practices as combinations of both causes of food waste and measures to prevent food waste. The analysis of qualitative data identified several general causes and measures within this theme. The results have been presented hereunder in the order in which the tasks were usually performed in the FV department.

3.2.1. Removal and Registration of Bad Produce

Frequent removal of bad produce was an important part of the work routines to reduce waste, since it minimised the risk of bad produce contaminating other produce. As a daily duty before opening, the employees always made a waste round in the morning. The employees controlled the quality of the fruits and vegetables and removed those that did not meet the quality criteria. When they removed bad produce from the shelf, they asked themselves, "Would I buy this myself?" If the answer was "No", the produce was removed. Minor details in the assessment differed; however, the differences among colleagues were considered to be an advantage, since customers also have different requirements. Information about the food waste, such as type, weight or amount, was fed into a small hand device, which later was connected to a computer and the database on food waste kept by the store. Only the regular employees did waste registrations in order to minimise mistakes. The registered information was used for internal waste targets and waste figures were reported at weekly internal meetings.

3.2.2. Ordering

Making accurate orders affected the amount of waste. The employees considered that placing correct orders was the foundation of having low levels of waste. Orders were placed on a daily basis, and even though all members in the FV department could do so, it was usually one of the most experienced employees who did it. To order the right quantity, the employees needed to consider up to ten different factors before making an order, as illustrated in Figure 3. Initially, the employees checked the department, warehouse and cooling area to make an inventory of the stock. The stores had a digital ordering tool that took into account how much of an item was in stock as well as sales statistics from the corresponding period of the previous year, and based on that, suggested the quantity to order. Due to thefts and errors from the self-scanning, the employees still had to verify the balance of certain items. Additionally, the employees needed to take into account campaigns, the weather forecast, paydays and public holidays, since different occurrences affected customers' demands. The employees also considered if the product had any replacement products; for instance, if the sweet peppers in bulk would go out of stock, there should be packaged sweet peppers to buy instead. The last factor to consider was to check who was going to work the following day, since regular and experienced personnel could handle large deliveries more easily.

3.2.3. Replenishment and Rotation of Produce

An important work routine at the FV department was the replenishment and rotation of products. New products were replenished from the upper part of the display units, and products with best before dates were replenished from behind so that those with earlier dates could be sold first for the purpose of reducing food waste, following the first in first out model. The replenishment was carefully conducted to avoid damaging the products. The secondary packaging was replaced regularly to avoid contamination.

3.2.4. Plan of Selling and Adjusted Pricing

Having a plan of selling and adjusting the price when needed kept the sales volume high and waste level low. The employees always planned the selling and pricing. If a product approached its best before date, and/or there was a surplus of a product in stock, the staff could adjust the price downward to increase sales and in that way prevent waste.

Figure 3. The employees had to consider up to ten factors when making orders of fruits and vegetables.

3.2.5. Placement and Exposure

The placement and exposure of products could increase shelf-life and sales volume, and thereby reduce the amount of waste. Shelf-life of some products could be lengthened if refrigerated, while some others were more durable at room temperature. It was sometimes a balance of decisions; for instance, peaches lasted longer in cooler temperatures, but the sales volume was higher outside since the exposure was better and it was easier for the customers to find the peaches. If products that preferred lower temperature could not be placed in a refrigerator, it was important that the turnover was high, so that the produce was not kept at a suboptimal temperature for too long. Proper placement and display were also essential for some products that were pressure-sensitive and for products which could not be kept in close proximity to certain others to obviate faster ripening.

3.2.6. Packaging and Functions

Packaging contributed both to a reduction of waste in some cases, and to an increase of waste in some others. The packaging system had large variation. The material of primary packaging varied but plastic dominated. Several products were sold both in bulk and with primary packaging. Primary packaging was important for protection of vegetables such as sweet pepper and tomato. The disadvantage with some packaging solutions, such as grapes or pears packed in plastic boxes, was that if one or two items turned out to be bad, the entire box was often discarded. Time constraints disallowed the employees to remove the defective pieces and retain the box for sale. In some other cases, primary packaging was used mainly for convenience for the customers, for instance in the sense that it was easier and faster for customers to grab a number of oranges in a plastic mesh bag or a number of pears in a plastic box without a lid wrapped in mesh net instead of picking several individual items. The weaknesses of such convenience packaging were twofold: it did not offer any protection, and there was no possibility to open, remove the bad produce and reseal. Packaged products with best before dates had a higher waste quota compared to other products belonging to the same FV category. It was also time-consuming for the employees to check, rearrange and remove products with a best before date.

Secondary packaging mainly consisted of cardboard boxes or plastic crates. These types of secondary packaging could be placed directly at the display units, or the products could be moved into another tray or shelf in the store. One problem with secondary packaging was the amount/quantity of the contents. For example, secondary packaging with mini carrots contained 16 plastic bags, which was more than the stores could sell before the carrots lost their freshness. The staff stated that they would have liked to have

the option to order smaller amounts (quantities), even if it meant the payment of a higher (unit) purchase price.

3.2.7. Campaigns

Products on campaign resulted in more waste. The stores had a policy that a product on campaign should never run out and thereby deliberately placed large orders so that availability could be guaranteed. The employees spent more time on products on campaign because they needed to be refilled continuously. Another detrimental side effect of campaigns was that they often lowered the sales of similar products.

3.3. People

Based on the employees' perspective, the qualitative analysis identified people as one theme, including both employees and customers. Employees were central actors in relation to keeping the level of waste down due to their knowledge, experience, mandate, awareness of product-specific causes and meeting customers' requirements. Customers affected the waste through their behaviour, demands and careless handling.

3.3.1. Customers' Demand and Unusual Products

Products with uneven demand and unusual products often had high waste, and employees had to handle trade-offs between customers satisfaction and waste reduction. The stores had therefore chosen to remove some of the unusual products, such as various exotic fruits, from their regular product range and only order them for particular weekends and holidays. The demand for fresh herbs was uneven, they periodically had high waste and the sales margin was low. Despite that, the stores had chosen to offer these products to customers. The low profit margins were acceptable in light of the fact that customer service was paramount and these products were difficult to replace. The stores also sold organic products at a lower profit margin, vis-à-vis conventional products. The stores still wanted to retain a low selling price with the customers' interest in mind, and they argued that if there were no cheap organic products, the store might lose the customer completely. On a regular basis, the staff inspected what products had high waste and low sales volume and occasionally removed those products from the range. When new products were brought into the department, the staff expected it to take some time before customers would find them, and higher waste in the initial phase was then accepted.

3.3.2. Customers' Behaviour

Customers' behaviour affected the amount of waste and the working routines. Theft and customers' mistakes committed during self-scanning of weight and price posed a challenge to the stores. Such anomalies resulted in an incorrect balance and could lead to inaccurate orders being placed. Another example of undesirable customers' behaviour involved selecting or handling fragile products such as avocados, in which case some customers squeezed the avocados to determine the level of maturity in a way that damaged the avocados and caused them to be discarded.

3.3.3. Employees' Knowledge and Experience

Employees affected the amount of waste. The complexity of the daily work at the FV department required skilful employees, and it was in this department that the management often placed the most experienced and committed employees. The role of employees was central, since most of the decisions were made and executed by employees. Their ability was affected by their knowledge, experience, time, and well-defined and established daily working routines. The employees' mandate and assignment of responsibility also influenced how they solved certain tasks during the day. For instance, if the employees noticed that they had too much packaged lettuce that was about to reach the best before date, they could independently decide to change the exposure and pricing of the lettuce in order to increase sales. The employees also played a central role in the daily work at the

department since it required constant supervision. They had to refill products that had run out, rearrange display units and shelves to make them look neat and tidy, and be available to customers. The employees often noticed changes in orderliness and a mismatch between orders and actual need after a period when a non-regular member of staff had been working. The employees explained several trade-off situations, for example, between maximising sales volumes and efforts to reduce food waste. The employees were updated and aware of how much waste the FV department generated. Waste figures of each department were discussed once a week at internal meetings and each department had internal waste goals. The employees regularly participated in training and group meetings arranged by the central organisation of the retail chain.

3.4. Product

The final theme was product. During the semi-structured interviews and participating observations, the employees highlighted and showed that different products have different preconditions in terms of sensitivity and durability, and therefore adjustments of practices were needed based on what product it was. Therefore, as a complement to the qualitative data, quantitative data were needed to capture the details of different products. To begin with, the quantitative data were analysed, including waste quotas and the differences of waste between packaged/unpackaged and organic/conventional products. Subsequently, both quantitative and qualitative results were analysed in order to identify product-specific causes of waste.

3.4.1. Amount of Food Waste

The total amount of FV waste at the three stores was 60 tonnes, with an average waste quota of 1.4%, and involved 73 different FV categories. The top FV categories that together corresponded to 80% of the total amount of waste were identified and consisted of 19 FV categories. Waste data for the 19 FV categories were analysed with special attention to packaged and unpackaged products as well as organic and conventional products, and are presented in Table 2. The total share of packaged products was 39% and the total share of organic products was 10%.

Table 2. Accumulated waste data for three supermarkets and the top 19 fruit and vegetable categories that together corresponded to 80% of the total waste, and the share of packaged and unpackaged products and organic and conventional products. Note: When the share was smaller than 5%, no data are provided and the field is marked with *.

FV Category	Wasted Mass [kg]	Waste Quota [%]	Share Packaged [%]	Waste Quota Packaged [%]	Waste Quota Unpackaged [%]	Share Organic [%]	Waste Quota Organic [%]	Waste Quota Conventional [%]
Potato	5600	0.6	51	1.1	0.1	*	-	-
Banana	4800	1.0	45	1.3	0.8	45	1.3	0.8
Apple	4600	1.6	8	1.4	1.6	5	3.6	1.5
Melon	4500	1.8	*	-	-	5	2.0	1.8
Lettuce	3600	2.8	100	2.8	-	9	6.1	2.5
Tomato	3500	1.2	58	0.9	1.6	5	3.6	1.1
Pear	3500	3.6	26	4.8	3.2	*	-	-
Sweet pepper	3100	3.1	48	2.1	4.0	*	-	-
Orange	2900	1.3	33	1.9	1.0	7	3.3	1.2
Clementine	2100	1.1	26	2.4	0.6	*	-	-
Grape	1600	1.4	98	1.3	11.0	*	-	-
Cabbage	1500	1.6	21	4.6	0.7	5	3.6	1.5
Nectarine	1300	2.2	47	3.3	1.2	*	-	-
Carrot	1300	0.6	91	0.5	2.0	17	0.5	0.7
Berry	1200	2.8	100	2.8	-	*	-	-
Onion	1000	0.4	33	0.6	0.3	5	1.4	0.4
Cucumber	900	0.6	100	0.6	-	*	-	-
Avocado	900	1.4	48	1.5	1.2	*	-	-
Lemon	900	1.7	5	5.6	1.5	*	-	-

3.4.2. Product-Specific Causes

When analysing and combining qualitative and quantitative results for each FV category, several causes of waste appeared. Policies and practices affected almost all products, for example, accurate orders and regular rotation of produce. In addition to these general causes, there were also specific causes for the different FV categories. An overview of product-specific causes is presented in Table 3 and is further elaborated upon below.

Table 3. Overview of product-specific causes. Qualitative and quantitative results were analysed to describe the product-specific causes of waste for each of the 19 fruit and vegetable categories.

FV Category	Product Range	Lack of Cooling	Fragile Produce	Customers' Behaviour	Packaging	Best Before Date	Organic
Potato	x	x				x	
Banana			x	x	x		x
Apple			x	x			x
Melon		x	x			x	
Lettuce	x			x		x	x
Tomato	x		x		x		x
Pear			x	x	x		
Sweet pepper		x	x				
Orange					x		x
Clementine					x		
Grape		x			x		
Cabbage	x		x			x	x
Nectarine			x		x		
Carrot	x	x					
Berry	x		x				
Onion	x				x		x
Cucumber	x						
Avocado			x	x			
Lemon		x			x		

A broad **product range** was kept by all three stores. For example, one store offered 49 different variants of lettuce and 32 different variants of tomatoes throughout the year, and the large selection increased the risk of waste because of difficulties in predicting the demand and making correct orders. Potato also had a large product range that made the demand difficult to predict. The waste quota of cabbage, carrot and onion was low, however, while some of the more unusual types with low demand within the same FV category had higher waste quotas. Berries have irregular demand from time to time, causing a high waste quota, but the stores still wanted to prioritise customer service and still offered the products. The case of cucumber differed, in the sense that it had high turnover and had few varieties. On the other hand, compared to, for instance, tomato that had many different varieties, the product could not be substituted with a similar product, and therefore the stores ordered some extra to make sure that they would always had cucumbers in stock.

Lack of cooling made several FV products lose their freshness quickly. Cooling prolonged shelf-life and resulted in lower waste. Potato, melon, sweet pepper, grape, carrot and lemon were usually placed in the cold, but due to a lack of cooling areas, there was always a compromise as to which products were placed in the refrigerator.

Some products were more sensitive and for **fragile produce** it was especially important to have correct execution of employees' practices. Banana was a sensitive product and required gentle replenishment and stacking. Pears and nectarines had a thin peel and needed thorough controls and removal of damaged products to avoid bad produce contaminating others. Other products considered sensitive were sweet pepper, berries, avocado and some types of cabbages. Tomatoes, apples and melons could be bruised by the employees when replenishing unpackaged products if not treated with care.

Customers' behaviour could cause food waste. For instance, it often happened that customers divided a bunch of bananas and single bananas were left on the displays. Customers were demanding and wanted green to yellow bananas and often rejected yellow ones with small brown dots. Moreover, customers often chose products, such as lettuce, with the longest best before date, leaving bags with fewer days on the shelves. Pears had thin and sensitive peel and the product could easily be damaged by customers when treated improperly. It was also common that customers damaged avocados when they tried to decide their maturity by squeezing them, and many items were discarded due to this behaviour. It happened frequently that customers took apples that were more expensive but self-weighed and labelled them as a variety with a lower price. This could lead to incorrect figures in the ordering system and in turn cause incorrect orders.

Products with primary **packaging** gave both higher and lower waste. An explanation for the high waste of packaged pear, grape, nectarine and onion was that if one piece of fruit was damaged, the entire lot was wasted. The waste quotas for packaged orange, clementine and lemon were higher than for the unpackaged alternatives. The packaging for these products was a mesh polypropylene bag, which did not have any protective function but made it easier for customers to grab a bag and move on. If one clementine, for instance, turned bad, the whole package was wasted. The waste quota for packaged clementine was 2.4% and for unpackaged, it was 0.6%. Some of the banana types were packaged in plastic bags and condensation was formed, which turned the bananas bad. For some other products, the packaging reduced the waste. The waste quota of packaged tomatoes was 0.9% and for unpackaged, it was 1.6%. The plastic clam shells dominated the packaging of tomatoes, but there were other plastic and cardboard packaging solutions available occasionally. Tomatoes were sensitive and could be bruised by the employees when replenishing unpackaged tomatoes, and the packaging protected the produce from damage. The waste quota for packaged sweet peppers was 2.1%, and unpackaged sweet pepper was 4%, indicating that the protective function of the plastic around the produce played a role in reducing waste from both handling and evaporation. The same case goes for carrots, as the waste quota of packaged carrots was 0.5% and for the unpackaged 2%.

Best before date was mainly used on washed and packaged products. The waste for potatoes depended mainly on the best before date. Packaged potatoes were removed when the best before date came close to expiring. Melons and some cabbages were sold cut and packaged in plastic wrapping. Produce cut at the department was forced by law to have a best before date label, which shortened the shelf-life and increased the waste. The store provided the service to households that did not want to buy an entire melon or cabbage. The lettuce also had a best before date and it was removed one or two days before the date expired. This increased the food waste. For lettuce, the waste quota for products with a whole plant and no best before date was 0.9%, and for packaging with lettuce leaves and a best before date, the waste quota was 5.1%.

Organic products often had higher waste quotas compared to their conventional counterparts. This was true for banana, apple, tomato, lettuce, orange, cabbage, and onion. Purchase prices for organic products often fluctuated over the course of the year, and the effect of pricing affected the willingness of customers to pay, while making it difficult to predict the demand.

4. Discussion

General causes of food waste at retail level have been addressed in the literature on an aggregated level [24] and the store owners' and store managers' perspective on food waste have been examined [19,21–23]. Nevertheless, there is a lack of research that explores the knowledge and approach of frontline employees and also studies where qualitative and detailed quantitative data are combined [24,25], as well as more in-depth analyses of food waste at the retail level [33,34]. In this study, frontline employees' perspective on cases of and measures to reduce waste was studied and a mixed methods approach was adopted, using data from interviews and observations and in-depth analyses of waste figures. This

resulted in new insights into food waste at supermarkets. The key findings are that employees with experience and mandate are crucial for reduced food waste. Furthermore, when developing waste reduction strategies, detailed knowledge about different products and an understanding of their respective causes are required. Based on the employees' point of view, four main themes explain the causes of food waste: policy, practice, people and product. The four main themes and their respective sub-themes are illustrated in Figure 2.

4.1. The Central Role of Employees

The employees have a critical role in the FV departments, as they actively manage the causes of food waste and are equipped to take a variety of precautionary measures to avoid and reduce food waste. The results in this study illuminate how complex the work in an FV department is, and highlight the need for well-defined and established operational activities. On a daily basis, employees must take into account the effort of the store to make a high profit, make customers satisfied and keep low waste figures. To handle the contradictory demands, the employees have some mandate to make their own decisions about several activities and find a balance between different needs.

An example of new detailed insights concerns how to make accurate orders, which is not as simple as other studies have suggested [11,15,27], nor have these previous studies appreciated the realities and complexities of this task. This study reveals that the employees have up to ten different factors to consider when making orders, as illustrated in Figure 3. In the ordering process, many decisions are made that can prevent food waste. It is therefore important with time allocated [26] for the ordering process and experienced employees. The results of this paper contribute to better understanding of the role of employees in preventing food waste, and demonstrate the positive consequences of granting members of staff more agency. Other studies [19,23] have highlighted the need for efficient store operations regarding replenishment and price adjustments for products close to expiration. The present study confirms that replenishment and adjusted price are of importance, and additionally, it elaborates on how employees can be involved in several other store operations to avoid and reduce waste. Staff are often portrayed negatively and presented as a root cause of food waste [14,24,25], but our results show the opposite. Employees who have knowledge, experience and mandate contribute actively to the monitoring of food waste and are crucial actors for reducing it, and the recommendation is to support the employees with training and time allocated to execute their tasks. This result is in line with a recent study [55] that highlights the role of training as the second most important strategy for food loss and waste mitigation. Since sustainability work can attract and engage employees [56], strategies and systematic work for reducing food waste can be important for the supermarkets to keep employees.

4.2. Product-Specific Causes

As fresh FV deteriorate for a number of reasons, it is important to adjust work routines for different products and further develop efficient waste reduction strategies and measures. Previous studies on the causes of food waste at stores have often presented findings on an aggregated level [24,25], that is, not adapted to different departments or products. The results show that previous general descriptions of the causes of retail food waste are not detailed enough for planning reduction measures. This study contributes with detailed descriptions of product-specific causes based on both qualitative and quantitative methods. It is important to be acquainted with the different product-specific causes, as described in Table 3, in order to reduce waste.

The results for products with primary packaging are ambiguous, as shown in Table 2. Different types of packaging have different purposes, and therefore it is precarious to draw any general conclusions. The impact of packaging must be examined on a case-by-case basis. In some cases, packaging protects the products and generates a lower waste quota, for instance as regards tomatoes, sweet peppers and carrots. In some other cases, packaged

products have a higher waste quota, for instance as regards pears, oranges, clementine, nectarines and lemons. Nonetheless, this study shows that packaging solutions with the only purpose of convenience for the customers and without protection increase waste. Many organic products, such as apples, tomatoes and oranges, have a higher waste quota compared to conventional products, and this could be explained by a lower turnover, uneven product range, price fluctuations and lack of cooling. However, if both supply and demand of organic products increase, the waste quotas may decrease.

The authors did not find any other studies in literature that have investigated causes of and measures to reduce waste for different FV categories, so in that sense it is difficult to compare our results with other studies. Nonetheless, other studies on in-store waste for FV have reported figures (3–7% in Mena et al., 2011 [15]; 4.3% in Eriksson et al., 2012 [52]; 8–9% in Beretta et al., 2013 [9]) that indicate higher levels of waste compared to the stores included in this study with an average of 1.4%. The general focus on food waste and the development in supermarkets in the past ten years can probably explain part of the lower waste quota in this study. Another possible explanation is the experienced personnel, well-developed store operations, and high turnover in the studied supermarkets.

4.3. An Overview of Causes and Measures: Policy, Practice, People, Product

In order to develop comprehensive strategies for reducing food waste at the retail store level, four different aspects should be included: policy, practice, people, and product. Previous studies have mostly focused the reduction strategies on policies and practices [24]. In this study, the authors have highlighted the fact that while policies and practices are important, the results also show that the role of employees, customers' behaviour and details about the products must be taken into account to handle the causes and measures. Our results complement and extend the findings from prior literature on food waste causes and waste reduction practices. The authors have not been able to find a hierarchy between the four different aspects, since they interact and influence each other both positively and negatively. Some of the aspects are more important and relevant than others depending on what product is examined, but all aspects are needed to develop a comprehensive strategy to prevent retail food waste. Taking into account all four aspects when planning the work also provides the department with a security system against food waste, meaning that if one part fails, the other parts will mitigate the mistake. For instance, if an order is made that exceeds the need, there are other routines that well-trained employees can apply to prevent waste, such as ensuring correct handling and storage and boosting sales through temporary price adjustments and changes in exposure. Just as the causes are manifold, the solutions to problems which arise are also multifarious. Policy, practice, people and product are crucial parts of the effective implementation of waste-reducing practices.

4.4. The Use of Results and Future Work

The results are relevant for understanding of causes and measures to reduce food waste at the retail store level. From a practical point of view, the description of causes can support the planning and implementation of food waste reduction strategies. The results capture that it is of high importance with experienced and committed employees, so they can handle complex situations with effective practice. This study focused on FV departments; however, some of the conclusions can probably be applied to other store departments with fresh food products and can support their efforts to plan cost-effective strategies and cut waste-related costs. Further development of the findings through supplementary research about the role of employees and behaviour change [57] at the FV department, along with the role of organisation and learning loops [58], is recommended. Additional research about the impact and efficiency of different measures is needed to further develop and implement effective waste prevention strategies.

4.5. Limitations of the Study

Due to the commercially sensitive nature of sharing information about food waste, and to reduce the inconvenience and distance between the interviewer and the interviewee, the interviews and observations were conducted without any audio recordings. To counteract that limitation, interviews and observations with the same employee were performed on several occasions by two researchers, and the findings were compared and discussed after every field visit. Another effort to minimise uncertainties was undertaken through respondent validations where the results were reviewed and verified by the employees at the FV departments. The supermarkets included in this study are part of the same retail chain and belong to the hypermarket segment, and are not representative of all grocery stores. Studies in other retail chains and smaller store formats are likely to have different waste patterns, due to different policies, practices, product range and turnover. Future studies in other retail chains, in smaller store formats and in other countries need to be undertaken to provide a more complete understanding of the grocery retail sector.

5. Conclusions

The grocery retail sector plays an important role in contributing to a sustainable food supply chain due to its central position in the food system. Identifying causes of food waste at the retail level is crucial for the development of effective measures to reduce waste. To generate in-depth insights about causes and reduction measures of fruit and vegetable waste at supermarkets, a mixed-methods approach was adopted, including qualitative data from the employees' perspective and primary quantitative data on food waste. The employees provided a different point of view and the results reveal some new insights. First, staff members are often portrayed as a root cause of food waste; the main results show the opposite. The employees are key actors as they manage causes and take a variety of precautionary measures to avoid and reduce food waste. The reality at the department is complex, for instance, the employees have up to ten different factors to take into account when making orders. The practices of the employees are closely intertwined with the policies of the management, the time allocation, knowledge and the trust they are given. Second, amount and causes of waste for several fruits and vegetables were studied in detail and there is no one solution that fits all. To develop efficient waste reduction measures at retail store level, detailed knowledge about different products and an understanding of their respective causes are preconditions. The findings reveal that a generic description of causes of food waste is not enough to use as a base when planning reduction measures; practices should be adapted for different products. Other factors affecting the waste are packaging, which in some cases reduces the waste, and in other cases increases it. This indicates that a nuanced approach and careful analysis of the different products and its packaging are required for providing good solutions. Third, to develop comprehensive strategies for reducing food waste, aspects of policy, practice, people and products need to be included and finely tuned.

The role of the employees has been neglected in earlier research and therefore ought to be given much more attention in future research on food waste reduction at the retail level. Employees who have knowledge, experience and mandate contribute actively to the monitoring of food waste and are crucial actors for reducing it, and the recommendation is to support the employees with training and time allocated to execute their tasks. The findings provide better understanding of general and product-specific causes of food waste and can support the planning and implementation of effective reduction strategies.

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References

1. IPCC. *Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*; Shukla, J.S.P.R., Calvo Buendia, E., Masson-Delmotte, V., Pörtner, H.-O., Roberts, D.C., Zhai, P., Slade, R., Connors, S., van Diemen, R., Ferrat, M., et al., Eds.; IPCC: Geneva, Switzerland, 2019.
2. Papargyropoulou, E.; Lozano, R.; Steinberger, J.K.; Wright, N.; bin Ujang, Z. The food waste hierarchy as a framework for the management of food surplus and food waste. *J. Clean. Prod.* **2014**, *76*, 106–115. [CrossRef]
3. Al-Obadi, M.; Ayad, H.; Pokharel, S.; Ayari, M.A. Perspectives on food waste management: Prevention and social innovations. *Sustain. Prod. Consum.* **2022**, *31*, 190–208. [CrossRef]
4. Jeswani, H.K.; Figueroa-Torres, G.; Azapagic, A. The extent of food waste generation in the UK and its environmental impacts. *Sustain. Prod. Consum.* **2021**, *26*, 532–547. [CrossRef]
5. Aschemann-Witzel, J.; de Hooge, I.; Amani, P.; Bech-Larsen, T.; Oostindjer, M. Consumer-Related Food Waste: Causes and Potential for Action. *Sustainability* **2015**, *7*, 6457–6477. [CrossRef]
6. Kulikovskaja, V.; Aschemann-Witzel, J. Food Waste Avoidance Actions in Food Retailing: The Case of Denmark. *J. Int. Food Agribus. Mark.* **2017**, *29*, 328–345. [CrossRef]
7. FAO. *Global Food Losses and Food Waste—Extent, Causes and Prevention*; Food and Agriculture Organization of the United Nations (FAO): Rome, Italy, 2011.
8. Vadakkepatt, G.G.; Winterich, K.P.; Mittal, V.; Zinn, W.; Beitelspacher, L.; Aloysius, J.; Ginger, J.; Reilman, J. Sustainable Retailing. *J. Retail.* **2021**, *97*, 62–80. [CrossRef]
9. Beretta, C.; Stoessel, F.; Baier, U.; Hellweg, S. Quantifying food losses and the potential for reduction in Switzerland. *Waste Manag.* **2013**, *33*, 764–773. [CrossRef] [PubMed]
10. Cicatiello, C.; Franco, S.; Pancino, B.; Blasi, E. The value of food waste: An exploratory study on retailing. *J. Retail. Consum. Serv.* **2016**, *30*, 96–104. [CrossRef]
11. Lebersorger, S.; Schneider, F. Food loss rates at the food retail, influencing factors and reasons as a basis for waste prevention measures. *Waste Manag.* **2014**, *34*, 1911–1919. [CrossRef]
12. Brancoli, P.; Rousta, K.; Bolton, K. Life cycle assessment of supermarket food waste. *Resour. Conserv. Recycl.* **2017**, *118*, 39–46. [CrossRef]
13. Cicatiello, C.; Franco, S.; Pancino, B.; Blasi, E.; Falasconi, L. The dark side of retail food waste: Evidences from in-store data. *Resour. Conserv. Recycl.* **2017**, *125* (Suppl. C), 273–281. [CrossRef]
14. Goodman-Smith, F.; Mirosa, M.; Skeaff, S. A mixed-methods study of retail food waste in New Zealand. *Food Policy* **2020**, *92*, 101845. [CrossRef]
15. Mena, C.; Adenso-Diaz, B.; Yurt, O. The causes of food waste in the supplier? Retailer interface: Evidences from the UK and Spain. *Resour. Conserv. Recycl.* **2011**, *55*, 648–658. [CrossRef]
16. Scholz, K.; Eriksson, M.; Strid, I. Carbon footprint of supermarket food waste. *Resour. Conserv. Recycl.* **2015**, *94*, 56–65. [CrossRef]
17. Bilska, B.; Piecek, M.; Kołożyn-Krajewska, D. A Multifaceted Evaluation of Food Waste in a Polish Supermarket—Case Study. *Sustainability* **2018**, *10*, 3175. [CrossRef]
18. Bech-Larsen, T.; Esbjerg, L. The Garden of the Self-Service Store. *J. Food Prod. Mark.* **2006**, *12*, 87–102. [CrossRef]
19. Teller, C.; Holweg, C.; Reiner, G.; Kotzab, H. Retail store operations and food waste. *J. Clean. Prod.* **2018**, *185*, 981–997. [CrossRef]
20. Cicatiello, C.; Blasi, E.; Giordano, C.; Martella, A.; Franco, S. "If only I Could Decide": Opinions of Food Category Managers on in-Store Food Waste. *Sustainability* **2020**, *12*, 8592. [CrossRef]
21. Horoś, I.K.; Ruppenthal, T. Avoidance of Food Waste from a Grocery Retail Store Owner's Perspective. *Sustainability* **2021**, *13*, 550. [CrossRef]
22. Filimonau, V.; Gherbin, A. An exploratory study of food waste management practices in the UK grocery retail sector. *J. Clean. Prod.* **2017**, *167*, 1184–1194. [CrossRef]
23. Gruber, V.; Holweg, C.; Teller, C. What a Waste! Exploring the Human Reality of Food Waste from the Store Manager's Perspective. *J. Public Policy Mark.* **2016**, *35*, 3–25. [CrossRef]
24. De Moraes, C.C.; de Oliveira Costa, F.H.; Pereira, C.R.; Da Silva, A.L.; Delai, I. Retail food waste: Mapping causes and reduction practices. *J. Clean. Prod.* **2020**, *256*, 120124. [CrossRef]
25. Chauhan, C.; Dhir, A.; Akram, M.U.; Salo, J. Food loss and waste in food supply chains. A systematic literature review and framework development approach. *J. Clean. Prod.* **2021**, *295*, 126438. [CrossRef]

26. Mattsson, L.; Williams, H.; Berghel, J. Waste of fresh fruit and vegetables at retailers in Sweden—Measuring and calculation of mass, economic cost and climate impact. *Resour. Conserv. Recycl.* **2018**, *130*, 118–126. [CrossRef]
27. Priefer, C.; Jörissen, J.; Bräutigam, K.-R. Food waste prevention in Europe—A cause-driven approach to identify the most relevant leverage points for action. *Resour. Conserv. Recycl.* **2016**, *109*, 155–165. [CrossRef]
28. Hanssen, O.J.; Stenmarck, A.; Werge, M.; Silvennoinen, K.; Katajajuuri, J.-M. *Initiatives on Prevention of Food Waste in the Retail and Wholesale Trades*; IVL Swedish Environmental Research Institute Ltd.: Stockholm, Sweden, 2011.
29. Thyberg, K.L.; Tonjes, D.J. Drivers of food waste and their implications for sustainable policy development. *Resour. Conserv. Recycl.* **2016**, *106*, 110–123. [CrossRef]
30. Verghese, K.; Lewis, H.; Lockrey, S.; Williams, H. Packaging's Role in Minimizing Food Loss and Waste Across the Supply Chain. *Packag. Technol. Sci.* **2015**, *28*, 603–620. [CrossRef]
31. Eriksson, M.; Strid, I.; Hansson, P.-A. Waste of organic and conventional meat and dairy products—A case study from Swedish retail. *Resour. Conserv. Recycl.* **2014**, *83*, 44–52. [CrossRef]
32. Aschemann-Witzel, J.; de Hooge, I.; Normann, A. Consumer-Related Food Waste: Role of Food Marketing and Retailers and Potential for Action. *J. Int. Food Agribus. Mark.* **2016**, *28*, 271–285. [CrossRef]
33. Xue, L.; Liu, G.; Parfitt, J.; Liu, X.; Van Herpen, E.; Stenmarck, Å.; O'Connor, C.; Östergren, K.; Cheng, S. Missing Food, Missing Data? A Critical Review of Global Food Losses and Food Waste Data. *Environ. Sci. Technol.* **2017**, *51*, 6618–6633. [CrossRef]
34. Huang, I.Y.; Manning, L.; James, K.L.; Grigoriadis, V.; Millington, A.; Wood, V.; Ward, S. Food waste management: A review of retailers' business practices and their implications for sustainable value. *J. Clean. Prod.* **2021**, *285*, 125484. [CrossRef]
35. European Commission. Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on Waste and Repealing Certain Directives. 2008. Available online: https://ec.europa.eu/environment/topics/waste-and-recycling/waste-framework-directive_en (accessed on 4 May 2022).
36. United Nations. Resolution Adopted by the General Assembly on 25 September 2015. 2015. Available online: http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E (accessed on 4 May 2022).
37. European Commission. A New Circular Economy Action Plan For a Cleaner and More Competitive Europe COM/2020/98 Final. 2020. Available online: https://www.eea.europa.eu/policy-documents/com-2020-98-final-a (accessed on 22 June 2022).
38. Ivankova, N.V.; Creswell, J.W.; Stick, S.L. Using Mixed-Methods Sequential Explanatory Design: From Theory to Practice. *Field Methods* **2006**, *18*, 3–20. [CrossRef]
39. Creswell, J.W.; Plano Clark, V.L.; Gutmann, M.L.; Hanson, W.E. An Expanded Typology for Classifying Mixed Methods Research into Designs. In *Handbook of Mixed Methods in Social and Behavioral Research*; Tashakkori, A., Teddlie, C., Eds.; SAGE Publications, Inc.: Thousand Oaks, CA, USA, 2003.
40. Kvale, S.; Brinkmann, S. *Den Kvalitativa Forskningsintervjun*; Studentlitteratur: Lund, Sweden, 2014.
41. Yin, R.K. *Case Study Research: Design and Methods*; SAGE: London, UK, 2009.
42. Denscombe, M. *The Good Research Guide: For Small-Scale Research Projects*, 5th ed.; McGraw-Hill Education: Maidenhead, UK, 2014.
43. Guy, C.M. Classifications of retail stores and shopping centres: Some methodological issues. *GeoJournal* **1998**, *45*, 255–264. [CrossRef]
44. ICA. ICA Sweden. 2022. Available online: https://www.icagruppen.se/en/about-ica-gruppen/our-operations/ica-sweden/ (accessed on 5 August 2022).
45. Cicatiello, C.; Franco, S. Disclosure and assessment of unrecorded food waste at retail stores. *J. Retail. Consum. Serv.* **2020**, *52*, 101932. [CrossRef]
46. Gioia, D.A.; Corley, K.G.; Hamilton, A.L. Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology. *Organ. Res. Methods* **2013**, *16*, 15–31. [CrossRef]
47. Schwalbe, M.L.; Wolkomir, M. Interviewing men. In *Handbook of Interview Research*; Gubrium, J.F., Holstein, J.A., Eds.; SAGE Publications, Inc.: Thousand Oaks, CA, USA, 2001.
48. Hoffmann, E.A. Open-Ended Interviews, Power, and Emotional Labor. *J. Contemp. Ethnogr.* **2007**, *36*, 318–346. [CrossRef]
49. Glaser, B.G.; Strauss, A.L. *The Discovery of Grounded Theory: Strategies for Qualitative Research*; Aldine: London, UK, 1967.
50. Krippendorff, K. *Content Analysis: An Introduction to Its Methodology*, 3rd ed.; SAGE: Thousand Oaks, CA, USA, 2013.
51. Saunders, B.; Sim, J.; Kingstone, T.; Baker, S.; Waterfield, J.; Bartlam, B.; Burroughs, H.; Jinks, C. Saturation in qualitative research: Exploring its conceptualization and operationalization. *Qual. Quant.* **2018**, *52*, 1893–1907. [CrossRef]
52. Eriksson, M.; Strid, I.; Hansson, P.-A. Food losses in six Swedish retail stores: Wastage of fruit and vegetables in relation to quantities delivered. *Resour. Conserv. Recycl.* **2012**, *68*, 14–20. [CrossRef]
53. Eriksson, M.; Ghosh, R.; Mattsson, L.; Ismatov, A. Take-back agreements in the perspective of food waste generation at the supplier-retailer interface. *Resour. Conserv. Recycl.* **2017**, *122*, 83–93. [CrossRef]
54. Holweg, C.; Teller, C.; Kotzab, H. Unsaleable grocery products, their residual value and instore logistics. *Int. J. Phys. Distrib. Logist. Manag.* **2016**, *46*, 634–658. [CrossRef]
55. Magalhães, V.S.; Ferreira, L.M.D.; Silva, C. Prioritising food loss and waste mitigation strategies in the fruit and vegetable supply chain: A multi-criteria approach. *Sustain. Prod. Consum.* **2022**, *31*, 569–581. [CrossRef]
56. Whelan, T.; Fink, C. The Comprehensive Business Case for Sustainability. *Harv. Bus. Rev.* **2016**, 2–8.
57. Michie, S.; Van Stralen, M.M.; West, R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implement. Sci.* **2011**, *6*, 42. [CrossRef] [PubMed]
58. Argyris, C. *On Organizational Learning*, 2nd ed.; Blackwell: Hoboken, NJ, USA, 1999.

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Consumer Psychology on Food Choice Editing in Favor of Sustainability

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Abstract: This article examines rationale behind consumers' vote for or against choice editing (reducing food choice) in favor of sustainable consumption to inform marketing communication strategies and sustainability policies. Based on a Qualitative analysis of free-text comments in a UK nationwide survey on sustainable healthy food consumption using inductive thematic analysis, we found that the majority (55.4%) disagreed with governments being given the right to minimize food choice options available to consumers by requesting that food industry players supply only sustainable food products whereas only 44.6% agreed with the idea. In-depth thematic analysis revealed that those who disagreed with it expressed the reasons to be "Freedom of choice", "Individual choice to decide and responsibility"; "Producers to be encouraged to develop sustainable products"; "Need for education"; "Consumers have power"; "Consumers should be made to fund health conditions they develop from unhealthy food."; "Government should fund production of sustainable foods"; and "this will lead to less competition within the market". On the other hand, the agreement expressed by respondents gave reasons such as, "Food industry's notorious for selling unhealthy food"; "Need to keep the price of sustainable products down."; "Government should legislate."; "All food sold should be whole natural food."; "Retailers should produce more healthy food as obesity is a problem."; "Healthy food is good for us."; "Government's obligation."; and "GMO foods, foods grown using artificial methods, harm the environment and humans." Our analysis revealed that change interventions have slowly reduced the pace of growth in the food industry, partially because of consumer awareness at a gradual rate. Moreover, sustainable food products are viewed as ineffective in the short run while market share for sustainable items remains substantially low. The implications of the results include inclusive policies for sustainable consumption, government intervention by making it mandatory to consume and produce sustainable items, accountability measures for food producers, the introduction of a rebate system for sustainable production, and the monitoring of food prices ensuring organic food is affordable to all.

Keywords: consumer psychology; choice limitation; consumer ethics; marketing communication; sustainable food policy

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1. Introduction

Sustainable Consumption as a Free Choice Consumer Practice

Over the past two decades, sustainable consumption research has progressed in describing challenges and problems associated with the sustainable food sector. For instance, prior research has highlighted the legendary barriers of availability, accessibility, and less variety of sustainable food products in various retail outlets such as supermarkets [1–4] as major inhibitors to sustainable consumption. Therefore, there were grounds for optimism on the part of sustainability researchers and practitioners that the introduction of

sustainable food products into the mainstream environment of supermarkets could help surmount these barriers and promote sustainable food market growth.

Anselmsson and Johansson [5] also underscored the efforts by food marketing managers to draw consumers' attention to sustainable products through creative merchandising. Yet, recent research shows consumers do not purchase ample amounts of sustainable food products to substantially support the attainment of sustainable development goals in the medium to long term [6,7]. Sustainable food products in the context of this paper refer to products that contribute to a single or a combination of economic, ecological, or social dimension(s) by virtue of their attributes or consequence [8,9].

Admittedly, a major shift towards sustainability requires an entire institutional change [10]. Indeed, Schubert [11] emphasized the need for an institutional overhaul to re-echo that a paradigm shift away from unsustainable production and consumption–' ... ... requires institutional change, not merely modifying individual behavior at the margin'. Thus, a broadened cross-sectoral, integrative, and stakeholder-oriented research approach that has the potential to resolve comprehensively inhibitors to sustainable food production and consumption is a fundamental requirement [10].

While previous studies have focused on sustainable consumption while covering briefly the role of government, the studies either heavily emphasized the numeric expression to explain the relationship or focused on the importance of sustainable consumption patterns. However, the consumer psychology for or against sustainable choices is understudied. The hidden embedded themes of the consumer's psychology regarding the choices and preferences remain largely understudied. Previous studies have mainly focused on the consumers' and the producers' perspectives while partially engaging the government's role in the due process, whereas the reasoning for a choice selection of the consumers (especially the consumer's psychology for selecting or opposing the organic products) have not been explored in depth. Moreover, the producer's role is often found to be discussed in a descriptive manner. This study fills the gap by providing a critical take on the producers' practices and activities as well as the futuristic role of the government in organic/sustainable items production and consumption. Thus, this study is an attempt to fill the existing gap in the literature by providing a qualitative perspective exploring the research phenomenon. The useful truth (qualitative perspective) is largely missing from the existing literature, while there is over-emphasis on the factual truth (quantitative perspective). This study also fills the gap in the methodological perspective by offering in-depth insight into the research phenomenon through the qualitative approach. Thus, the current study seeks to address an important but unexplored area of overt paternalism by examining the psychology behind consumers' reasons to vote for or against a proposal for the government to legislate food choice editing in favour of sustainable alternatives. We deem this research enquiry as the "elephant in the room of sustainable consumption scholarship". It is, in our view, a critical issue with huge implications for public health and nutrition status, consumer policy towards sustainable food production, and consumption and consumer ethics. The research is novel as it addresses the elephant in the room of sustainable consumption which has previously been ignored by researchers and academics. There is limited evidence to explore the research phenomenon by bringing the hidden embedded themes through qualitative analysis. The previous studies established the relationship through numeric expression while failing to examine the hidden themes of consumer psychology. Thus, this research is unique and novel in providing an in-depth understanding of the consumers' vote for or against sustainable items.

The academic novelty includes contributing a new body of knowledge by overcoming numeric expression and exploring the research phenomenon through a qualitative perspective. Thus, this paper has a robust methodology. Moreover, the existing literature needed updated information behind consumer psychology, producers' existing practice, and the role of the government in the due process–all being covered under one umbrella research. Moreover, the practical implication includes suggested innovative techniques and the promotion of sustainable consumption and production practices and procedures.

The structure of the manuscript after the introduction includes a literature review, which critically evaluates the existing studies, followed by a research methodology explaining the methods and materials employed in the existing study to gather the information and commence the primary investigation. The next section after methods and materials is qualitative findings and discussions expressing the current findings in relation to the previous literature at hand. This is followed by a conclusion and implications. Lastly, the manuscript contains research limitations and future studies.

2. Literature Review

A vast literature has confirmed that, in several economies, sustainability is a prevailing key problem, particularly in the agri-food industry [9,10,12–15]. Furthermore, regarding sustainable food consumption, several attributes are found to be connected to the differentiation of products, thus, assisting and enabling agri-food ventures to increase the value of their respected commodities [12,14–17]. In addition to that, those organizations that demonstrate the triple bottom approach (caring for people, the planet, and profit) by being ethical, social, and environmentally responsible reflect a higher corporate image [14,18,19]. Nonetheless, the consumers' psychology and their input are still understudied. The work of Haque et al. [14] carried out in a similar dimension, primarily focused on "amenable to reduce food selection options available in order to offer increased sustainable alternatives" while giving very little scope and detail about why the consumers would/would not be willing to consume sustainable/organic items. Thus, there is a need to explore the in-depth themes that reflect the consumer psychology of two types: (a) those in favor of sustainable consumption and (b) those opposing sustainable consumption practices.

Haque et al. [14] argued that there is still no agreement on a widely accepted definition of sustainability. Equally, the concept of sustainable food has not been studied under one standard approach [10,20]. From the lens of food production, there are several products that are marketed as sustainable items by showing ethical and/or environmental aspects. Labels and certifications are also used to show their credibility so that consumers can easily identify them [21,22]. Some consumers might buy but still may not buy those items. The useful truth must be explored to know the consumer's psychology behind or against decisions. Interestingly, "per current status, there is no omnibus label for sustainable food, but rather reflected in ethical, social, and environmental elements being the focal point for any scheme is expressed in fairtrade, organic, or eco-labels" [15]; cited from Haque et al. [14].

Discourses on behavior-change intervention have also reinforced the centrality of the food consumer stakeholder as the main actor behind the slow pace of growth of this important industry [3,4,6,7]. Indeed, notable strands of sustainable food consumption scholarship have emerged to promote awareness and behavior change include: (1) Consumer-behavior research focused on closing the attitude-behavior gap [23–25] and (2) Green nudges studies [11,26–31]. These efforts notwithstanding, it is arguable that strategies based on the 'attitude-behavior gap' and 'green nudges' research aimed at promoting the patronage of sustainable food products appear ineffective in the short term, as their impact on the market share of the sustainable food industry has been minimal [7,32]. Therefore, the sense of optimism that heralded mainstreaming of sustainable food products into the mainstream environment of supermarkets has not significantly engendered sustainable consumption. This situation serves to remind researchers and practitioners about the dynamic and complex nature of consumer behavior and the need to explore research avenues beyond attitude-behavior gaps and nudges to promote sustainable consumption.

Consumers frequently like to associate themselves with sustainable items reflecting higher concern for society, healthy food, or commodities exhibiting greater fairness towards food producers [14,33]. Worldwide, there is an increased awareness of consumption patterns escalating the demand for the production of sustainable items [14,34,35]. Globalization has significantly influenced the expansion of the market by reducing boundaries for the exchange of information and goods and services [15]. Yet, it is not free from the challenges it has brought to sustainable consumption. In fact, it could be argued that

globalization is one of the hurdles to uniform sustainable consumption practices in the country. However, there are arguments proposed by the champions in favor of globalization that global consumers have higher market awareness and enable the promotion fairtrade practices [36–40]. Yet, from the extracted literature at hand, we could not find a study that has examined the reasoning behind being for or against sustainable consumption. The consumer's psychology in this regard is still understudied.

A plethora of studies has focused on environmental sustainability while primarily concentrating on the specific dimension of sustainable food consumption [15]. A wide range of studies found that "sustainability has mainly focused on environment-friendly consumption and the consumption of organic products" [1,41–43]. Criticism about the organic sector is that it has still failed to capture a large segment of the market despite having the potential. Thus, our study is an attempt to investigate the reasoning behind the failure of organic items being unable to capture their potential. Yet, few attempts are carried out by research academics that explore fairtrade as a facet of ethical consumption [44,45] or animal welfare [41,46].

The work of Sidali and Hemmerling [47] found that consumers often have higher expectations from the producers to produce sustainable products. Yet, consumers themselves take little or no initiative to travel a long distance to purchase and consume sustainable food. For example, the work of Sirieix et al. [48] revealed that, for seasonal items, consumers are not very enthusiastic about travelling long distances; they would instead consume the items that are easily accessible. However, we are looking to explore the reason reflecting consumer psychology about the sustainable food available in the supermarket, which is closer and easily accessible. We attempt to understand the reason for favouring or opposing it.

3. Methods and Materials

Four months (from November 2018 to February 2019) of data was gathered by means of nationwide data collection from UK supermarket Fairtrade consumers. Participants were screened to capture respondents that were responsible for the majority of food purchases for their household and that had purchased sustainable food within the previous three months. We used an online consumer survey circulated through the SurveyMonkey platform. This technique enabled us to gather a large response set while providing the convenience of time flexibility in the participation process to the target audience. Networking and connections played a pivotal role in the attainment of loyalty card data from the UK supermarkets. The use of networking and connection is a handy and credible approach in social science research [49,50]. This technique also enabled us the filtering and identification of specific participants primarily responsible for most of their household shopping and particular items consumed by those individuals. Furthermore, the cluster sampling strategy was also incorporated to ensure the aim of a large-scale survey to delimit the regional specification and enhance the geographical spread of the sample. The regional delimiting technique is also a credible and valid approach previously used in social science studies [51,52]. Thus, the spread of this sample covered six regions in the UK (the East of England, Northern Scotland, Scottish Borders, Northern Ireland, Wales and the West of England, and Southern England).

The cluster sampling technique enabled us to attain fair representation [51] through regional quotas, therefore, 16% of each regional quota representation was attained. Interestingly, a total of 1601 usable questionnaires were returned and completed, indicating a 58% response rate (which is adequate and acceptable in drawing a fair conclusion). It also helps in the attainment of an appropriate sample size ratio [14,49]. Moreover, the selective extrapolation method used in this study is effective in avoiding non-response bias [53]. Frequently, in qualitative studies, the sample size is not about numeric quantification because it is to understand the hidden embedded themes in-depth [49]. The focus is more on the useful truth rather than the factual truth [54,55].

The survey questions were partly adapted from a study by Sidali et al. [15] but it was conducted in English. We asked for the views of survey participants on which food industry stakeholders ought to be directly responsible for ensuring or deciding that sustainable food

alternatives be made available on the consumer market. The survey featured an open-ended question to enable researchers to undertake a thematic analysis of whether governments have the approval of shoppers to reduce food choices by requesting food producers and retailers to selectively offer sustainable healthy food products. A dichotomous question was asked to elicit consumers' readiness to back a government proposal for choice editing in favor of sustainable foods and to allow them to give the rationale behind their respective positions. Subsequently, the survey enquired of respondents an estimate: "By discounting price, how much of your shopper freedom in terms of food selection options are you ready to surrender to enable your favourite supermarkets to supply sustainable healthy foods?" Data of 1601 respondents were used in the analysis. The study employed qualitative analysis of free-text comments in a UK nationwide survey on sustainable healthy food consumption using inductive thematic analysis. The responses were saved in an Excel spreadsheet. We used Bar Diagrams to visually represent the agreement and disagreement of the consumers. This was followed by Pro Word Cloud to visually present the main themes drawn from the agreed and disagreed consumers.

4. Qualitative Analysis and Discussion

Following the section above that highlights our data choice and methods, here we critically discuss the qualitative findings. The results are examined and discussed using the extant literature as the basis to confirm or contradict existing scholarship. We established from the results that there is a split opinion among consumers, as categorized into two: (a) in favor, and (b) against the idea that the government be allowed to reduce consumer food choice (See Figure 1).

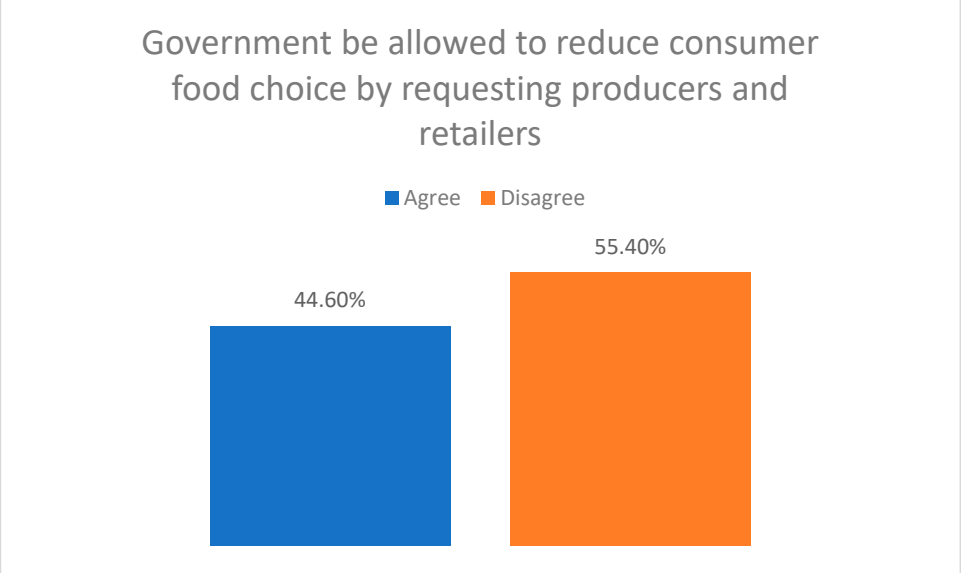

Figure 1. UK Consumers' response to the government is allowed to reduce consumer food choices by requesting producers and retailers.

The qualitative analysis involved a thematic analysis of consumer opinions on whether the government should be given the right to edit consumer food selection options by encouraging food producers and retailers to offer to the market only sustainable healthy food products. Out of the sample of 1598 responses, 712 (44.6%) agreed that the government should be given the right to edit consumer food selection options by encouraging food producers and retailers to offer to the market only sustainable healthy food, while a majority of 886 (55.4%) disagreed (See Figure 1).

Of the majority who disagreed or discouraged food choice reduction intervention, the main thematic responses were "Freedom of choice"; "Individual choice to decide and responsibility"; "Producers to be encouraged to develop sustainable products"; "Need for education";

"Consumers have power"; "Consumers should be made to fund health conditions they develop from unhealthy food."; "Government should fund the production of sustainable foods"; and "This will lead to less competition within the market" (See Figure 2).

Figure 2. Thematic response/reasoning given by the disagreed consumers.

The in-depth exploration of the emerged themes revealed that opposing the idea of forced choices meant that consumers have no freedom to select their preferred choices. Thus, many disagreed by supporting that freedom of choice is an important aspect. The exerted force is still a force without one's own willingness, even if it is meant to be healthy and sustainable. Another theme evident from the disagreed phenomenon was the final decision and responsibility component. This indicates that the final decision and responsibility of selecting the food from the shelves should be with the consumers. They should be deciding upon what is right or not for them. A third theme emerged about why consumers should be forced to change their choice. The burden of sustainable behavior should not be solely on the consumer, instead, the produced should be forced to produce sustainable items. If non-sustainable items are on the shelves, consumers will buy them because they are inexpensive. Thus, the producers should be held responsible to develop and produce sustainable items. The burden of sustainable consumption should not be on the consumers, but the burden of sustainable production should be on producers.

Another interesting argument that emerged from those who oppose the idea is that government should start educating people before imposing ideas of consumption. People would switch to sustainable items when they have awareness of the benefits and needs of sustainable consumption. There was also a theme that consumers have the power and should always be empowered to make the decision about consumption. Such thoughts emerged from the notion that money and purchasing power lies with the consumers so they should make the choice whether to consume any item or not.

Another theme emerged that is more of a suggestion from those who disagreed with the imposed idea of sustainable consumption, which is that such consumers who do not want to reduce their non-sustainable consumption pattern should be asked to make health donations. This would at least balance out the sustainable act/behavior to a larger extent. On the other hand, the argument also emerged that if the government wants the consumers to adopt sustainable consumption behavior, then they should fund production of sustainable foods. Perhaps that will make it less expensive and easier for consumers to buy.

The last theme that emerged was that the forced choice upon the consumers will also mean that all the producers are producing sustainable items, which is again a threat to

competition. Competition keeps businesses active and dynamic, while the possibility of competition shrinking is likely because of such decisions. It is good to have competition because it benefits the consumers and producers. Therefore sustainable consumption should not be forced to keep the competition alive.

The discussion based on the present qualitative findings in the light of the literature at hand shows that sustainable consumption is a consistent yet progressive challenge that is evident in the sustainable food sector. Despite the governmental efforts and enhanced social awareness among the consumers through digital and other platforms about organic and sustainable consumption, there is still higher reluctance among the consumers toward sustainable food. Thus, our findings to a large extent aligned with previous studies [6,7,50,56]. The qualitative findings also revealed that there is an argument that there is very little variety of sustainable consumption items and accessibility in many retail outlets; supermarkets, for example, are substantially lower in organic and/or sustainable items, which further proves to be a hurdle in developing taste and preference for sustainable food consumption. Hence, the findings of the present study partially support the previous work of [1–4].

However, for those who agreed or encouraged food choice reduction intervention, the main thematic responses were "Food industry's notorious for selling unhealthy food"; "Need to keep the price of sustainable products down."; "Government should legislate."; "All food sold should be whole natural food."; "Retailers should produce more healthy food as obesity is a problem."; "Healthy food is good for us."; "Government's obligation."; and "GMO foods, foods are grown using artificial methods, harm the environment and humans." (See Figure 3).

Figure 3. Thematic response/reasoning given by the agreed consumers.

On exploration of the reasons behind the agreement, it is evident that participants believe that the food industry has been notorious for selling unhealthy food. Thus, forcing the development of sustainable consumption patterns would also drive the food producers to give up on their unhealthy food production process and invest in sustainable practices. Interestingly, there emerged a theme about prices, which is more of a suggestion that sustainable product prices should be kept lower because organic products prices are higher which discourages the consumers from buying them. Thus, the government control of reducing non-sustainable choices in favor of sustainable items would also include a reduction in the prices of sustainable items. Another theme evident along similar lines is

that government should legislate and regulate the prices and patterns in the food industry. Such legislature of monitoring would enable the consumers to have healthy food choices while the producers would also develop healthy food processing and production practices. Interestingly, some of the participants stated that all unnatural foods should be removed from the shelves and replaced with whole natural food. If there were no such choice of selection between natural and unnatural existing and only natural food were on shelves, the consumers would automatically develop a sustainable consumption pattern.

The participants advocating sustainable food choices stated that obesity is a big problem, thus retailers should be urged to produce more healthy items to promote sustainable consumption patterns and behaviors. Another reasoning that emerged from the supportive group in the study is that healthy food is good for consumers, so, therefore, even if it is forced, it is for the benefit of the consumers.

Interestingly, some respondents stated that it is the obligation of the government to impose sustainable practices. They should play an active role in the process. Lastly, the argument also emerged that switching to sustainable consumption is essential because artificial methods of grown goods (inorganic food) are harmful to humans as well as the environment. Thus, there should be sustainable consumption practices, and it should be strictly imposed on all stakeholders for the betterment of societies and communities. The work of Mauri et al. [56] revealed that in the UK, the government has now included calories in restaurant menus. The study also revealed through the experiment that sugar is indeed not sustainable [56]. Hence, there are traces in recent times that efforts are made to create consumer awareness about their consumption patterns and unhealthy choices.

Although, in the present study, the disagreement ratio is higher than the agreed, there are traces for the sustainable producers too because over 40% agreed, which means that there is still optimism about the prevalence of sustainable items on shelves. It is possible that mainstream supermarkets can play a pivotal role in the promotion and growth of the sustainable food market.

The extracted themes of those supporting the work of Anselmsson and Johansson [5] have also underscored the efforts by food marketing managers to draw consumers' attention to sustainable products through creative merchandising. Yet, recent research shows consumers do not purchase ample amounts of sustainable food products to substantially support the attainment of sustainable development goals in the medium to long term [6,7]. Sustainable food products in the context of this paper refer to products that contribute to a single or a combination of economic, ecological, or social dimension(s) by virtue of their attributes or consequence [8,9].

The thematic analysis revealed that the change intervention has gradually reduced the pace of growth in the food industry, but the rate of consumer awareness is retained at a sustainable rate. Thus, this study partially supports the work of previous studies including [3,4,6,7]. Interestingly, our findings revealed that sustainable food products are viewed as ineffective in the short term while the market share of sustainable good items remains substantially low. Therefore, the present findings to a larger extent support the previous findings [7,32] whereas they reflect the concept of attitude-behavior gap [23–25] and the concept of green nudges [11,26–31].

5. Conclusions

The conclusion is drawn from the findings of current research that a major shift toward sustainability requires an entire institutional change in relation to the consumers' rationale behind votes for or against choice editing, specifically reduction in the food choices in favor of sustainable consumption. The majority of the consumers revealed that they disagree with the idea that government should be allowed to impose the selection choices. There is less willingness to give up on the product preferences in order to encourage and develop sustainable consumption patterns. The clear division between disagreed and agreed consumers enables the research to explore the reasons behind their choices for and against sustainable consumption. Those who disagreed that government should be allowed to force

sustainable consumption and reduce the consumers' preferred items stated various reasons; however, the most common that emerged is such force is against freedom of choice. This reflects that consumers have the right to choose for themselves, irrespective of the fact that the selection might not be sustainable. Other themes driven by the disagreement include: the responsibility and ultimate decision lie with what the individual prefers. Instead of forcing the decision on the consumer, the burden of sustainability should be upon the producers. They should be forced rather than the consumers. Interestingly, the theme also emerged that, before forcing a choice, there is a need for education about the importance of sustainable consumption. The opinion also emerged that power is and should be with the consumers. Ultimately, the argument is that if the consumer is spending money, then it is their right to buy what they like. Another interesting thought also occurred that consumers who do not develop sustainable consumption behavior should make donations to health organizations for such acts while others thought that it is the government's responsibility, thus, they should fund the production of sustainable foods. Perhaps it will make it less expensive and easier for consumers to buy. The last theme that emerged was that the competition in the market will shrink because only sustainable items would be available. There should be a wide range to keep the competition, which ultimately benefits the consumers and producers.

On the other hand, those in favor of the government imposing sustainable practices by force stated their various reasons. The most widely stated theme was that the food industry has been renowned for being notorious for selling unhealthy food, thus, sustainable consumption should be imposed to eradicate unhealthy food selling practices. The food processors and producers must be bound to produce healthy and sustainable items. Moreover, the prices should be kept reasonable so that consumers can afford to buy organic products. A strong reason for avoiding organic food also is that it is expensive in comparison to inorganic products. Governments should play a key role in controlling production and consumption patterns by ensuring there are only organic items on shelves ensuring that the prices are monitored and legislating and regulating the production process. This would encourage healthy and sustainable food production and consumption patterns and behaviors. Moreover, there is also the suggestion that there should only be whole natural food production and promotion in the market. Government and producers should work together to ensure that only organic choices are available on shelves by discarding inorganic and unhealthy food items.

Obesity is a critical issue and unhealthy food is the main reason behind the increasing obesity problem. Retailers should be encouraged to produce sustainable items to control the issue of obesity. There are no harms in organic food, but there is an extremely adverse impact of inorganic (unhealthy) food on both humans and the environment. Thus, the government should legislate, regulate, and control the adverse impact by intervening in the process. Such intervention would promote sustainable consumption behavior and sustainable production practices and would contribute towards healthy communities. Neuromarketing (NM) application could be valuable; neuroimaging and physiological tools such as emotions, decision-making, attention, and memory towards brands and advertisements [57] should be frequently used by the producers to correlate the consumer's behavior. Thus, the use of innovation and technology would further help in understanding the consumer's psychology. Moreover, the use of eye-tracking and electroencephalogram (EEG) are other effective marketing innovations [58,59] that could help in improving the understanding of consumer psychology.

We also conclude that change interventions have been gradually reducing the growth pace of the industry. There have been traces of more consumer awareness, encouraging sustainable practices, yet most consumers are still not being fully educated about the benefits of organic items and the adverse impact of unhealthy food, resulting in higher opposition to the sustainable consumption pattern.

6. Implications

We encourage that there should be inclusive policies for sustainable consumption that would enable consumers to engage in sustainable food practices and gradually democratize sustainability to ensure mutual benefits for business, consumers, and society. Inorganic and unhealthy food has a huge adverse impact on public health and nutrition status. Thus, we propose that government should intervene by making it mandatory to consume and produce sustainable items at a reasonable rate. However, before that, it is essential that government start educating people about the benefits of sustainable consumption practices. There has been a vast majority opposing the idea of sustainable practices, but the consumers' ethics in such regard could only be questioned if they were properly informed about the adverse impact of inorganic items.

Furthermore, the food processing industry should be accountable for its practices and production. They should be legislated and controlled by imposing restrictions on production methods. They should be encouraged with rebates for producing sustainable items. The government should not only replace the inorganic items with organic items on shelves but also control the prices so that consumers can afford them too. Neuromarketing (NM), eye tracking, and electroencephalogram (EEG) are some of the effective innovations that could create better awareness about consumer psychology and thus should be incorporated during the production and processing of sustainable items.

There is a need to revisit the consumer policy toward sustainable food production and consumption practices. The psychology of the majority of consumers remains focused on pricing, thus the items should be available to consumers at affordable prices.

7. Research Limitations and Future Directions

Despite the best effort to produce comprehensive results, there is always room for improvement. One of the constraints of the present study is over-emphasis on the qualitative findings, which subsequently led to ignoring quantitative findings. The idea was to attain useful truth rather than factual truth. Hence, the numeric expression of the relationship is ignored. It would be good to use follow-up quantitative findings in future studies because it would make the methodology more robust. The useful truth would be backed by factual truth. Therefore, future studies shall incorporate the follow-up quantitative methods to further robust the methodology.

The present model examined the qualitative perspective; however, the model does not include in-depth discussion with the experts. Therefore, future studies shall consider the model of research with experts' views in this regard. The current model opens the way to understand consumer psychology, while future studies should include in their model the role of information technology to attain whether more a comprehensive understanding and education of the consumers would lead to sustainable consumption patterns.

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References

1. Aertsens, J.; Verbeke, W.; Mondelaers, K.; van Huylenbroeck, G. Personal determinants of organic food consumption: A review. *Br. Food J.* **2009**, *111*, 1140–1167. [CrossRef]
2. Buder, F.; Feldmann, C.; Hamm, U. Why regular buyers of organic food still buy many conventional products: Product-specific purchase barriers for organic food consumers. *Br. Food J.* **2014**, *116*, 390–404. [CrossRef]
3. Chkanikova, O.; Mont, O. Corporate supply chain responsibility: Drivers and barriers for sustainable food retailing. *Corp. Soc. Responsib. Environ. Manag.* **2015**, *22*, 65–82. [CrossRef]
4. Grimmer, M.; Kilburn, A.P.; Miles, M.P. The effect of purchase situation on realized pro-environmental consumer behavior. *J. Bus. Res.* **2016**, *69*, 1582–1586. [CrossRef]
5. Anselmsson, J.; Johansson, U. Corporate social responsibility and the positioning of grocery brands: An exploratory study of retailer and manufacturer brands at point of purchase. *Int. J. Retail. Distrib. Manag.* **2007**, *35*, 835–856. [CrossRef]
6. Kristensson, P.; Wästlund, E.; Söderlund, M. Influencing consumers to choose environment friendly offerings: Evidence from field experiments. *J. Bus. Res.* **2007**, *76*, 89–97. [CrossRef]
7. Yamoah, F.A.; Acquaye, A. Unravelling the attitude-behaviour gap paradox for sustainable food consumption: Insight from the UK apple market. *J. Clean. Prod.* **2019**, *217*, 172–184. [CrossRef]
8. Reheul, D.; Mathijs, E.; Relaes, J. Elements for a future view with respect to sustainable agri-and horticulture in Flanders. *Rep. Proj. Sustain. Agric.* **2001**.
9. Vermier, I.; Verbeke, W. Sustainable food consumption: Exploring the consumer "attitude-Behavioral Intention" Gap. *J. Agric. Environ. Ethics* **2006**, *19*, 169–194. [CrossRef]
10. Reisch, L.; Eberle, U.; Lorek, S. Sustainable food consumption: An overview of contemporary issues and policies. *Sustain. Sci. Pract. Policy* **2013**, *9*, 7–25. [CrossRef]
11. Schubert, C. Exploring the (behavioural) political economy of nudging. *J. Inst. Econ.* **2017**, *13*, 499–522. [CrossRef]
12. Codron, J.M.; Sirieix, L.; Reardon, T. Social and environmental attributes of food products in an emerging mass market: Challenges of signaling and consumer perception, with European illustrations. *Agric. Hum. Values* **2005**, *23*, 283–297. [CrossRef]
13. Grunert, K.G.; Scholderer, J.; Rogeaux, M. Determinants of consumer understanding of health claims. *Appetite* **2011**, *56*, 269–277. [CrossRef]
14. Haque, A.U.; Yamoah, F.; Sroka, W. Willingness to Reduce Food Choice in Favour of Sustainable Alternatives: The Role of Government and Consumer Behaviour. In *Perspectives on Consumer Behaviour*; Sroka, W., Ed.; Springer: Berlin/Heidelberg, Germany, 2020; Chapter 3.
15. Sidali, K.L.; Spiller, A.; von Meyer-Höfer, M. Consumer expectations regarding sustainable food: Insights from developed and emerging markets. *Int. Food Agribus. Manag. Rev.* **2016**, *19*, 141–170. [CrossRef]
16. Dosi, C.; Moretto, M. Is ecolabelling a reliable environmental policy measure? *Environ. Resour. Econ.* **2001**, *18*, 113–127. [CrossRef]
17. McEachern, M.G.; McClean, P. Organic purchasing motivation and attitudes: Are they ethical. *Int. J. Consum. Stud.* **2002**, *26*, 85–92. [CrossRef]
18. Carlson, L.; Grove, S.; Kangun, N.; Polonsky, M.J. An international comparison of environmental advertising: Substantive vs. associative claims. *J. Macromark.* **1996**, *16*, 57–68. [CrossRef]
19. Morris, L.A.; Hastak, M.; Mazis, M.B. Consumer comprehension of environmental advertising and labelling claims. *J. Consum. Aff.* **1995**, *29*, 328–350. [CrossRef]
20. Johnston, P.; Everard, M.; Santillo, D.; Robèrt, H. Reclaiming the definition of sustainability. *Environ. Sci. Pollut. Res.* **2007**, *14*, 60–66. [CrossRef]
21. Caswell, J.A.; Padberg, D.I. Toward a more comprehensive theory of food labels. *Am. J. Agric. Econ.* **1992**, *74*, 460–468. [CrossRef]
22. Jahn, G.; Schramm, M.; Spiller, A. The reliability of certification: Quality labels as a consumer policy tool. *J. Consum. Policy* **2005**, *28*, 53–73. [CrossRef]
23. Jacobs, K.; Petersen, L.; Hörisch, J.; Battenfeld, D. Green thinking but thoughtless buying? An empirical extension of the value-attitude-behaviour hierarchy in sustainable clothing. *J. Clean. Prod.* **2018**, *203*, 1155–1169. [CrossRef]
24. Cotton, D.; Shiel, C.; Paço, A. Energy saving on campus: A comparison of students' attitudes and reported behaviours in the UK and Portugal. *J. Clean. Prod.* **2016**, *129*, 586–595. [CrossRef]
25. Terlau, W.; Hirsch, D. Sustainable consumption and the attitude-behaviour-gap phenomenon-causes and measurements towards a sustainable development. *Int. J. Food Syst. Dyn.* **2015**, *6*, 159–174.
26. Lehner, M.; Mont, O.; Heiskanen, E. Nudging—A promising tool for sustainable consumption behaviour? *J. Clean. Prod.* **2016**, *134*, 166–177. [CrossRef]
27. Bucher, T.; Collins, C.; Rollo, M.E.; McCaffrey, T.A.; De Vlieger, N.; Van der Bend, D.; Truby, H.; Perez-Cueto, F.J. Nudging consumers towards healthier choices: A systematic review of positional influences on food choice. *Br. J. Nutr.* **2016**, *115*, 2252–2263. [CrossRef] [PubMed]
28. Gunn, M.; Mont, O. Choice editing as a retailers' tool for sustainable consumption. *Int. J. Retail. Distrib. Manag.* **2014**, *42*, 464–481. [CrossRef]
29. Wilson, A.L.; Buckley, E.; Buckley, J.D.; Bogomolova, S. Nudging healthier food and beverage choices through salience and priming. Evidence from a systematic review. *Food Qual. Prefer.* **2016**, *51*, 47–64. [CrossRef]

30. Bruns, H.; Kantorowicz-Reznichenko, E.; Klement, K.; Jonsson, M.L.; Rahali, B. Can nudges be transparent and yet effective? *J. Econ. Psychol.* **2018**, *65*, 41–59. [CrossRef]
31. Roberto, C.A.; Pomeranz, J.L.; Fisher, J.O. The need for public policies to promote healthier food consumption: A comment on Wansink and Chandon (2014). *J. Consum. Psychol.* **2014**, *24*, 438–445. [CrossRef]
32. Madichie, N.O.; Yamoah, F.A. Revisiting the European horsemeat scandal: The role of power asymmetry in the food supply chain crisis. *Thunderbird Int. Bus. Rev.* **2017**, *59*, 663–675. [CrossRef]
33. von Meyer-Höfer, M.; Olea Jaink, E.; Padilla-Bravo, C.; Spiller, A. Mature and emerging organic markets: Modelling consumer attitude and behaviour with partial least square approach. *J. Food Prod. Mark.* **2015**, *21*, 626–653. [CrossRef]
34. BBMG; GlobeScan; SustainAbility. Re: Thinking Consumption Consumers and the Future of Sustainability. The Regeneration Roadmap. 2012. Available online: http://www.globescan.com/component/edocman/?view=category&id=1&Itemid=591 (accessed on 18 October 2019).
35. National Geographic & GlobeScan. Greendex Report. Consumer Choice and the Environment—A Worldwide Tracking Survey. 2012. Available online: https://environment.nationalgeographic.com/environment/greendex/2012-survey (accessed on 20 October 2019).
36. Craig, C.S.; Douglas, S.P. Beyond national culture: Implications of cultural dynamics for consumer research. *Int. Mark. Rev.* **2006**, *23*, 332–342. [CrossRef]
37. Court, D.; Narasimhan, L. Capturing the world's emerging middle class. *McKinsey Q.* **2010**, *3*, 12–17.
38. Douglas, S.P.; Craig, C.S. Convergence and divergence: Developing a semiglobal marketing strategy. *J. Int. Mark.* **2011**, *19*, 82–101. [CrossRef]
39. Miller, T. Global segments from "Strivers" to "Creatives". *Mark. News* **1998**, *32*, 11–12.
40. Shermach, K. Portrait of the world. *Mark. News* **1995**, *29*, 20.
41. Honkanen, P.; Olsen, S.O. Environmental and animal welfare issues in food choice: The case of farmed fish. *Br. Food J.* **2009**, *111*, 293–309. [CrossRef]
42. Loureiro, M.L.; McCluskey, J.J.; Mittelhammer, R.C. Assessing consumer preferences for organic, eco-labeled, and regular apples. *J. Agric. Resour. Econ.* **2001**, *26*, 404–416.
43. Roberts, J.A. Green consumers in the 1990s: Profile and Implications for Advertising. *J. Bus. Res.* **1996**, *36*, 217–231. [CrossRef]
44. Adams, M.; Raisborough, J. Making a difference: Ethical consumption and the every day. *Br. J. Sociol.* **2010**, *61*, 256–274. [CrossRef]
45. McCluskey, J.J.; Durham, C.A.; Horn, B.P. Consumer preferences for socially responsible production attributes across food products. *Agric. Resour. Econ. Rev.* **2009**, *38*, 345–356. [CrossRef]
46. Lagerkvist, C.J.; Hess, S. A meta-analysis of consumer willingness to pay for farm animal welfare. *Eur. Rev. Agric. Econ.* **2011**, *38*, 55–78. [CrossRef]
47. Sidali, K.L.; Hemmerling, S. Developing an authenticity model of traditional food specialties: Does the self-concept of consumers matter? *Br. Food J.* **2014**, *116*, 1692–1709. [CrossRef]
48. Sirieix, L.; Kledal, P.; Sulitang, T. Organic food consumers' trade-offs between local or imported, conventional or organic products: A qualitative study in Shanghai. *Int. J. Consum. Stud.* **2011**, *35*, 670–678. [CrossRef]
49. Faizan, R.; Haque, A.U.; Cockrill, A.; Aston, J. Females at Strategic Level affecting Logistics Firms' Competitiveness: Qualitative Comparative Analysis. *Forum Sci. Oeconomia* **2019**, *7*, 57–71.
50. Haque, A.U.; Basuki, B.; Aston, J.; Widyanti, R. Do Different Stressors Affect Working Efficiency of Public University Personnel Differently? *Pol. J. Manag. Stud.* **2021**, *23*, 172–187. [CrossRef]
51. Haque, A.U.; Aston, J.; Kozlovski, E. The impact of stressors on organisational commitment of managerial and non-managerial personnel in contrasting economies: Evidences from Canada and Pakistan. *Int. J. Bus.* **2018**, *23*, 152–168.
52. Haque, A.U.; Oino, I. Managerial Challenges for Software Houses related to Work, Worker and Workplace: Stress Reduction and Sustenance of Human Capital. *Pol. J. Manag. Stud.* **2019**, *19*, 170–189. [CrossRef]
53. Armstrong, J.S.; Overton, T.S. Estimating nonresponse bias in mail surveys. *J. Mark. Res.* **1977**, *14*, 396–402. [CrossRef]
54. Haque, A.U. Varying Occupational Stress and Organisational Commitment within the University Staff of Contrasting Economies (Cross-Sectional Comparative Study of Middle Range Public Universities in Pakistan and the UK). Ph.D. Thesis, University of Wales Trinity Saint David, Lampeter, UK, 2020. Available online: https://repository.uwtsd.ac.uk/id/eprint/1570/ (accessed on 29 July 2022).
55. Haque, A.U.; Yamoah, F.A. The Role of Ethical Leadership in Managing Occupational Stress to Promote Innovative Work Behaviour: A Cross-Cultural Management Perspective. *Sustainability* **2021**, *13*, 9608. [CrossRef]
56. Mauri, C.; Grazzini, L.; Ulqinaku, A.; Poletti, E. The effect of front-of-package nutrition labels on the choice of low sugar products. *Psychol. Mark.* **2001**, *38*, 1323–1339. [CrossRef]
57. Alsharif, A.H.; Md Salleh, N.Z.; Baharun, R.; Alharthi, R.H. Neuromarketing research in the last five years: A bibliometric analysis. *Cogent Bus. Manag.* **2021**, *8*, 1978620. [CrossRef]
58. Khushaba, R.N.; Wise, C.; Kodagoda, S.; Louviere, J.; Kahn, B.E.; Townsend, C. Consumer neuroscience: Assessing the brain response to marketing stimuli using electroencephalogram (EEG) and eye tracking. *Expert Syst. Appl.* **2013**, *40*, 3802–3812. [CrossRef]
59. Alsharif, A.H.; Md Salleh, N.Z.; Baharun, R. Neuromarketing: Marketing research in the new millennium. *Neurosci. Res. Notes* **2021**, *4*, 27–35. [CrossRef]

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Power Relations in Multistakeholder Initiatives—A Case Study of the German Initiative on Sustainable Cocoa (GISCO)

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Abstract: Multistakeholder initiatives (MSIs) are formalized networks with member organizations from the private, public and not-for-profit sector. Even though members interact to achieve sustainability goals they cannot reach alone, research indicates that they are heterogeneous actors with their own and sometimes conflicting goals. There is no consensus in the literature regarding how those conflicting goals are negotiated. Power is seen as an important factor affecting network governance, but various concepts exist which can be applied to MSIs to different degrees. We explore the impact of person-, organization- and network-based power relations among actors in an MSI on the achievement of its own goals. To this end, we conducted 18 qualitative expert interviews with people involved in the MSI to explore decision making. Our results show that institutionally defined subgroups with similar actors (stakeholder groups) collectively represent their interest in the MSI. All stakeholder groups thus have a specific form of group-based organizational power. Our study shows that these are not negotiated; consequently, the MSI faces constraints in terms of dysfunctional power relations, as well as obstacles to finding solutions for sustainability issues on a global scale.

Keywords: multistakeholder initiatives; network governance; actors; wicked problems; collaboration; GPN; power relations; institutions

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1. Introduction

Complex problems on a global scale are often referred to as "wicked problems" [1–3]. Frequently studied "wicked problems" relate to the massive environmental and social imbalances in global food supply chains [4–6]. Other examples include climate change, biodiversity loss, child labor, or persistent poverty in parts of the world. Such multidimensional problems affect diverse and various stakeholders or are influenced by them [7,8] (p. 9). Therefore, dealing effectively with such problems requires joint and networked action by different groups of actors inside and outside (food) supply chains [9]. A significant advantage of such cooperation between different actors and groups of actors is the circumvention of possible competitive disadvantages of sole entrepreneurial engagement [8] (p. 9).

Multistakeholder initiatives (MSI) are an opportunity for heterogeneous actors inside and outside supply chains to cooperate in order to achieve sustainability goals [10]. MSIs are defined as "[. . .] formalized arrangements in which organizations from diverse sectors (private, public, and not-for-profit) commit to work together in mutually beneficial ways to accomplish goals that they otherwise could not achieve alone" [11] (p. 1837). Together, the member organizations of an MSI can define their own standards and develop certifications for products in the context of (food) supply chains. Due to voluntary participation, decisions usually have no legally binding effect and are therefore referred to as soft law [12]. In addition to such standard-setting MSIs, there are MSIs that can be described as a "continuous improvement model" [13]. In this case, MSIs usually focus on the entire value chain and develop principles and indicators that members can implement and use to track progress. It is therefore a different approach compared to standard-setting MSIs. Hence, MSIs focusing on continuous improvement rely primarily on dialogue and successive improvements through negotiations between actors and groups of actors.

The influence of an MSI on global economic contexts depends to a large extent on the ability of the participating actors to act together in an efficient way. However, MSIs bring together a variety of actors whose interests may diverge or be entirely opposed [14]. Moreover, individual members may prioritize the achievement of common goals very differently given their individual goals [15]. In the case of an empirical study of an MSI in the Indonesian cocoa sector, divergent values and interests between actors from the so-called Global South and those from the so-called Global North represent one of the key challenges to collaboration [16]. Considering this, it seems important to develop a better understanding of the interactions between actors in MSIs. This knowledge is the basis to assess the implications of MSIs in terms of the "wicked problems" that MSIs were created to address [17].

De Bakker et al. identify three thematic research areas on MSIs. The first area deals with the development of MSIs into stable institutions. The second area focuses on the impact of MSIs, including studies that deal with outputs and outcomes. The third thematic research area examines the functioning of MSIs in more detail. This research area "is related to discussions about how MSIs are created and managed; it concerns the actors, decisions, processes, and practices that give rise to MSIs" [18] (p. 356). Within the area, research on the underlying processes of coordination and alignment between organizations has mainly taken place in the context of standard-setting organizations or certification partnerships [16,18]. In the development of standards, they refer to power as a factor that influences outcomes. "Although power is a key theoretical concept within this line of work, the literature acknowledges this only implicitly. Interestingly, power is mostly ascribed to actors possessing valuable resources or operating in a favorable position (e.g., lead firms in global value chains [19]). Other faces of power, such as manipulation (e.g., shaping anticipated results) or domination (e.g., manufacturing consent), are not discussed in the literature" [18] (p. 360). For MSIs of the "continuous improvement model" [13], it can also be assumed that power influences the negotiation process, as well as the concrete shaping of results. This is where this article comes in, by aiming to contribute to a more nuanced understanding of power in MSIs that, on the one hand, builds on different approaches from the interdisciplinary literature on power in networks and MSIs and, on the other hand, is adapted to the specifics of the governance of MSIs of the "continuous improvement model" [13]. For this purpose, a conceptual framework on power in MSIs is outlined in Section 2. The framework allows us to show at which levels power occurs in an MSI, as well as the impact of different forms of power that take place on these levels with their effects on achieving its own goals. To this end, a case study is conducted on a German MSI working for sustainable cocoa. In order to empirically capture the power relations between the actor groups and the actors in the negotiations, two methods were used: An analysis of minutes from meetings and guideline-based expert interviews, which are presented in Section 3 after the introduction to the case study. The results in terms of power in the studied MSI are presented in Section 4. These empirical results are discussed with regard to the relations between the dimensions of power and the conceptual framework (Section 5). This paper concludes with a brief summary and a proposal for a conceptualization of power in MSIs of the "continuous improvement model" [13] (Section 6).

2. Power in MSIs

To capture the negotiations between actors in MSIs, an understanding of power is proposed that distinguishes between three levels on which power occurs: (a) organizations, (b) individuals and (c) network-based regulations (see Table 1).

A suitable starting point for the conceptualization of (a) organization-based power is a definition from the Global Production Network (GPN) approach. GPNs capture which actors are involved in the global production, trade and consumption of goods and services and how they are related to each other [20]. In a GPN, an actor is considered powerful if it has the ability "[. . .] to exercise and achieve control over a particular strategic outcome in its own interests [. . .]" [21] (p. 66). The GPN literature distinguishes between three forms

of power in a GPN, each of which they assign to one of the actor groups: private, public and non-profit [20,22]. The authors refer to the power of companies as corporate power, meaning the ability to influence the decisions and resource allocations of other companies in their own interest due to their market power. Institutional power is exercised by states and transnational organizations over lead firms to influence their investments or other decisions. Non-governmental organizations such as trade unions have collective power and can use it against lead firms or other external actors. Empirically, to what extent these forms of power can be transferred to the actors in an MSI is an open question. GPNs are understood in the context of this paper as umbrella networks in which actors are connected to each other in various ways [20]. Actors participating in an MSI are connected through formal membership and their interactions in a separate network—the MSI—within the GPN's higher-level frame of reference. Thus, in Coe and Yeung's understanding, GPNs are a "network of networks" [23] (p. 778). Hence, the existence of power relations between actors in the MSI can be assumed. However, how interactions and negotiations take place within MSIs is currently insufficiently researched [18,24].

In an MSI, private, public and non-profit organizations are members, but they are represented by individuals. In contrast to organizations, these individuals have different possibilities to act powerfully by negotiating skillfully and making decisions. Accordingly, the proposed understanding of power in MSIs considers (b) person-based power [25,26]. Saffer et al. interpret power in MSIs as the ability of individual actors to influence communication in the network [27]. A prerequisite for this is the existence of necessary resources. Furthermore, actors in formally legitimized positions (offices) have a greater influence on communication, as this position gives additional weight to contributions [27]. This finding can be placed in theory through the analytical distinction of different effects of power, as Mossig undertakes with reference to Keohane and Nye and Bathelt and Taylor [28,29] (pp. 92–93), [30,31]: Power, through control and possession of resources, is based on formally assigned decision-making authority, e.g., due to the position as an elected board member, veto rights or the possession of relevant resources such as special financial resources ("power over" [32]). This form of power over others is related to strength and dominance and often originates in the (im-)material resource endowment outside the network. The second effect of power described by Mossig is power through relationships, which results from the power of persuasion and the ability to win over other actors to one's own ideas and conceptions ("power to" [32]) [28,29] (pp. 92–93). Although formulated more positively, this corresponds to an alternative form of influence hinted at by de Bakker et al. [18]. This reflects a relational understanding of power as a resource that understands powerful actors as those who are able to engage other actors in networks and motivate them to act together [33] (p. 65). Thus, unlike "power over", "power to" has its origin in the personality of the actors, on the one hand, and, on the other hand, this form of power is tied to the network itself. Individuals representing their respective organizations in the MSI are therefore not understood as isolated entities without external connections, but as integrated nodes in their respective individual (ego-) networks [34,35]. This means they simultaneously use their personal characteristics and capabilities, as well as the forms of power of the organization they represent. Thus, power is transferred from the conceptual forms of institutional, corporate and collective power from the GPN literature to the empirically ascertainable level of influence by individuals in an MSI.

However, conceptually linking the two levels does not resolve the open question of how power differentials are expressed in network interactions [18,24]. Thus, an unequal distribution of power can lead "less powerful groups to feel their identity threatened, hamper the ability to mobilize agreement, and result in a lack of commitment to the process" [36] (p. 246). Conversely, an unequal distribution of power among actors can also promote efficient collaboration and problem solving [31]. Well-defined hierarchies and responsibilities shorten decision-making processes [28], so that time-consuming discussions about the supposedly best solution can be reduced significantly.

In addition to organizations and individuals, (c) network-based regulations influence the cooperation of actors in MSIs. They arise from behaviors and past interactions across the actors. The resulting values and norms have a disciplining effect on the individual actors and thus reduce uncertainties [29] (p. 93). Such institutions as a form of power can be defined "[. . .] as ongoing and relatively stable patterns of repeated social interaction, based on mutual expectations that owe their existence to purposeful constitution or unintentional emergence" [37] (p. 123). Such established patterns of social behavior can be conceptually distinguished between formal and informal institutions. The former are based on sets of rules, such as bylaws, contracts, or regulations, while the latter emerge in the concrete practice of action and are mutually recognized and reproduced by the actors [37]. Network institutions are to be understood as interdependent with person-based power because, on the one hand, they only emerge through the actions of actors and, on the other hand, the ability of an actor to make use of the power form of network institutions corresponds to the "power to" understanding of power.

Table 1. Dimensions of power in the context of an MSI.

Levels of power	Organization-based power [20,22]	Person-based power [25,26]	Network-based regulations [29] (p. 93)
Forms of power	Network-external origin in the form of: • Institutional power • Corporate power • Collective power [20,22]	• Network-external origin through the endowment of (im-)material resources and personality, • Network-internal origin through offices and own abilities [28,29] (pp. 92–93), [33] (p. 65)	Institutions in networks [28,37], [29] (pp. 92–93)
Effect of power	• Power through control and the possession of resources ("power over") • Power through relationships ("power to") [18,27,28,30–33], [29] (pp. 92–93)		Values and norms from behaviors and past interactions that discipline actors and in this way create mutual certainty of expectation [29] (p. 93)

Thus, from the literature review, power can be considered in three dimensions: first, at the level of occurrence (organization, individual person, network); second, at the level of its effects ("power over", "power to", institutions); and third, closely related to this, through the forms of power (external to the network through resources and personality, internal to the network through offices and their own capabilities) (see Table 1).

3. Case Study and Methods

The case study was conducted using the German Initiative on Sustainable Cocoa (GISCO), which was registered in April 2014 as an association based in Berlin [38]. In December 2019, a total of 75 organizations from the German cocoa and chocolate sector were involved in it. Each stakeholder is assigned to one of the four stakeholder groups: (Stakeholder Group A) the German Federal Government, which includes two federal ministries; (B) the Cocoa, Chocolate and Confectionery Industry, with 48 organizations; (C) the Retail Grocery Trade, with seven organizations; as well as (D) Civil Society, with 18 organizations (see Figure 1). GISCO has three main goals: "1. To improve living conditions of cocoa farmers and their families and to contribute to a secure living. 2. To conserve and protect natural resources and biodiversity in cocoa producing countries. 3. To increase cultivation and commercialization of sustainably produced cocoa" [39].

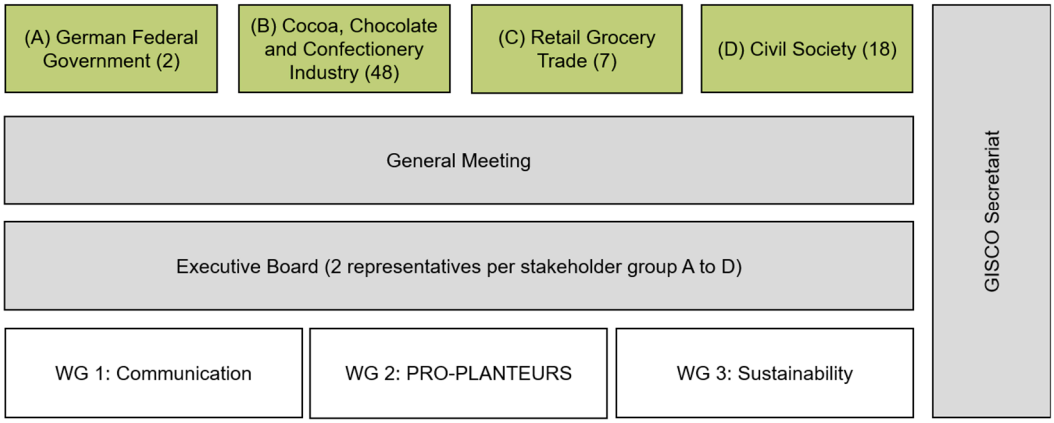

Figure 1. Organization Chart of GISCO.

GISCO has an eight-member executive board composed of two representatives from each stakeholder group and a secretariat with a managing director (see Figure 1). Members can get involved by attending annual general meetings and participating in three working groups (WGs): WG 1: Communication, WG 2: PRO-PLANTEURS and WG 3: Sustainability. These are responsible for the public relations work of GISCO, the monitoring of the project "PRO-PLANTEURS", which aims to improve the socio-economic living and working conditions of 30,000 farmers in Côte d'Ivoire [40] and for developing further measures to increase the sustainability of cocoa on the German market.

To understand the power relationships in GISCO, member perspectives are included through the use of qualitative research. In preparation for the expert interviews with representatives of organizations from all four stakeholder groups, board members and secretariat staff, 84 min from MSI meetings between May 2014 and December 2019 were analyzed to capture network activity in terms of decision making. Minutes of the general meetings, board meetings and WG meetings were provided exclusively by GISCO for analysis. Three findings should be noted: First, the minutes indicate which actors were present at the meetings. Thus, over the five-and-a-half-year study period, it was possible to count which organizations were particularly active. These were later requested for an interview through the GISCO secretariat. Second, the minutes indicate which actors in GISCO were given tasks. It was possible to count the delegations recorded in the minutes. This shows that it is mainly the secretariat that carries out a wide range of tasks. The executive board is the central committee in the MSI that delegates administrative tasks in particular to the secretariat and technical tasks primarily to the WGs in their function as think tanks. Third, the minutes show what was discussed in the meetings and what decisions were made. This made it possible to ask competent follow-up questions in the interviews and to better understand the answers. However, minutes lack the reasons, underlying arguments, compromises, or concessions through which the respective decisions were reached. This gap was closed with the help of guided expert interviews [41].

Building on the preparation through the analysis of the minutes, a guideline was drafted that included questions about GISCO's network governance [42] (pp. 55–70). Among other things, the interviewees were asked about their goals, strategies for implementation and exemplary negotiation processes in the network. The guideline was evaluated with a staff member from GISCO's secretariat and constantly evolved between interviews. Fifteen individuals representing member organizations were interviewed from April to August 2020. The sample includes at least one person from each stakeholder group. In addition to the 15 interviews, three supplemental interviews were conducted. One with two staff members of the secretariat and two others during the preparation of the research project in 2018. There, one interview each was conducted with a representative of a member organization and with a representative of the secretariat. Thus, the evaluation is based on a total of 18 interviews. With one exception, all of the experts are or were involved in

the executive board or in working groups (WGs) and are therefore likely to have a strong knowledge of governance-relevant processes in GISCO (see Table 2).

Table 2. Comparison of the distribution of actors by stakeholder groups in GISCO and in the sample.

Stakeholder Group	Number and Share (in %) in the Sample	Number and Share (in %) in GISCO	Share
(A) German Federal Government	2 (11.1%)	2 (2.6%)	100%
(B) Cocoa, Chocolate and Confectionery Industry	7 (38.9%)	48 (63.2%)	14.6%
(C) Retail Grocery Trade	1 (5.6%)	7 (9.2%)	14.3%
(D) Civil Society	6 (33.3%)	18 (23.7%)	33.3%
Secretariat	2 (11.1%)	1 (1.3%)	100%
Total	18 (100%)	76 * (100%)	23.7%

* 75 organizations represent 100% of the membership (as of 2019). The two people in the secretariat are counted here as another stakeholder.

Due to COVID-19, the interviews were conducted by telephone or video calls in the summer of 2020. Although this only slightly limited the quality, it resulted in a challenging interview process, as described by Christmann [43]. The average duration of the interviews was 65 min, and all conversations were recorded with a voice recorder and transcribed into standard written German using simple transcription rules [44] (pp. 125–126). Each interviewee was assigned a unique identification code consisting of a letter and a number. The letters "A" to "D" stand for membership in one of the four stakeholder groups, and "G" represents the secretariat. The numbering is incremented continuously and has no meaning in terms of content. Subsequently, a "Thematic Qualitative Text Analysis" was conducted using the QDA software "MAXQDA" [44] (pp. 69–88). In a total of seven steps, main categories are first derived from theory, whose respective subcategories are inductively formed on the material (in this case, the transcripts). The final category system has a total of 2364 codings in 135 main categories and subcategories organized into five hierarchical levels [45]. The results regarding power relations derive from this analysis, although this is an excerpt.

4. Results

The presentation of the results begins with a description of the network-based regulations (Section 4.1). This is followed by a description of organization-based power (Section 4.2) and person-based power (Section 4.3).

4.1. Network-Based Regulations

As expected from the conceptual framework, it became clear in the interviews that not only individuals and organizations influence other actors and negotiations, but cooperation is also determined by institutionalized forms and processes that have become established in this multistakeholder network. GISCO's bylaws define the tasks of the committees (the executive board, general meetings and working groups), the composition of the executive board and the mode of decision making, thus providing a system of rules for the negotiations. The stakeholders involved agreed in the in the course of founding GISCO that no stakeholder group can be overruled. Such veto power for all decisions made by the executive board means that formally all stakeholder groups A to D have equal power. The underlying goal is to force consensus decisions. However, the bylaws do not stipulate that the decisions reached are binding on the members. Exclusion of members is the

only sanction available to the executive board. Furthermore, because MSI decisions are not legally binding on members, there has been no reason to make use of the sanction option to date. In addition, the bylaws do not contain any formal arbitration, just as they do not contain any concrete regulations on the conduct of members. "What we haven't implemented at all, or what we don't have in any form, is some kind of arbitration jurisdiction. We don't have that at all. [In one conflict], this led to telephone calls between the chairperson of the board and individual stakeholders in order to calm things down a bit" (B3 2020: para. 103) (The interviews were conducted in German; the quotations were translated by the authors).

In addition to formal institutions, which have their origins in bylaws of the MSI, informal institutions such as the telephone calls have emerged in the course of cooperation that affect and are reproduced by all actors. Examples of such informal institutions that underlie collaboration in GISCO include how members interact within and outside the network, how problems are solved and the typical steps of processes that emerge over time. The process steps are mutually recognized by the stakeholders involved in GISCO and perceived by interviewees as highly formalized, although it is not specified in the bylaws. Rather, the sequence of steps has evolved through collaboration, each linked by the work of the secretariat. The schematic reconstruction of an exemplary process is shown in Figure 2.

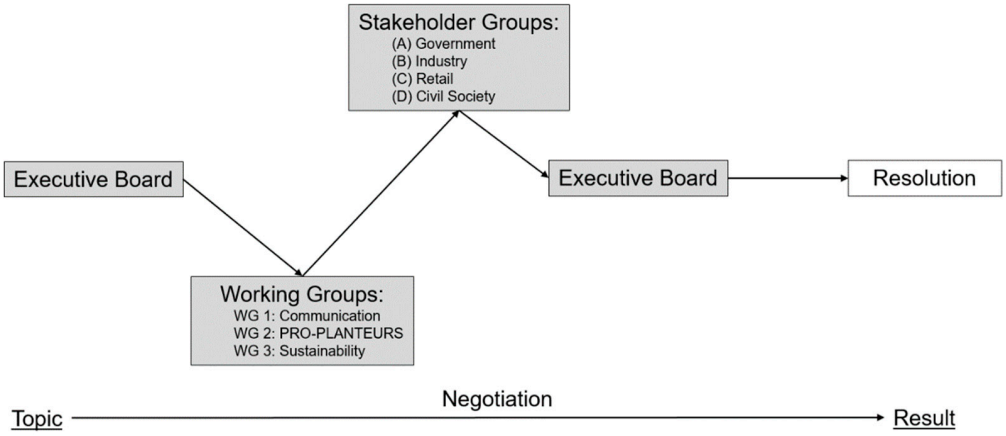

Figure 2. Process steps in GISCO.

(1) New content is usually discussed by the executive board and, if necessary, delegated for further elaboration to one of the three working groups (WG 1: Communication, WG 2: PRO-PLANTEURS, or WG 3: Sustainability). In these WGs, the discussion takes place between the present members. The negotiations usually extend over a longer period of time, with several meetings in which the interim results are elaborated by the secretariat and critically reviewed by the individual stakeholder groups. The influence of individual persons still appears to be comparatively great at this stage and to decrease further on in the process: "Someone makes a proposal and then you look at it and then it sounds good at first and then it always goes back to the stakeholder groups again and you notice that it then becomes much more cumbersome" (B5 2020: para. 35).

(2) Subsequently, the recommendations of the WGs are distributed to the individual stakeholder groups as elaborated decision papers by the secretariat via the representatives of each stakeholder group. The development of a common position within the stakeholder groups serves to prepare the representatives for the board meetings. The evaluation of the decision papers can sometimes differ quite significantly between the stakeholder groups.

(3) After the stakeholder groups have commented on the decision papers, the board members hold a meeting to finalize a decision. If there is no consensus among the stakeholder groups, these aspects are discussed. It has happened that compromises proposed in the WGs have been withdrawn again by stakeholder groups in the board meeting. Some interviewees saw it as a strategic move to rescind compromises found in WGs at the board

meetings. If a compromise is found in the board meeting, a board resolution is passed. The interviewees characterize such resolutions, which are ultimately the main outcomes in GISCO, as compromises. However, this means that consensus is often the lowest common denominator among stakeholders. This can also be reflected in the fact that the agreed-upon formulations "sometimes become a bit fuzzy" (B5 2020: para. 47). If it is not possible to find a compromise in the board meeting, the discussions are delegated again to the WGs and/or the individual stakeholder groups. This loop is repeated with varying frequency depending on the content until, ideally, a consensus is reached among the stakeholder groups in a board meeting. If it is not possible to reach a compromise, even after several loops, such content is taken off the agenda and not pursued further (for the time being).

4.2. Organization-Based Power

The reconstruction of the process as an informal institution in GISCO shows that the individual member organizations of different stakeholder groups usually only enter negotiations with each other in the three working groups (WGs) to develop decision papers. Decisions at the network level of the entire MSI are usually made by the representatives of the four stakeholder groups in the executive board. The individual board members' positions are prepared in meetings within the respective stakeholder groups. It follows that the use of individual organizations' forms of power takes place particularly within their own stakeholder group, whereas in the negotiations between the stakeholder groups, a powerful position of an individual organization plays a subordinate role, since the previously negotiated position of the entire stakeholder group is usually represented on the executive board.

The stakeholder group of the German Federal Government (Stakeholder Group A) consists of two federal ministries with different technical orientations. These cannot always be brought to a compromise, so the two ministries do not have a unified position in all processes. Examples of differing positions described by individual interviewees include divergence on a basic understanding of power structures in agricultural supply chains and the Act on Corporate Due Diligence in Supply Chains (for further information see [46]). While one ministry wants to prevent a law in the perception of one interviewee, the second uses the dialogue in GISCO to gain a sense of the implementability of such a law. The impression that emerges from the interviews is that the activity of the stakeholder group in GISCO is additionally interpreted by all sides as a kind of patronage. One of the two ministries initiated GISCO and both ministries financially supported GISCO in its early days. More recently, one of the ministries has provided funding to outsource a complex drafting process to an external consultancy to advance a stalled process. Other deployments of financial resources by a ministry also occur outside of GISCO, e.g., for partnerships and in other initiatives in sustainable resources to initiate interactions between different supply chains. Another potential power designates a ministry's representatives the ability to withdraw from GISCO if dissatisfied.

Companies in the Cocoa, Chocolate and Confectionery Industry (B) are characterized by their heterogeneity, both in terms of company sizes, ranging from small and medium-sized enterprises (SMEs) to transnational corporations (TNCs), and in terms of their business models. The interviews show that the level of activity in GISCO does not directly depend on company size, but much more on the willingness to engage. The willingness of individual companies to contribute to progress towards sustainability goals by engaging in GISCO beyond sourcing certified cocoa and paying the membership fee differs. Due to the high expectations, one interviewee sees blocking attitudes on the part of commercial enterprises in some cases. In the negotiations, some interviewees from other stakeholder groups see the interbranch organizations, which are also members of GISCO and coordinate "their" respective Stakeholder Groups B and C, as particularly obstructive. Within the stakeholder group, the interbranch organization is perceived as a coordinating and moderating actor that tries to bring together the heterogeneous positions of the group members. Contributing to the perception may be that the two board

members of the industry stakeholder group jointly represent the resolutions worked out in the industry group in the board meetings and do not give any approvals that deviate from them. If it is not possible to reach a consensus within the group, the board members also represent this within the board meetings. The decision-making process is sometimes controversial within the stakeholder groups. As an example, one interviewee describes: "But there I would say that in the individual groups it is the democratic system that the louder ones, the bigger ones and the majority have the heard opinion and the others tend to be unheard" (B2 2020: para. 57). While some interviewees explain that processes are sometimes dragged out by industry and retail actors, others refer to the time-consuming process steps in GISCO. In addition, the company representatives see it as their task in GISCO, with their practical experience in the cocoa and chocolate sector, to pay attention to the implementability of resolutions and not to give hasty approvals that they cannot keep. The quotation of an interviewee (B1 2018: para. 75) underlines the knowledge about the influence of the stakeholder group: "[. . .] insofar it was quite a process, [. . .] if we had not played along, there would have been no change at all. These are, of course, compromise situations". This also becomes clear in the dependence on the payment of membership and project fees for "PRO-PLANTEURS" (for further information about the project in Côte d'Ivoire implemented by GISCO, see [40]). The form of financing from membership fees paid by the stakeholder groups from industry (B) and trade (C) distinguishes GISCO from other initiatives in the perception of one of the staff members from the office. In addition, a high financial contribution means a corresponding commitment from the members. The "PRO-PLANTEURS" project is not financed by membership fees; instead, companies can participate financially on a voluntary basis.

There is a parallel between the Cocoa, Chocolate and Confectionery Industry (B) and the Retail Grocery Trade (C) in that the two interbranch organizations play a central role and act as coordinators and spokespersons for their stakeholder groups. Apart from this, the Retail Grocery Trade (C) is described as comparatively homogeneous with a few, but very large and powerful companies. As in industry, the involvement of individual retail companies varies. There are different views on retail companies' potential to exert change on the supply chains. Therefore, it is disputed whether the actors of the trade group are sufficiently engaged in GISCO. Industry representatives in particular would like to see more engagement, while others acknowledge the existing engagement and/or do not want to equate the retail companies with industrial companies.

Civil Society (D) in GISCO consists of different subgroups, each with their own objectives. NGOs and standard-setting organizations were particularly frequently distinguished from one another. The standard-setting organizations are sometimes criticized for their position between companies and NGOs as part of a common stakeholder group D. Nevertheless, consensus building within the Civil Society group is described as constructive, although not always easy and, due to the process underlying GISCO, just as time-consuming as in the other stakeholder groups. Interviewees from other stakeholder groups also share the impression that Civil Society is a very active, articulate and well-organized group that puts content on the agenda and formulates demands to other stakeholder groups. At the same time, interviewees from the industry group sometimes see a certain lack of awareness in the demands and make it clear that, in some cases, there is a lack of expertise about internal company processes and concrete approaches to solutions. In order to advance their concerns, strategies were discussed in the interviews which the Civil Society actors can draw on:

- They also conduct campaigns outside GISCO. In doing so, they find themselves in a balancing act between the use of the strategic instrument to build up public pressure on the companies and maintaining a trusting cooperation in GISCO.
- Representatives of civil societies threaten to leave GISCO. For example, the stakeholder group's consideration of leaving GISCO united at a particularly difficult point in a negotiation process was described, in order to "deprive GISCO of some of its legitimacy" (D6 2020: para. 39).

- Also mentioned in the interviews is the increasingly international networking with the civil societies of the other European MSIs in the cocoa sector in Belgium, Switzerland and The Netherlands.

4.3. Person-Based Power

The interviews revealed that board members in particular have the greatest influence among individual persons because negotiations between stakeholder groups take place primarily in the board meetings. Consequently, individuals that hold office have a particular degree of influence on the communicative negotiation processes in GISCO. A key task is to mediate between the executive board and the stakeholder groups. This happens in two ways: Board members organize stakeholder group-internal meetings to develop their positions as group representatives on the executive board. This can be described as bottom-up. In particular, experts from member organizations in groups B and C emphasize the need to ensure that their board members are aware of their position, take it into account and, if necessary, bring it to the board meetings. At the same time, board members act as the first point of contact for their members, also in cases of dissatisfaction. The other direction in which board members mediate between the executive board and stakeholder groups can be described as top-down. This involves communicating with their groups before and after board meetings, sharing information, reporting on activities and, in some cases, soliciting approval for resolutions, discussing votes in advance and feeding decisions from the board meeting back into the respective internal stakeholder group meetings.

The chairperson of the executive board also exerts an influence on negotiations in GISCO. The chair's personal characteristics are described as neutral, balanced, consensus-seeking, coordinating, calming and moderating. With these characteristics, the chairperson shapes the discussion as an individual and exemplifies a constructive form of interaction. At the same time, he also appears in other ways: In internal cooperation, the chairperson presides over board meetings and, together with a deputy, the WG 3: Sustainability. He is actively involved in resolving conflicts and, together with the deputies, acts as a contact person for the secretariat and the managing director, with whom the chairperson maintains an intensive dialogue. The chairperson of the executive board represents GISCO, together with the managing director, in international meetings and committees.

The heads of the three working groups, WG 1: Communication, WG 2: PRO-PLANTEURS and WG 3: Sustainability, work closely with the secretariat and are responsible for the preparation and follow-up of the meetings in terms of content and organization. It is clear from the interviews that the exercise of these offices is not automatically accompanied by a strong influence on the negotiations.

In addition to the people who hold offices in GISCO (board members, chairperson of the executive board, along with deputies, as well as heads of the WGs), other people also exert influence on negotiations. This became clear in the interviews when the interviewees were asked what distinguishes individuals whose word has a high weight in committee meetings or stakeholder groups. In general, the interviewees emphasize that all members formally have the same voting rights and that factors such as resource endowments of the organizations do not influence this. However, some respondents say that there are definitely individuals in the industry stakeholder group who are more active in discussions and are seen as leaders. Interestingly, three reasons crystallize in all stakeholder groups as to why the contributions of some individuals in committee meetings seem to attract more attention than those of others: first, their perceived competence; second, their personal appearance; and third, their conscientiousness and persistence in pursuing goals. These three characteristics are superficially independent of the respective offices held by the individuals. Nevertheless, it is likely that elected board members hold office and shape discussions based on their personalities, in addition to the presence of financial resources in their organizations that permit such honorary office. In contrast, holding office or being employed by the secretariat (such as the managing director or staff of the secretariat) are not mandatory prerequisites for being granted influence by other actors.

It becomes clear from the interviews that the interviewees are highly serious about their involvement in GISCO. Thus, they explain their strategies when participating, which interestingly correspond to the described characteristics of influential actors:

- Regardless of their own stakeholder group, most of them emphasize the relevance of actively involving themselves and their own points in GISCO's discussions. This applies in particular to participation in the WG meetings and the stakeholder group-internal meetings.
- Reading and commenting on all documents received in advance of the meetings is important for most experts. In the event of their own absence in an internal stakeholder group meeting, the majority of company representatives make a point of informing their group's board members about their own position. For some representatives from the industry and retail stakeholder groups, this also includes persistently defending one's own position, vetoing if necessary and not allowing oneself to be carried away into rash agreements and promises.
- In addition to the importance of attending meetings in WGs and stakeholder group-internal meetings, some emphasize the relevance of informal discussions and convincing other actors of one's own position.

5. Discussion: Relations between the Different Dimensions of Power in GISCO

After describing the respective forms of power at different levels, this subsection focuses on the interdependent relationships between these levels. At the network level, as described by Glückler and Bathelt, Mossig, as well as Bathelt and Taylor, formal and informal institutions are the basis of cooperation [28,29,31,37] (p. 93). These are mutually recognized and reproduced by the members. Relevant in terms of power are the voting relationships that emerge from the bylaws. Thereby, all four stakeholder groups A to D in GISCO have veto rights. Institutionally, this ensures that no group can outvote the others. In other words, a balance has been created and individual stakeholders' power over others has been ruled out. Also formally established is the (so far unused) possibility of excluding members, which, however, as a last resort does not guarantee stable cooperation. The actors' manners of dealing with each other have established themselves as an informal institution in the course of cooperation. Other informal institutions in GISCO include solving conflicts through personal discussions and moderation, as well as the actors' mutual expectations of professional and fair dealings with each other inside and outside GISCO. The order of the process steps in which content is negotiated has also become such an institution in the network that is recognized by all participants without being written into the bylaws. Those values and norms have a disciplining effect on the individual actors and thus reduce uncertainties [29] (p. 93). Figure 3 shows the schematic process in GISCO already known from Figure 2, but supplemented by the dominant levels of power on each step.

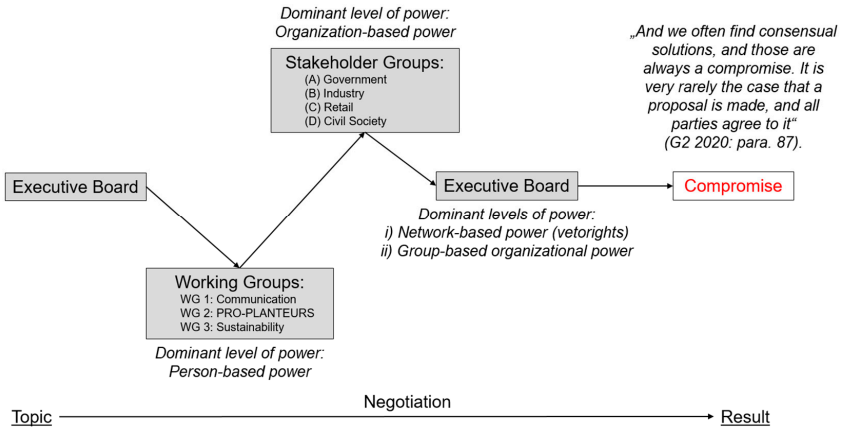

Figure 3. Processes and power relations in GISCO.

As shown in Figure 3, processes in GISCO usually start in the executive board. The members of the executive board decide whether a topic should be discussed further. If so, it is delegated to one of the workings groups (WGs) for more in-depth discussion. Within WG 1: Communication, WG 2: PRO-PLANTEURS and WG 3: Sustainability, the influence of individuals is high. The interviews show that individuals with appropriate personality, perceived expertise and persistence in GISCO can influence the debate, using corresponding strategies of influence. This behavior is consistent with Saffer et al.'s conceptualization of power, in which power in MSIs is associated with influence over communication [27]. This, in turn, is consistent with the "power to" approach of influence through relationships and one's own persuasiveness described in prior theoretical work [29] (pp. 92–93). However, the person-based power decreases in favor of the stakeholder groups with each step of the process.

In the next step of the processes in GISCO, the four stakeholder groups A to D discuss the decision papers negotiated before in the thematic working groups. Contrary to what might be expected from theory, organization-based power is primarily relevant within these stakeholder groups. In the executive board, the groups act (more or less) cohesively as interest groups. This can be seen, first, in the fact that the interbranch organizations of industry (stakeholder group B) and retail (C) exercise a coordinating function within their stakeholder groups and speak for their groups at the network level. Secondly, it is clear from the fact that stakeholder groups sometimes reject compromises reached in the WGs. Third, in the further steps of the process, negotiation loops take place between the stakeholder groups whose representatives on the executive board conduct negotiations. Consequently, in the context of MSIs we should speak of organization-based power *within* the stakeholder groups and group-based organizational power *between* them, which becomes more relevant than person-based power in the further steps of the negotiation processes. Accordingly, membership of a stakeholder group is important for the assertion of common interests. Although the division of the 75 member organizations (as of 2019) into four stakeholder groups—(A) Federal Government, (B) Cocoa, Chocolate and Confectionery Industry, (C) Retail Grocery Trade and (D) Civil Society—structurally reduces the heterogeneity in GISCO to a certain extent, the groups' common interests must first be negotiated.

As shown in the results, all stakeholder groups have specific forms of power, which come to play in the executive board. Empirical evidence shows that, due to the structure of GISCO with its four stakeholder groups, these specific forms of power are less likely to be used by individual organizations at the level of the overall network, but rather are first negotiated by the respective stakeholder groups themselves. Industrial and retail companies use group-based organizational power in a form described in the literature on GPNs as corporate power [20,22]. In GISCO, this is reflected in the perception of corporate representatives that it is their responsibility to intensively scrutinize proposals from other groups in terms of their feasibility. Another way of exerting influence is that no measures can be implemented without their ideational and financial support. Therefore, a materially conditional form of influence, coupled with the use of the veto, is characteristic for companies. This effect can be assigned to the "power over" approach, while the explanation of internal processes and practical experiences to other stakeholder groups corresponds to the argumentative "power to" approach. Civil Society has a specific group-based organizational power that corresponds to collective power [20,22]. It is virtually the "counterpole" (B6 2020: para. 107) of the industrial group. The Civil Society group is described as active and demanding and appears comparatively cohesive, despite its diverse composition. The interviews show that the opportunities for civil societies to exert influence lie primarily in their power of persuasion, their arguments and demands, and the mobilization of others' resources for their concerns. This effect is in line with the "power to" approach. Nevertheless, this stakeholder group also has (immaterial) resources in the sense of "power over": a threatened withdrawal from GISCO would deprive the initiative of legitimacy to a large extent, and some NGOs use their legitimacy as a resource in public campaigns to exert pressure on companies. Furthermore, policymakers have

their own group-based organizational power, equivalent to institutional power [20,22]. The ministries not only assume a kind of patronage for GISCO, but also work on the content of the initiative. Financial support for policy corresponds to the effect of a resource-based "power over" approach to influence. This includes the possibility of opting out of GISCO or becoming legislatively active if necessary. One of the ministries is monitoring the possibility for a legislative regulation. At the time of the interviews, it appears that the ministries want to encourage companies to become more involved without a regulation, which again is in line with the "power to" approach.

Table 3 summarizes the effects of the empirically observed forms of group-based organizational power in GISCO. Here, the representatives are understood as representing their respective organizations, transferring the power of their organizations in global economic contexts in the form of actions in the context of an MSI [34,35].

Table 3. Empirically observable effects of group-based organizational power in GISCO.

	(A) Government	(B) Industry and (C) Trade	(D) Civil Society
"Power over" in GISCO	• Withdrawal from GISCO • Financial support outside GISCO and financing of individual processes • Regulatory possibilities outside GISCO	• Financial investment, without which no change is possible • Will to change essential for any implementation • Use of the veto	• Diminishing legitimacy through withdrawal • Campaigns
"Power to" in GISCO	• Encourage agreement among stakeholders	• Explaining company-internal processes	• Convince, argue, make demands • Networking with civil societies, European MSI

The diversity of the effects of group-based organizational power in GISCO means that no stakeholder groups are clearly more powerful in relation to others. With reference to Bathelt and Taylor, it can be seen that the power symmetry between the four stakeholder groups does not lead to quick and efficient decisions [31]. This often results in stalemate situations. The following quotation from B5 (2020: para. 35) illustrates a typical agreement process: "Of course, there is a lot of discussion about such small formulations, which sometimes makes it a bit fuzzy. But that's because, based on the positions that the members have, there can't be as much room for maneuver as one might give the other person in normal life". The lack of necessity and willingness to leave the respective positions leads to situations in which compromises are only reached on a voluntary basis. The quotation from interviewee G2 in Figure 3 shows the tough struggle for compromises: "And we often find consensual solutions, and those are always a compromise. It is very rarely the case that a proposal is made, and all parties agree to it" (G2 2020: para. 87).

It can be concluded that the diversity of power forms leads to a dysfunctional power constellation in GISCO in relation to its goals. Moreover, the group-based organizational power of corporations is institutionally advantaged through their veto power. In comparison, the demanding role of civil societies has been elaborated, which are presumably less dependent on veto power than corporations to achieve their goals. This disparity is not overcome in the negotiation processes. The interviews suggest that within the stakeholder groups, precisely because of the use of organization-based power by individual organizations, it is possible, in most cases, to work out a common position. Negotiations at the network level between the stakeholder groups, on the other hand, are often more difficult because there is no clear power hierarchy between the actors. By their very nature,

consensus reached between stakeholder groups in this way is often the lowest common denominator. With regard to the MSI's goals regarding the sustainability of the cocoa sector, it should be noted that these have (so far) not been achieved. One interviewee exemplifies: "[. . .] the problems in the cocoa sector have been known for over ten years and the problems haven't really changed that much or even improved. So I think the results are still not that earth-shattering" (B2 2020: para. 117). From the interviews it emerges that the opportunities of GISCO lie rather in generating attention, bringing diverse stakeholders into contact with each other and enabling them to learn with and from each other. Improvements regarding the socio-economic living and working conditions of farmers are achieved by GISCO less directly, but much more indirectly or on a smaller scale through the project "PRO-PLANTEURS". In terms of the global cocoa and chocolate sector, interviewees emphasize the steadily increasing amount of certified cocoa processed in Germany by GISCO members. However, many interviewees state that certification as an instrument alone is not sufficient to solve the "wicked problems" [1] in the food supply chain of cocoa in a sufficient way.

6. Conclusions

With regard to the "wicked problems" in the cocoa and chocolate sector, such as poverty, child labor and deforestation, the interviews conducted revealed that GISCO is not a panacea. In the previous section, it became clear that power influences the collaboration of actors in the MSI in many ways. For example, on the one hand, the search for compromise in often multiple loops of negotiation usually produces lowest common denominator agreements among stakeholder groups. On the other hand, the case study shows that in-depth knowledge of the interactions in an MSI contributes significantly to gaining a better understanding regarding its possible impacts. The findings show that GISCO, as an MSI in global economic contexts, is an arena in which power asymmetries between actors are diminished only to a certain extent.

In order to examine power in MSIs, existing concepts of power in the literature on network governance, institutions and GPNs were drawn upon and related to each other in the context of MSIs. The case study conducted at a German MSI shows which forms of power occur at different levels in the network and how their relationships to each other can be described. In summary, it appears that power in MSIs is expressed in various forms and effects and occurs at different levels. With this knowledge, a conceptualization of power in MSIs can be formulated according to the "continuous improvement model" that does justice to this insight. It is modeled on the conceptualizations of power described at the outset. The empirical study confirmed that power operates between persons and organizations within a stakeholder group, as well as between stakeholder groups. It operates in different forms, which have their origin partly inside, partly outside the MSI. Furthermore, these power relations underlie network-based regulations, which apply to all actors. Person-based and organization-based power can be distinguished in their effects between "power over" and "power to".

Yet, this conceptualization of power in MSIs does not reflect that organizations negotiate within their stakeholder groups to determine what interests they *collectively* represent. To this end, group-based organizational power was introduced as a specific level of power within an MSI as a result of the empirical study. It is particularly this form of group-based organizational power that makes it so difficult to achieve far-reaching results in GISCO. At the same time, the specificity of the network with its institutions is conceptually considered. The observed negotiations in GISCO indicate the relationship between the specific forms of power of each stakeholder group in global economic contexts and how these are (not) negotiated. Further research could explore in more depth how organizations perceive their power in global economic contexts and what factors influence how representatives in MSIs strategically use this perceived power. Since this case study only examined one MSI of the "continuous improvement model", expanding the research to include other MSIs, especially standard-setting MSIs, is urgently needed.

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References

1. Dentoni, D.; Bitzer, V.; Schouten, G. Harnessing Wicked Problems in Multi-Stakeholder Partnerships. *J. Bus. Ethics* **2018**, *150*, 333–356. [CrossRef]
2. Levin, K.; Cashore, B.; Bernstein, S.; Auld, G. Overcoming the Tragedy of Super Wicked Problems: Constraining our Future Selves to Ameliorate Global Climate Change. *Policy Sci.* **2012**, *45*, 123–152. [CrossRef]
3. Rittel, H.W.J.; Webber, M.M. Dilemmas in a General Theory of Planning. *Policy Sci.* **1973**, *4*, 155–169. [CrossRef]
4. Ingram, V.; van Rijn, F.; Waarts, Y.; Gilhuis, H. The Impacts of Cocoa Sustainability Initiatives in West Africa. *Sustainability* **2018**, *10*, 4249. [CrossRef]
5. Khan, A.S.; Neis, B. The Rebuilding Imperative in Fisheries: Clumsy Solutions for a Wicked Problem? *Prog. Oceanogr.* **2010**, *87*, 347–356. [CrossRef]
6. Kolk, A. Mainstreaming Sustainable Coffee. *Sustain. Dev.* **2013**, *21*, 324–337. [CrossRef]
7. Dentoni, D.; Bitzer, V. The Role(s) of Universities in Dealing with Global Wicked Problems Through Multi-Stakeholder Initiatives. *J. Clean. Prod.* **2015**, *106*, 68–78. [CrossRef]
8. Grimm, J. *Private Governance as an Institutional Response to Wicked Problems*; Nomos: Baden-Baden, Germany, 2019.
9. Dentoni, D.; Hospes, O.; Ross, R.B. Managing Wicked Problems in Agribusiness: The Role of Multi-Stakeholder Engagements in Value Creation: Editor's Introduction. *Int. Food Agribus. Manag. Rev.* **2012**, *15*, 1–12.
10. Bush, S.R.; Oosterveer, P.; Bailey, M.; Mol, A.P.J. Sustainability Governance of Chains and Networks: A Review and Future Outlook. *J. Clean. Prod.* **2015**, *107*, 8–19. [CrossRef]
11. Sloan, P.; Oliver, D. Building Trust in Multi-stakeholder Partnerships: Critical Emotional Incidents and Practices of Engagement. *Organ. Stud.* **2013**, *34*, 1835–1868. [CrossRef]
12. Mena, S.; Palazzo, G. Input and Output Legitimacy of Multi-Stakeholder Initiatives. *Bus. Ethics Q.* **2012**, *22*, 527–556. [CrossRef]
13. Buckley, K.J.; Newton, P.; Gibbs, H.K.; McConnel, I.; Ehrmann, J. Pursuing Sustainability Through Multi-Stakeholder Collaboration: A Description of the Governance, Actions, and Perceived Impacts of the Roundtables for Sustainable Beef. *World Dev.* **2019**, *121*, 203–217. [CrossRef]
14. Søreide, T.; Truex, R. Multi-Stakeholder Groups for Better Sector Performance: A Key to Fighting Corruption in Natural-Resource Governance? *Dev. Policy Rev.* **2013**, *31*, 203–217. [CrossRef]
15. Grabs, J.; Ponte, S. The Evolution of Power in the Global Coffee Value Chain and Production Network. *J. Econ. Geogr.* **2019**, *19*, 803–828. [CrossRef]
16. Wijaya, A.; Glasbergen, P.; Leroy, P.; Darmastuti, A. Governance Challenges of Cocoa Partnership Projects in Indonesia: Seeking Synergy in Multi-Stakeholder Arrangements for Sustainable Agriculture. *Environ. Dev. Sustain.* **2018**, *20*, 129–153. [CrossRef]
17. Cashore, B.; Knudsen, J.S.; Moon, J.; van der Ven, H. Private Authority and Public Policy Interactions in Global Context: Governance Spheres for Problem Solving. *Regul. Gov.* **2021**, *15*, 1166–1182. [CrossRef]
18. de Bakker, F.G.A.; Rasche, A.; Ponte, S. Multi-Stakeholder Initiatives on Sustainability: A Cross-Disciplinary Review and Research Agenda for Business Ethics. *Bus. Ethics Q.* **2019**, *29*, 343–383. [CrossRef]
19. Elgert, L. Certified Discourse? The Politics of Developing Soy Certification Standards. *Geoforum* **2012**, *43*, 295–304. [CrossRef]
20. Henderson, J.; Dicken, P.; Hess, M.; Coe, N.; Yeung, H.W.-C. Global Production Networks and the Analysis of Economic Development. *Rev. Int. Political Econ.* **2002**, *9*, 436–464. [CrossRef]
21. Coe, N.M.; Yeung, H.W.-C. *Global Production Networks. Theorizing Economic Development in an Interconnected World*; Oxford University Press: Oxford, UK, 2015.

22. Coe, N.M.; Dicken, P.; Hess, M. Global Production Networks: Realizing the Potential. *J. Econ. Geogr.* **2008**, *8*, 271–295. [CrossRef]
23. Coe, N.M.; Yeung, H.W.-C. Global Production Networks: Mapping Recent Conceptual Developments. *J. Econ. Geogr.* **2019**, *19*, 775–801. [CrossRef]
24. Huber, K.; Schormair, M.J.L. Progressive and Conservative Firms in Multistakeholder Initiatives: Tracing the Construction of Political CSR Identities Within the Accord on Fire and Building Safety in Bangladesh. *Bus. Soc.* **2019**, *60*, 454–495. [CrossRef]
25. Berardo, R.; Fischer, M.; Hamilton, M. Collaborative Governance and the Challenges of Network-Based Research. *Am. Rev. Public Adm.* **2020**, *50*, 898–913. [CrossRef]
26. Huxham, C.; Vangen, S. Ambiguity, Complexity and Dynamics in the Membership of Collaboration. *Hum. Relat.* **2000**, *53*, 771–806.
27. Saffer, A.J.; Yang, A.; Taylor, M. Reconsidering Power in Multistakeholder Relationship Management. *Manag. Commun. Q.* **2018**, *32*, 121–139. [CrossRef]
28. Mossig, I. The Networks Producing Television Programmes in the Cologne Media Cluster: New Firm Foundation, Flexible Specialization and Efficient Decision-Making Structures. *Eur. Plan. Stud.* **2004**, *12*, 155–171. [CrossRef]
29. Mossig, I. *Netzwerke der Kulturökonomie: Lokale Knoten und globale Verflechtungen der Film-und Fernsehindustrie in Deutschland und den USA*; Transcript-Verlag: Bielefeld, Germany, 2006.
30. Keohane, R.O.; Nye, J.S. Macht und Interdependenz im Informationszeitalter. *Eur. Rundsch.* **1999**, *27*, 15–26.
31. Bathelt, H.; Taylor, M. Clusters, Power and Place: Inequality and Local Growth in Time-Space. *Geogr. Ann. Ser. B Hum. Geogr.* **2002**, *84*, 93–109. [CrossRef]
32. Allen, J. Economies of Power and Space. In *Geographies of Economies*; Lee, R., Wills, J., Eds.; Arnold: London, UK; New York, NY, USA; Sydney, Australia; Auckland, New Zealand, 1997; pp. 59–70.
33. Bathelt, H.; Glückler, J. *The Relational Economy. Geographies of Knowing and Learning*; Oxford University Press: Oxford, UK, 2011.
34. Bueger, C.; Stockbruegger, J. Actor-Network Theory: Objects and Actants, Networks and Narratives. In *Technology and World Politics: An Introduction*; McCarthy, D.R., Ed.; Routledge: London, UK, 2017; pp. 42–59.
35. Dorstewitz, P.; Lal, D. Re-Imagining Business Agency Through Multi-Agent Cross-Sector Coalitions: Integrating CSR Frameworks. *Philos. Manag.* **2022**, *21*, 87–103. [CrossRef]
36. Levesque, V.R.; Calhoun, A.J.K.; Bell, K.P.; Johnson, T.R. Turning Contention into Collaboration: Engaging Power, Trust, and Learning in Collaborative Networks. *Soc. Nat. Resour.* **2017**, *30*, 245–260. [CrossRef]
37. Glückler, J.; Bathelt, H. Institutional Context and Innovation. In *The Elgar Companion to Innovation and Knowledge Creation*; Bathelt, H., Cohendet, P., Henn, S., Simon, L., Eds.; Edward Elgar Publishing: Cheltenham, UK, 2017; pp. 121–137.
38. GISCO. About Us: Organizational Structure. Available online: https://www.kakaoforum.de/en/about-us/organizational-structure (accessed on 15 July 2022).
39. GISCO. Overall Objective. Available online: https://www.kakaoforum.de/fileadmin/Redaktion/Downloads/Oeffentliche_Downloads/Verein/GISCO_Objectives.pdf (accessed on 15 July 2022).
40. GISCO. Our Work: PRO-PLANTEURS Project. Available online: https://www.kakaoforum.de/en/our-work/pro-planteurs-project (accessed on 15 July 2022).
41. Bogner, A.; Littig, B.; Menz, W. *Interviews mit Experten: Eine praxisorientierte Einführung*; VS Verlag für Sozialwissenschaften: Wiesbaden, Germany, 2014.
42. Kaiser, R. *Qualitative Experteninterviews: Konzeptionelle Grundlagen und praktische Durchführung*; VS Verlag für Sozialwissenschaften: Wiesbaden, Germany, 2014.
43. Christmann, G.B. Expert Interviews on the Telephone: A Difficult Undertaking. In *Interviewing Experts*; Bogner, A., Littig, B., Menz, W., Eds.; Palgrave Macmillan: London, UK, 2009; pp. 157–183.
44. Kuckartz, U. *Qualitative Text Analysis: A Guide to Methods, Practice & Using Software*; SAGE Publications Ltd.: London, UK, 2014.
45. Schuster, D. *Die Governance von Multistakeholder-Initiativen: Eine Untersuchung am Beispiel des "Forum Nachhaltiger Kakao e.V." als MSI im Kakao-und Schokoladensektor*; Nomos: Baden-Baden, Germany, 2022; *in press*.
46. The Ministry for Economic Cooperation and Development (BMZ). More Fairness in Global Supply Chains—Germany Leads the Way. Available online: https://www.bmz.de/en/development-policy/supply-chains (accessed on 15 July 2022).

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Sustainability Governance: Insights from a Cocoa Supply Chain

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Abstract: The food industry is one of the main drivers of climate change, with serious impacts on the living and working conditions in developing countries. Due to these sustainability issues, consumers, governments, and non-governmental organizations are pressuring food companies to rethink their current business concepts of food production. Food companies rely on supply chain governance and its mechanisms to implement sustainability standards across all tiers of their supply chains. This study examines the sustainability governance at all stages of a cocoa supply chain, from the raw material production to the retailer, by using a qualitative case study approach. The results show a differentiation of the sustainability governance according to the different supply chain stages. At the raw material production stage, sustainability is mainly improved using contracts, extensive and frequent knowledge sharing, and audits. After the raw material production stage, environmental and social sustainability is almost exclusively coordinated by certificates, while other governance mechanisms are used to foster long-term economic business relationships. This study gives detailed insights into the application intentions and the functioning of sustainability governance mechanisms and provides propositions on how to efficiently improve sustainability in food supply chains.

Keywords: food supply chain; sustainability; governance; mechanism; certificate

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1. Introduction

The food industry has a significant impact on the environment and society. Up to 37 percent of man-made greenhouse gas emissions is caused by the food industry, making the industry a major driver of climate change [1]. Today's food production affects entire ecosystems through converting land use, threatening biodiversity, consuming large amounts of water, overfertilizing soils, and damaging or destroying biotopes [2,3]. Additionally, social standards, such as the industry's working conditions and wages, are poor, especially in developing countries [4].

Consumers, governments, and non-governmental organizations (NGOs) are increasingly aware of the environmental and social effects of the food industry. They are calling for compliance with higher sustainability standards [5]. While many food companies aim for improving their sustainability, they face the challenge of implementing sustainability standards throughout their whole supply chains. Limited transparency in the supply chains and a missing influence on sub-suppliers, for example, make it difficult for food companies to increase sustainability throughout the whole supply chain [6]. To counteract these challenges, companies rely on supply chain governance and its mechanisms, which encourages partners to adopt more sustainable behaviors [7].

Supply chain governance refers to a system of mechanisms that aims to influence business partners' behavior, coordinate transactions, and safeguard against opportunism [8]. Implementing sustainability standards in food supply chains using governance has already been researched (e.g., [9–11]) whereby the focus was mainly on individual sections of supply chains (e.g., raw material production) [7]. To gain a comprehensive insight into the actual application intentions and the effects of the governance, research on the governance of supply chains should, however, consider the perspectives of all stages of a supply chain. Schäfer [12] investigated, for example, an entire supply chain in the food industry,

focusing on the ethical aspects of animal husbandry in food production. While the isolated focus on certain sustainability dimensions provides detailed insights on how to improve corresponding sustainability standards, it is recommended to consider the simultaneous implementation of environmental, economic, and social sustainability standards to ensure long-term compliance [13].

Therefore, this research aims to investigate the governance of food supply chains to simultaneously implement social, environmental, and economical sustainability standards at all stages of a supply chain. We focus on governance mechanisms (GM), which can be used by companies to actively influence actors and thus coordinate their activities in the supply chain [8]. To properly represent and analyze the influence of GMs throughout the whole supply chain and thus provide a holistic picture of the functioning of sustainability governance, it is important to consider all stages of the supply chain, from the raw material production to the retailer, during data collection. Therefore, we conduct a case study research of a whole food supply chain to answer the following research questions:

RQ1: How do governance mechanisms increase sustainability in food supply chains?

RQ2: How do the functioning and the application intentions of governance mechanisms differ between the stages of food supply chains?

This research contributes to the operations and sustainability literature by identifying and analyzing GMs for a holistic and long-term sustainability enhancement in food supply chains. We show how the application of GMs differs on the different tiers of supply chains and what actors intend by using certain GMs. Various propositions can be derived, which provide new insights for theorists but also practitioners interested in the sustainability governance of food supply chains.

2. Materials and Methods

2.1. Supply Chain Governance

Supply chain governance is a multi-faceted term used in various disciplines of academia and practice, such as political or economic science [14]. Supply chain governance refers to a concept for managing and coordinating business relationships between companies by providing a behavioral and decision-making framework when conducting transactions [15]. Governance aims to increase value creation in the supply chain and avoid opportunism [16,17]. While governance itself is not an activity, GMs are used to actively influence partners' behavior in business relationships.

GMs are distinguished into formal and informal mechanisms. Formal GMs are characterized by clear structures, which are often contractually defined. Formal mechanisms, such as contracts, establish a set of mutually accepted and required behaviors that define how to interact in the supply network [18]. Formal standards serve to specify product quality and define certain process requirements. Furthermore, the formal definition of roles and functions between organizations and individuals in a supply chain is another important mechanism within formal coordination [19].

Informal GMs, also called relational or social GMs, are based on a social, non-contractual level [20–22]. They enforce certain behavior in business relationships on a social–relational level (e.g., through social identification with the relationship or social pressure). Shared norms and values, repetitive social interactions, and trust build the basis of informal mechanisms. Informal mechanisms, such as an open communication culture and a willingness to comprise, provide substantial support for the coordination of business relationships [18,23]. Poppo and Zenger [23] emphasize that formal and informal governance are not substitutes for each other but support each other. Informal governance can, for example, be used to fill contractual gaps [24].

2.2. Sustainability Governance in Food Supply Chains

Compared to supply chains of other industrial and consumer goods, the coordination of food supply chains is challenging due to the perishability of food. Product spoilage must be prevented, and food safety must be ensured through appropriate transportation

measures and storage temperatures [25,26]. Additionally, volatile consumption on the consumer side and weather-dependent production of raw materials affect the design and coordination of supply chains in the food industry [27].

Food products pass through several companies in a supply chain, including farmers, distributers, processors, and retailers (see Figure 1) [28,29]. These actors share the responsibility of meeting consumer needs [30]. Actors in food supply chains should therefore work closely together to have a smooth flow of goods in the supply chain and to be able to ensure the sustainability of the products [31].

Figure 1. Actors in global food supply chains.

Sustainability can be defined as the "result of the activities of an organization, voluntary or governed by law, that demonstrate the ability of the organization to maintain viable its business operations (including financial viability as appropriate) whilst not negatively impacting any social or environmental systems" ([32], pp. 73–74). Sustainability is distinguished into social, environmental, and economic sustainability dimensions. The different dimensions support each other, and long-term sustainability can only be achieved by considering all three aspects of sustainability [33]. Sustainability in food supply chains refers specifically to environmental aspects, such as food waste, greenhouse gas emissions during production, and transportation distances from the point of production to the point of consumption [34], as well as social aspects, such as the employees' wages or work place safety [35]. There are different approaches to increasing sustainability within food supply chains, e.g., local sourcing to reduce transport distances [36] or reducing food waste [37].

Companies are increasingly designing their supply chain governance to ensure the sustainability of agricultural inputs. For example, Bastian and Zentes [38] show that a high level of information exchange or the inclusion of sub-suppliers in supply chain coordination leads to greater transparency in food supply chains, which increases social and environmental, but also economic sustainability. Previous research has mainly focused on the governance perspective of retailers or manufacturers, with little investigation of the role of intermediaries (e.g., [39]). However, Grabs and Carodenuto [7] emphasize that, for example, traders in the intermediate stages of the supply chain can also substantially influence sustainability governance and therefore calls for a holistic investigation of the governance of all actors in food supply chains. Therefore, we aim to investigate sustainability governance in food supply chains considering all actors, from raw material producers to retailers.

3. Methodology

We conducted a single case study to achieve the research objective and answer the research questions. Case studies are suitable for exploratory, descriptive, and explanatory research. Case studies are differentiated into multiple and single case studies according to the number of research objects. If a research object is analyzed in detail, single case studies are methodologically suitable [40]. In order to be able to develop a holistic governance approach for sustainability enhancements in food supply chains while considering the interactions and dynamics between all participants, we decided to conduct a single case study.

Following Yin [40], the methodological approach for case study research is divided into four phases: planning and design (1), data collection (2), data analysis (3), and reporting (4).

First, we developed the research goal, determined the research questions, designed the study, and selected the case. The analyzed food supply chain was selected because the final products (confectioneries) are advertised as particularly environmentally and socially sustainable. The trading company aims to enhance sustainability in the food industry and wants to trade exclusively organic and fair-trade products. The trading company claims

that all individual stages of the supply chain act sustainably, allowing comprehensive insights into the sustainability governance of the whole supply chain. It is striking that all actors in the supply chain do not implement their sustainability efforts due to political pressure. Instead, actors behave sustainably out of their own intention: "[. . .] it has to be [. . .] good for the environment, good for the business and good for the people [. . .]" (IP2). Most companies in the supply chain are therefore motivated and committed to ensuring that their business activities are as sustainable as possible.

Additionally, the sustainability standards required by the trading company exceed all legal minimum sustainability standards in the affected countries. Thus, few companies also increase the sustainability of their activities due to pressure from supply chain partners. The actors may only be part of the supply chain if they implement the sustainability standards set by the trading company, as these are, for example, required for marketing the end product. Actors who normally only comply with legal sustainability requirements (e.g., company D) therefore implement higher sustainability standards in order to earn money as a manufacturer in the supply chain.

We conducted semi-guided expert interviews at each stage of the supply chain. The interview guide consisted of four different interview sections. First, the partners were welcomed, the interview topic was introduced, and a mutual understanding of the most important terms was created (1). Afterward, the governance and coordination of the supply chain (2), sustainability in the organization and the supply chain (3), and, in the last section of the interviews, sustainability governance in the examined supply chain (4) were discussed. We selected at least one interviewee from each stage of the supply chain, from the raw material production to the food retailer (Table 1). The experts were selected based on their role in the companies. In order to make statements about supply chain processes and their sustainability, plant managers, purchasing managers, supply chain managers, and sustainability managers were mainly interviewed. The interviewees have an average professional experience in their current job position of over five years. Overall, the interviews at each company lasted an average of 1 h and 5 min. It was not possible to interview a representative of the raw material production cooperative in South America in person because they do not have a sufficient internet or phone connection. Instead, a comprehensive questionnaire based on the interview guide was completed by the farm.

Table 1. Interview participants.

Part of the Supply Chain	Company	Position of the Interview Partner	Interviewee Mnemonics
Raw material production	Company A	Supply Chain Manager	IP1
Raw material import	Company B	CEO	IP2
Commodity wholesale	Company C	CEO	IP3
Manufacturer	Company D	Plant Manager	IP4
Logistics service provider	Company E	Director of E-Commerce	IP5
Transportation service provider	Company F	Head of Transportation Purchase	IP6
Trading company	Company G	Project coordinator Sustainability	IP7
		Supply Chain Manager	IP8
Food wholesale	Company H	Head of Purchasing	IP9
		Sustainability Manager	IP10
Food retailer	Company I	Procurement Officer	IP11

The audio recordings of the interviews were transcribed and served as the primary data source. The structured and qualitative content analysis of the transcripts was performed according to Mayring [41] and was supported by the analysis software *MAXQDA 2020*. *MAXQDA* allowed us a software-based coding of the interview transcripts to structure the data analysis. The coding categories were first deductively derived from the preliminary theoretical consideration and the interview guide. Three categories were formed at the first coding level. The first category "General Information" includes all statements about the interview partners, the company or introductory formalities. The second category "Governance Mechanisms" includes all parts of the interviews in which mechanisms are named or described that manage and coordinate supply chains and contribute to increasing sustainability. In the third category "Sustainability", all passages of the interviews that refer to the three dimensions of sustainability are coded. In order to better assess and distinguish the statements in the interviews, several subcodes were assigned to each coding category. The category of "Governance Mechanisms", for example, was divided into formal and informal mechanisms, and within these categories, further subcategories regarding the individual mechanisms (e.g., contracts, audits and monitoring) were listed.

During the analysis of the interview transcripts, additional sub-categories were inductively developed and implemented into the coding system. For example, "obstacles to sustainable supply chains" were coded, which describe blockages that stand in the way of a more sustainable coordination of supply chains and reveal more about the actual application intentions of the individual mechanisms.

MAXQDA can help by creating overviews of code overlaps, e.g., of all text passages in the transcripts that deal with informal governance mechanisms and social sustainability aspects simultaneously. This allows a more precise and reliable analysis of the interviews since the researcher has a quicker overview of all text passages relevant to a certain topic and can easily detect agreements and contradictions between the interviewees.

The interviewees' answers and comments mainly refer to the examined supply chain. In some cases, they also reflect general experiences regarding sustainability governance from other food supply chains. These comments are also considered as supplementary information in the results and discussion section to present the sustainability efforts at each stage of the supply chain more comprehensively.

While the interviews serve as the primary data source, we also collected secondary data to verify the interviewees' statements. For this purpose, we analyzed documents and websites of the examined companies (e.g., sustainability reports) for aspects related to sustainability governance. This data triangulation makes it possible to identify contradictions in the primary data and, if necessary, to clarify them together with the interviewees. The results of the data analysis are presented in the next section, and the conclusions, which can be drawn from the analyzed data, are highlighted in the discussion section.

Quality Criteria of a Case Study

To ensure the high quality of our case study research, we considered several quality criteria for conducting qualitative case studies according to Yin [40], e.g., objectivity, reliability, internal, external, and construct validity.

First of all, the objectivity and reliability of a case study should be guaranteed to enable the reproducibility of the case study. Transparency and controllability of the scientific procedure are essential characteristics of reliable research. For this purpose, a research protocol was prepared, the case study data (e.g., transcripts) were archived, and the implementation of the case study was described in detail [40].

The case study validity is divided into construct validity, as well as internal and external validity. Construct validity ensures the choice of the correct measures for answering the research questions [40]. The interviewees received a summary of the interview guideline to prepare for the interview. Additionally, a non-disclosure agreement was signed to ensure that interviewees could freely disclose information without fearing social or professional consequences. During the development of the interview guide, a wide variety of already

existing scientific knowledge was used as a basis for the research to enhance construct validity. Further, the interviews were conducted with nine organizations in the same supply chain, allowing mutual data triangulation. Possible biases in the subjective expert perceptions could be identified, and any contradictions between the interviewees' answers could be clarified, e.g., through inquiries after the interviews.

Internal validity is characterized by the logical presentation of the cause–effect relationships in the research data [40,42]. Patterns in the data should be compared systematically and transparently, which was granted in the study by structuring the data analysis using a coding system. Furthermore, contradictions in the research data were searched for to ensure internal validity. External validity refers to the generalizability and transferability of the findings. Even though case studies are not intended to provide empirical evidence in research fields but are exploratory, we emphasized case selection to enhance external validity [40]. We chose a supply chain with nine actors extended over several countries and continents to best represent the challenges of governance across multiple supply chain stages. Additionally, the selected supply chain already provides sustainable end products (confectionaries), which allows the analysis of a consistently sustainable supply chain.

4. Sustainability Governance Approaches at Various Stages of Food Supply Chains

The analysis of the interviews shows a focus in the investigated supply chain on seven GMs, viz. contracts, certifications, audits and monitoring, risk sharing, shared values, information and knowledge sharing, as well as a trusting and close relationship. In the following sections, we show the intentions behind applying these GMs at the individual stages of the supply chain and how they coordinate the actions of the different actors in the supply chain. Thereby, we especially, but not exclusively, focus on how the GMs contribute to achieving the economic, environmental, and social sustainability goals. Table 2 summarizes the mechanisms' most important characteristics and their impact on sustainability at the different supply chain levels. Figure 2 provides an overview of all actors involved in the supply chain.

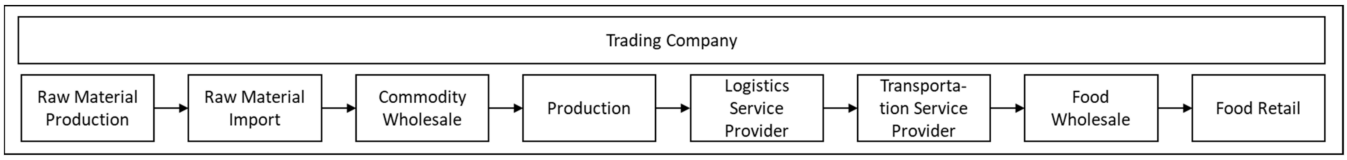

Figure 2. Investigated supply chain with black arrow indicating the material flow.

Table 2. Governance mechanisms at the different food supply chain stages and their effects on the ecological (ecol.), economic (econ.), and social (s.) sustainability dimensions.

	Formal Governance Mechanisms				Formal and Informal Governance Mechanism	Informal Governance Mechanisms	
	Contracts	**Certifications**	**Audits and Monitoring**	**Risk Sharing**	**Information and Knowledge Sharing**	**Shared Values**	**Trusting and Close Relationship**
Raw material production	- Bundling effects, market access, and a secure income by forming a cooperative using contracts - Informal agreements to use organic pesticides and fertilizers (econ., ecol., s.)	- Organic and fair-trade certifications to prove water and soil resource savings and ensure fair payment (ecol., s.)	- Audits of all farms to ensure the contractually defined environmental and social standards (ecol., s.)	- Farming cooperative jointly owned by all involved farms increases economic stability and enables joint distribution (econ.)	- Regular training and on-site contacts with the farmers lead to: - Coordinated product and price management - Education regarding ecological cultivation methods and increase of efficiency (econ., ecol., s.)	- Shared values are not used as governance mechanisms at the raw material production stage	- Close relationship to all farmers enables provision of technical tools and skilled workers, leading to higher efficiency and more ecological methods of cultivation (econ., ecol.)
Raw material import	- Contractual exclusion of pesticides, protection of the environment, preservation of biodiversity, and agreement on payment of fair wages (ecol., s.)	- Organic and fair-trade certification to enhance environmental and social sustainability standards - Certifications allow better marketing in European market (econ., ecol., s.)	- Site visits to control the sustainability of the farmers - Inspection of the delivered goods for compliance to organic standards (ecol., s.)	- Risk sharing is not used as a governance mechanism at the raw material import stage	- Regular exchanges with local employees to improve farming methods - Transparent communication with customers leads to higher willingness to pay, and greater awareness for sustainability (econ., ecol., s.)	- Considering the social and ecological values when selecting new suppliers (ecol., s.)	- Alignment of mutual needs regarding the three dimensions of sustainability - Willingness to compromise (econ., ecol., s.)
Commodity Wholesale	- Long-term commitment of important suppliers through contracts - Contractual regulation of price and delivery conditions - Contractual regulation of energy management (econ., ecol.)	- Certified compliance with organic standards - Certified fair payment and working conditions (ecol., s.)	- Verification of ecological aspects of incoming goods - Randomized audits in upstream stages (ecol., s.)	- Joint investments with raw material producers for more economic and environmentally friendly manufacturing practices (econ., ecol.)	- Strengthening of the business relationship via regular face-to-face meetings - Exchange of operational data (econ.)	- Consideration of a social and ecological value base when selecting new suppliers (ecol., s.)	- Aiming for a close, long-term relationships to enhance economic security, knowledge sharing and joint optimization of sustainability performance (econ., ecol.)
Production	Contractually binding and safeguarding of the financial parts of the business relationship through contracts (econ.)	- Certificates enable market access Expanding the potential customer base and secures ecological and social manufacturing practices (econ., ecol., s.)	Quality monitoring for incoming goods (econ.)	Joint investment in better production technologies (econ.)	- No exchange of information or data	- Shared values are not used as governance mechanisms at the production stage	- Little trust - Formalities dominate coordination

Table 2. *Cont.*

	Formal Governance Mechanisms				Formal and Informal Governance Mechanism	Informal Governance Mechanisms	
	Contracts	**Certifications**	**Audits and Monitoring**	**Risk Sharing**	**Information and Knowledge Sharing**	**Shared Values**	**Trusting and Close Relationship**
Logistics Service Provider	- Contractual commitment to customers Safeguarding of the financial parts of the business relationship (econ.)	- Certificates enable market access - Set minimum environmental and social requirements Expanding the potential customer base (econ., ecol., s.)	- Yearly assessment of suppliers and customers regarding KPIs, such as delivery or payment accuracy Internal audits at their own sites to enhance social sustainability (econ., s.)	Joint investment in better warehouse technologies (econ., ecol.)	- Informal exchanges to ensure good, personal business relationships Optimization of operational business through data exchanges (econ.)	- Shared values simplify sustainability improvements Shared values as supplier selection criterion (econ., ecol., s.)	Price increases are negotiated in a trusting and close partnership (econ.)
Transportation Service Provider	- Safeguarding of the financial parts of the business relationship Sustainability requirements are specified for partners by Code of Conduct (econ., ecol., s.)	- No industry-wide sustainability certificates available	- Audits and monitoring are not used as governance mechanisms by the transportation service provider	Sharing financial risks and promoting greener technologies through joint investment with sub-service providers (econ., ecol.)	- Strengthens business relationship and joint planning - Creates transparency and controls reliability through information and data exchanges (econ.)	Code of conduct to communicate values to all partners (ecol., s.)	Close, long-term cooperation is sought and fostered through joint investments with partners in more ecological technologies (econ., ecol)
Trading Company	Safeguarding of the financial parts of the business relationship (esp. with producer) (econ.)	- Uses exclusively organically certified raw materials and products - Certification for fair working conditions - Certificates enable market access Certified plastic-free packaging (econ., ecol., s.)	- Control of food safety Organic certificates are checked (econ., ecol.)	- Risk sharing is not used as a governance mechanism by the trading company	Information and data exchanges coordinate operational business activities and support strategic planning (econ., ecol.)	Shared values with customers create higher willingness to pay for sustainability of products (econ., ecol., s.)	- Close relationship with partners for flexible purchase volumes and stable prices Joint coordination regarding sustainability approaches (econ., ecol.)
Food Wholesale	Safeguarding of the financial parts of the business relationship (econ.)	- Uses exclusively organically certified raw materials and products Certification for fair working conditions (ecol., s.)	- Audits and monitoring are not used as governance mechanisms by the food wholesaler	- Shared financial risk through joint investments (e.g., in better refrigeration equipment at customer's site) Over- or underproduction is compensated by adjusted distribution strategy (econ., ecol.)	- Regular supplier visits to strengthen relationships Information and data exchanges simplify the operational business (econ., ecol., s.)	Shared values as a criterion for supplier selection simplifies sustainable approaches (ecol., s.)	Close collaboration with partners to strengthen regional structures (econ.)

Table 2. *Cont.*

	Formal Governance Mechanisms				Formal and Informal Governance Mechanism	Informal Governance Mechanisms	
	Contracts	**Certifications**	**Audits and Monitoring**	**Risk Sharing**	**Information and Knowledge Sharing**	**Shared Values**	**Trusting and Close Relationship**
Food Retail	Safeguarding of the financial parts of the business relationship (econ.)	Uses organically certified raw materials and products (ecol.)	- Audits and monitoring are not used as governance mechanisms by the food retailer	- Little risk sharing - Few loans for partners to reduce risks	- Supplier visits and trainings to strengthen trade relationships - Regularly feedback is obtained on all topics (econ., ecol., s.)	- Regionality as most important value to ensure short transportation routes Strengthening of regional, social, and economic structures (econ., ecol., s.)	Close business relationships to strengthen regional, social, and economic structures (econ., s.)

4.1. Raw Material Production

The main ingredient of the confectioneries produced in the investigated supply chain is cocoa, which originates in South America. The cocoa is produced by a farming cooperative that brings together over 200 farmers. The farmers are the owners of the cooperative, and they are closely connected. To collect data from the raw material production stage, a supply chain manager was interviewed who manages the relationships between the cooperative and the farmers and can thus show the perspective of the raw material production stage on the governance of its business relationships.

Contracts are used to coordinate the business relationships between the farmers and the cooperative to set prices and delivery quantities. In addition to formal contracts, the cooperative relies on informal agreements to ensure sustainability standards, e.g., ecological farming practices. The cooperative regularly audits the farming practices (e.g., compliance with the ban on child labor or deforestation). Additionally, the cooperative has several sustainability certificates that ensure that the protection of the environment, soils, groundwater, and employees and are regularly reviewed by certificate issuers (e.g., EU organic logo, Fair Choice certificate, and local organic logo). The EU organic logo restricts, for example, companies in the use of fertilizers, and prohibits the use of genetic engineering [43]. These regulations are regularly checked by EU inspection bodies or correspondingly commissioned audit companies [44].

Informal GMs are also important for the cooperative when working with farms. The cooperation informally supports the farms with the implementation of the sustainability standards, e.g., by providing training to the farmers. The coordinators are constantly exchanging knowledge and information with the farms, e.g., regarding the cocoa beans' cultivation, harvesting, or collection. The close relationship between the cooperative and the farms makes it possible to coordinate production quantities and harvest times at the cooperative level to meet customers' needs. IP1 emphasizes that the close cooperation between the cooperative and the farmers creates a trusting relationship and can generate efficiency gains in cultivation, which also improves the economic sustainability.

4.2. Raw Material Import

An import company (Company B) transports the cocoa beans on container ships from South America to Europe. The import company is specialized in fair and ecological trading. When selecting raw materials, the import company places great emphasis on sustainability and tries to enforce these claims on the suppliers.

The basis of the cooperation between the cooperative and the import company is a signed contract, which includes social and environmental aspects (e.g., exclusion of pesticides during cultivation, and fair wages). The contract does not include quantities and prices and is negotiated in personal meetings. Further, the raw material importer requires social and environmental certificates (e.g., EU organic logo or Fair Choice certificate) from its suppliers: "You cannot market a product as organic if it is not certified [. . .]" (IP2).

Company B supports its partners' sustainability efforts using informal mechanisms such as frequent information exchange and trust-based partnerships. The employees seek face-to-face interaction with suppliers and sub-suppliers through regular site visits. Some employees are even stationed in the farming areas and carry out regular audits as part of the supplier selection and development process: "We visit them [new suppliers] to hear and to see what their goals are, what they want. Because then I see, we are in the same track." (IP2). During the visits, a lively exchange of information on sustainability-related topics is possible. For example, the raw material import company can pass on the increasingly important sustainability requirements of the customers (e.g., call for water resource conservation) to allow the farmers to react to these requirements. On the other hand, the actors can exchange information on acute challenges in cocoa cultivation and discuss how, for example, fertilizers can be used as sustainably as possible, which has an impact on ecological (soil conservation) and social sustainability (e.g., less contact of employees with fertilizers that are harmful to health).

The import company also tries to build close relationships with customers. The company records the sustainability wishes and needs of the downstream stages and passes them on to the raw material production. The expert sees the company in the role of a mediator and would like to connect all parties of the supply chain so that an exchange of communication occurs in the whole supply chain: "I think all the partners are interested in having a strong relationship." (IP2).

4.3. Commodity Wholesale

The cocoa is supplied to the production facility by a commodity wholesaler (Company C). Commodity wholesalers buy large quantities of commodities and raw materials from importers or directly from producers and break the deliveries into smaller subquantities. Company C is a medium-sized commodity wholesaler and started as a pure commodity trader, although they now see themselves as "value chain shapers" (IP3).

Both formal and informal GMs are used to coordinate and manage partnerships of Company C. Suppliers from whom goods are purchased regularly are bound by contracts, ensuring delivery quantity and quality. The commodity wholesaler does not use contracts for small purchase quantities and short-term requirements. Since Company C has a very large number of suppliers, they do not audit and control the compliance to sustainability standards at the suppliers' sites on their own due to cost reasons. However, compliance with sustainability standards is verified using certificates. All products of suppliers must have the EU organic logo. At Company C, incoming goods are visually inspected for their organic certification and damage. Additionally, samples are taken for analytical quality control. Here, the products are tested, e.g., for pesticide residues, to verify compliance with organic standards.

The formal coordination instruments are supported by regular, personal exchange and close cooperation: "We have known [. . .] them [partners] for a very, very long time. [. . .] So with [our] partners we have very close relationships [. . .], we make regular visits." (IP3). IP3 states that a trusting relationship between partners improves sustainability. If partners trust each other, the actors fear less that a partner could behave opportunistically and, for example, leave the business relationship. This enables long-term investments in sustainable equipment and facilities, e.g., in a new oil mill, which can produce with less waste and thus increase the ecological (resource conservation), but also the economic sustainability (more output at the same cost).

Additionally, trust in business relationships allows comprehensive knowledge exchanges. If actors believe that their partners will not leave the business relationship, they are willing to invest time and effort in sharing knowledge with partners and giving them training, e.g., on a more sustainable cultivation method, which can improve the ecological (e.g., water conversation), the social (e.g., improved working conditions), and the economical sustainability (e.g., cost reduction).

4.4. Production

From the commodity wholesaler, the products are transported to the producer (Company D). Company D produces confectioneries for its own labels, but also for labels from other trading companies as a contract manufacturer.

Sustainability standards are mainly implemented to be able to sign contracts with organic labels: "It is quite clear [. . .] these decisions [to produce a sustainable product] are, after all, always economically driven." (IP4). Ecological improvement processes, such as packaging optimization, are driven by economic considerations. Company D does not set its own environmental sustainability targets.

Contracts with customers include details on packaging, delivery terms, quality levels, penalties, insurances, and pricing. According to IP4, there is hardly any exchange of information on a personal level between the producer and their partners: "There is a contract; we have to establish the ability to deliver. At that point, the friendly relationship [. . .] stops." (IP4). IP4 states that "facts dominate purchasing and no[t] personal preference[s]" (IP4).

Due to the formal nature of Company D's business relationships, there is no significant difference in the cooperation with long-term partners compared to new partner companies.

Contracts are supplemented by production standards, which the company needs in order to sell produced food in certain countries. Additionally, some products are certified and produced according to kosher, organic, or fair-trade conditions. When purchasing raw materials, Company D watches out for certain certificates, such as the RSPO label for sustainable palm oil: "[. . .] environmentally conscious purchasing or certificate-driven purchasing" (IP4) is important to fulfill customers' sustainability expectations.

IP4 sees producers generally under high pressure to respond to customers' demands. Trading companies are in the position to choose from many contract manufacturers and can thus use their market power to depress prices and dictate contract terms: "[. . .] retailers already have a high power." (IP4). Company D sees itself in a price war with the retail companies: "[. . .] they present themselves as the advocate of the end customer." (IP4).

4.5. Logistics Service Provider

The finished products are picked up from the production and transported to a refrigerated warehouse of a logistics service provider (Company E). Company E is a medium-sized company with expertise in intralogistics, transportation, storage services, and value-adding services (e.g., product finishing, and labeling), especially in the food industry.

When coordinating supply chain processes in the food industry, Company E uses contracts to determine the scope of services, contractor and customer obligations, insurances and liabilities, inventory procedures, running times, fees, or payment modalities. Company E uses industry-specific and sustainability certificates (e.g., IFS, Smeta Sedex, and EU organic logo) to be more attractive to its customers and determine the sustainability standards in its business relationships. IP5 calls for mandatory social and environmental standards in the logistics industry so that all companies can work under the same conditions and workers can be paid fairly: "[. . .] of course I think it makes sense to implement this [standards] in the industry because then everyone will have the same conditions and [. . .] the employees in logistics will also benefit from this [. . .]." (IP5).

In addition to formal governance, coordination on an informal level is also important for Company E. Personal exchanges begin during the initial contract negotiations and continue throughout the contractual relationship. Company E exchanges information with both customers and service providers (e.g., disposal partners or transportation companies). Particularly in the case of price increases, e.g., due to rising personnel costs, the business relationship on a personal level is advantageous. The understanding for price increases is largely present due to mutual trust: "[. . .] we introduced a price increase [. . .] at the end of the year, [and] our customers understand that." (IP5).

At the logistics service provider level, the ability of the governance to increase environmental and social sustainability in the supply chain is limited. However, Company E itself pays attention to increasing sustainability, e.g., through energy-efficient warehouses or ecological waste systems. Additionally, all employees receive fair pay and additional performance bonuses.

4.6. Transportation Service Provider

The confectioneries are transported from the warehouses of Company E to the wholsesalers and the retailers by two different transportation companies. We interviewed IP6 as a representative of one of the transportation companies (Company F). Company F is a large logistics group that focuses on transporting, sorting, and delivering mail and parcel shipments. Packaged dry products, such as confectioneries, can be shipped with the transportation service provider.

The business relationships of Company F are all based on written contracts: "[. . .] we only work based on written contracts, [. . .] they are standardized [. . .]" (IP6). With subcontractors providing transportation services, e.g., the routes, prices and number of transports are regulated through contracts. The company's own sustainability standards

are passed on to partners through a code of conduct. The expert criticizes the lack of industry-wide standards, especially in the field of sustainability: "[. . .] it would be great if there were standards that were generally specified. Unfortunately, we lack something like that completely. That's why we are already working on developing our own internal standards for the [freight division of the company], for example [. . .]" (IP6).

When outsourcing orders to other logistic service providers, Company F pays attention to compliance with social and environmental standards and regulations. The payment of the local minimum wage, for example, is a basic requirement for entering into a contractual relationship with other companies. In order to increase sustainability in the supply chain, the group uses its market share and the associated negotiating power to let supply chain actors compete against each other regarding their sustainability level.

Furthermore, joint sustainability efforts are developed in bilateral discussions, and the logistics group creates incentives for its partners to act more sustainably (e.g., using electric transportation means).

4.7. Trading Company

The central actor of the examined supply chain is the trading company (Company G). Company G has developed the central product of the supply chain and connects all actors in the supply chain. Two employees—one from sustainability management [IP7] and one from supply chain management [IP8]—were available for interviews. The supply chain management department maintains contact with all supply chain actors and interacts in case of disruptions or other challenges. The trading company has particular strong governance of its business relationships to the production and retail stages of the supply chain. Generally, the company pursues a sustainable mission: "Behind all the products, [. . .] there is of course something much bigger, namely our mission. [We want . . .] to give something back to this planet through sustainable consumption and through doing something for the climate." [IP7].

The trading company uses several formal and informal mechanisms to coordinate the business relationships in the supply chain and its sustainability. Contracts on minimum purchasing quantities per year and order, prices, the desired method of communication, delivery conditions, and penalties are concluded exclusively with the producer in the supply chain. Sustainability aspects are not included in the contract. All other relationships are maintained on a transactional basis without contracts.

Certificates play a very important role in coordinating sustainability ambitions in the supply chain. The company's products are certified as organic and vegan. Some suppliers and producers are additionally Fairtrade certified, and some farms of the cocoa cooperative have the Control Union Fair Choice label. The packaging of the confectionaries is certified with a Plastic Free label. The carbon footprint of all products will also be communicated using a seal in the future. Due to many different seals and certificates on the market, IP8 would like to see more "[. . .] uniformly recognized certificates that are analyzed, monitored, [and] audited by an independent organization."

In addition to formal mechanisms, personal agreements and trust-based business relationships are pursued when working with producers and their suppliers. Interaction is often based on trust, as contracts make the company less flexible: "[. . .] but we [have] a very good relationship [. . .] with the suppliers and producers in a personal, professional context [. . .]" (IP8). The close and trusting partnerships enable a high degree of willingness to compromise. In the event of disruptions or overproduction in the supply chain, for example, the delivery quantities can be flexibly adjusted, strengthening economic (e.g., no contractual penalties due to insufficient delivery quantities) and ecological sustainability (e.g., no destruction of food in the event of overproduction). Additionally, information and data sharing is fostered in close and trusting relationships, which increases the transparency in the supply chain. The increased transparency also promotes the disclosure of all sustainability-related aspects. Since actors know their activities are transparently visible, they are more likely to comply with the agreed-upon sustainability standards. Otherwise,

they will be seen as unreliable actors by the trusting partners, which could damage the long-term business relationship.

Next to the direct cooperation with the producer and the retailers, Company F is also interested in integrating the supply chain vertically and aims to establish contacts with the suppliers of the producers. Company F has specifically selected the cooperative for cocoa production in South America which supplies the main ingredients of the confectioneries. However, the contract manufacturer procures other ingredients of the confectioneries (e.g., sugar) from suppliers with whom the trading company has no close contact. IP8 states that contract manufacturers are rarely willing to disclose their trade relationships: "But of course, they won't tell us the exact name of this supplier, because they run the risk that we will then bypass them and source from them [. . .] directly." (IP8).

4.8. Food Wholesale

The trading company's products are sold through a variety of sales channels. The products are sold either via the company's own online store directly to the end consumers or via various retail companies. The most important retail customers are drugstores, organic food retailers, and food retailers. These stores purchase their products through food wholesalers, such as Company H. Company H mainly supplies stores close to the company's headquarters and defines itself by high sustainability standards. The company works with many small producers in the region but also large industrial companies. The interview was conducted with the purchasing manager [IP9] and the quality and sustainability manager [IP10].

As the basis of its business relationship, Company H relies on contracts that define, for example, delivery formalities. The purchasing manager describes how the business relationships are coordinated more formally, especially with large or international companies: "[. . .] the exchange exists on a formal level [. . .]" (IP9). Further, certificates and standards play an important role for Company H when managing transactions and selecting new partners. The EU organic logo is a basic requirement for any cooperation with Company H. In addition to the EU organic logo, other social and environmental sustainability certificates are requested of the suppliers. The wholesaler does not conduct audits at its suppliers, as sustainability standards are guaranteed by certifications and are verified by the certificate issuer.

In the cooperation with producers, Company H compensates for cultivation risks and crop failures: "[. . .] if there should be crop failures in the fruit and vegetable sector with our regional suppliers, [. . . we] compensate for this by means of prices, which are then calculated differently [. . .]" (IP10). In cases of overproduction, Company H tries to sell additional quantities so that no economic damage occurs for the companies involved. In its cooperation with customers, the organic wholesaler strives to promote investments in sustainable technologies. For example, a joint investment was made in a new refrigeration system for an organic market by providing a one-time payment and a loan from Company H.

The organic wholesaler complements the formal arrangements with close and trusting partnerships, especially with regional suppliers and customers: "[this kind of] partnership cooperation is quite strong. So we have intensive contacts here, we have regular meetings [. . .]" (IP9). Site-visits and the trust gained from the close contacts replace audits: "You know the region here, so there's really no need for an in-depth audit [. . .]." (IP10).

4.9. Food Retail

The wholesaler distributes the finished products to the food retailers (e.g., Company I). Company I is a regionally active company with a dense network of stores in the urban area, which customers use "[. . .] to cover their daily needs." [IP11]. The size of the retail stores ranges from 100 to 1000 square meters and are mostly located in urban areas.

The formal coordination of the supplier relationships depends on the size of the suppliers: "supplier contracts are only common with large suppliers [. . .]" (IP11). Contracts

with large suppliers regulate, for example, the assurance of delivery days, advertising cost subsidies, and refunds. Sustainability aspects are not part of any written agreements or contracts. Company I purchases most of its products through wholesalers and maintains direct contractual relationships with most trading companies in parallel. These agreements are not about formal delivery conditions but about advertising measures and a better external presentation of the brand in the grocery stores. To ensure the sustainability of the purchased products, Company I relies on certificates. All organic products need to be labeled with the EU organic logo.

In the case of direct supplier relationships without a wholesaler as an intermediary, Company I aims for long-term supplier relationships since they are more rational to manage. In long-term relationships, the partners understand each other better, and through the existing, familiar communication channels (sustainability), demands can be understood and implemented in the supply chain more quickly. To build long-term relationships, the suppliers are visited in person: "I take a look at the production facilities, you get to know each other in person [. . .]." (IP11). By visiting the production sites, trust is built, and the companies become more connected: "Those who like to show their production sites and also give tours; you [. . .] have a more trusting relationship with them." (IP11).

Besides using sustainability certificates, the promotion of social or environmental sustainability among its partners is not fostered in any particular way by Company I.

5. Discussion

After analyzing the different GMs at each stage of the supply chain, the following section discusses the results to extend the current findings from the literature. The analyzed data from the interviews will be compared with the literature to develop propositions that provide new insights into sustainability governance in food supply chains.

The analysis of the interviews shows that contracts and certificates are popular GMs to increase sustainability. In the examined supply chain, the producer and the actors of the following stages use contracts to increase the economic sustainability of their business relationships, while certificates are used to ensure ecological and social sustainability standards. At the raw material production stage, in addition to the economic aspects, also ecological and social requirements are included in contracts and informal agreements (e.g., cultivation methods or energy management). The inclusion of ecological and social standards in contracts and agreements fosters the certification of all farmers at the raw material production stage. The interview partners emphasize that the implementation of certificates is very complex and expensive. Especially for individual farmers, it is difficult to become certified on their own. Often, small farms lack the necessary financial and human resources to implement the certification requirements [45]. Therefore, the pooling of capacities (e.g., [46]) in cooperatives is observed in the case study at the raw material production level. Training provided by the cooperative to the farms, as well as the sharing of technical equipment, enables the certification of all farms in the cooperative. The cooperative supports the farmers in implementing the certificates' standards and controls them itself, e.g., through audits. To ensure that the cooperative's strong commitment to helping certify farms is profitable, the cooperative needs a warrant for the long-term compliance of the farms with the required minimum sustainability standards and thus the retaining of the certification. Therefore, the cooperative uses contracts and informal agreements with the farms, which specify the compliance with all required sustainability standards in the long-term. Contracts urge farmers to comply with social and environmental sustainability standards (e.g., fair and safe working conditions, and limited use of pesticides), as there can be, for example, penalties for non-compliance. On the other side, contracts allow the cooperative to be more committed during the certification process, as the effort promises long-term benefits. Thus, through the use of contracts, sustainability standards can be jointly implemented (e.g., ecological cultivation methods, and improvement of working conditions), which enable the certification of the supply chain.

P1: At the raw material production level, sustainability standards should be included in formal contracts and informal agreements to enable the certification of farming cooperatives.

After the raw material production and import stage, only transactions of particularly economically important business relationships are coordinated and controlled using contracts. Strategically and financially unimportant business relationships are less frequently governed by contracts to remain flexible and agile when fluctuations in production, raw material prices, or the sales market occur. For example, raw materials can be procured at short notice from other suppliers if there are no contractually binding minimum purchase quantities or rhythms.

Although different types of contracts are discussed in the literature for managing sustainable supply chains (e.g., [47,48]), no contractual regulations on environmental and social aspects are used in the examined supply chain after the raw material production and import stage. Instead, sustainability standards are ensured via certificates. The use of certificates enables spontaneous purchases from different suppliers who have the same certificates. Minimum sustainability requirements of products do not have to be regulated by contracts and checked with the help of audits but are ensured through certifications. We can therefore draw up the following proposition:

P2: After the raw material production and import stage, companies should mainly use certificates to secure environmental and social sustainability, while contracts should be used to secure economic interests.

Formal and informal information and knowledge sharing are among the most intensively used GMs in the analyzed supply chain. Information and knowledge are exchanged at every stage of the supply chain and mostly personally through emails and phone calls.

The exchange of information in food supply chains is a common phenomenon to support the operational business, for example, by providing demand data (e.g., [49,50]). The exchange of operational data makes it possible to create greater transparency in the supply chain. The increased transparency allows actors to anticipate, for example, when deliveries will arrive from the upstream stages of the supply chain, which enables a more efficient planning and handling of the receipt, transport, processing and storage of the goods. As a result, capacities (e.g., transport or storage capacity) can be optimized and saved, which increases economic sustainability in the supply chain.

It is remarkable that in the analyzed supply chain, not only are data regarding operational processes exchanged, but also knowledge on sustainability issues is shared—specifically by the actors involved in the production of raw materials. The cooperative, and the import company share, for example, their technical and agricultural knowledge with the farms in trainings and on-site visits to enable the certification of the farms. An active and honest exchange of information and knowledge between the farms and the cooperative allows sustainability challenges to be addressed openly. Farmers can receive, for example, training and information on how to use pesticides to prevent crop failure. The training enables the farmers to use the right pesticides in the right quantities in order to not endanger ecological sustainability (e.g., groundwater damage due to excessive pesticide use), but also to increase economic sustainability through good crop yields.

P3: The exchange of information and knowledge should be specifically used to improve social and environmental sustainability in the raw material production stage, e.g., through training and knowledge exchanges on new cultivation methods.

A distinction is made between formal and informal information exchanges in the literature. The formal exchange of information and data happens in a professional relationship without personal or social intentions [18]. In the analyzed supply chain, information and data are, for example, exchanged formally to support the operational handling and planning of the business processes.

The informal exchange of information is rather unplanned and mostly happens in personal conversations, e.g., after a meeting [51]. At the stage of the raw material production and import of the examined supply chain, the informal exchange of information

is used, for example, to increase sustainability by informally explaining and supporting more sustainable farming methods. In subsequent stages of the supply chain, information related to sustainability is still exchanged informally, but it does not include advice on implementing sustainability measures. The informal exchange of information rather relates to the future strategic direction of the business relationship. The food retailer informs, for example, the trading company and its other partners informally about new perceived sustainability demands of the end consumers. The trading company can check the implementation possibilities of these new sustainability claims and spread according plans in the supply chain. Currently, for example, customers increasingly call for the implementation of the Fairtrade certificate. Its implementation is now being planned in the entire supply chain which contributes greatly to increasing environmental and social sustainability (e.g., bans on exploitative child labor and hazardous pesticides). Therefore, the following proposition can be made.

P4: After the raw material production and import stage, informal information exchanges should be used to align strategic interests regarding the implementation of environmental and social sustainability standards.

Certificates are used on every level of the analyzed supply chain to manage the supply chain's environmental and social standards. The early stages of the supply chain use the EU organic logo to demonstrate environmentally friendly farming practices, pesticide exclusion, and biodiversity to their customers. The downstream organizations use these certificates to be allowed to advertise the product as organic and environmentally friendly. Fair trade and good working conditions are also ensured by certificates, such as the Fairtrade or Fair Choice labels, at several supply chain stages.

In the literature, certificates are mainly seen as a mechanism to support customers in their purchasing decisions (e.g., [52,53]). While interviewees support the use of certificates for such promotional and advertising purposes, they also emphasize a reduced control effort of the required sustainability standards, thanks to the certificates. Most actors in the supply chain refrain from conducting their own audits of partners and rely on external audits by the certificate issuers. The effort required for carrying out their own audits would not be feasible for most companies due to insufficient financial and human capacities (e.g., IP3, IP7, IP8, and IP10). Thus, certificates ensure compliance with the most important social and ecological sustainability standards at no great expense to trading companies, which is why the following proposition can be made.

P5: Certificates should be used not only to market a product but also to ensure compliance with sustainability standards without having to conduct own audits and monitor supply chain partners.

All companies maintain formal and informal governed business relationships with their direct upstream and downstream partners in the supply chain. The trading company maintains business relationships not only with its direct partners, but also with all other actors in the supply chain and thus holds an informal leading role in the supply chain. The trading company uses formal and informal GMs to maintain relationships with its most important partners, such as the manufacturing company or the food retailers. In addition, informal mechanisms are used in the relationships with all other partners, especially with the raw material production stage, in order to control and influence compliance with sustainability standards. Through these "non-operational", informal business relationships, the trading company can not only identify possible challenges and disruptions earlier, but also creates additional incentives for compliance with the sustainability standards. Actors who particularly stand out in complying with the sustainability standards could, for example, also be included in the supply chains of other products of the trading company in the future. As a leading company, the retail brand also performs an overarching cohesion function for the supply chain and contributes new product ideas and sustainability goals for the whole supply chain.

Further, the leading role of the trading company will be important in the future to comply with new supply chain due diligence laws. Governments are increasingly obliging

companies to make their entire supply chains transparent (e.g., [54]). Trading companies could fulfill this due diligence obligation particularly well due to their central, cross-company role, as they maintain contacts with all partners and can present their activities transparently. The following proposition can therefore be derived.

P6: The trading company should hold a leading role in the supply chain in order to coordinate and foster the sustainability efforts holistically and to create additional incentives for increasing sustainability.

This study provides several novel findings, compared to the existing literature. In particular, we place special emphasis on showing how the governance in food supply chains differs at the various stages of the supply chain to improve sustainability (see Figure 3).

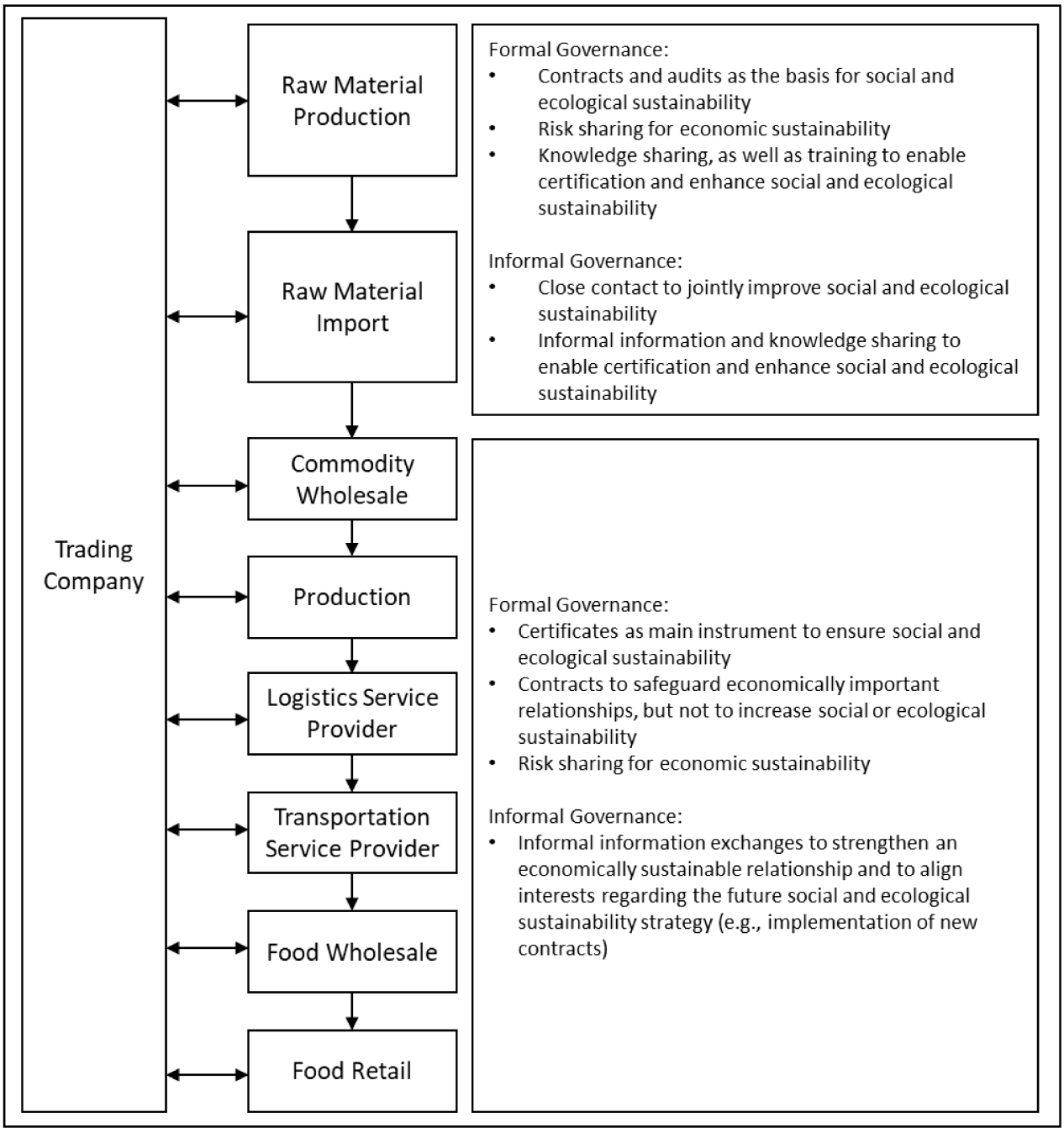

Figure 3. Governance mechanisms distinguished based on the different steps of the food supply chain.

At the raw material production and importing stage, sustainability standards are implemented using contracts and are verified through audits. Close contact with regular mutual visits, training on new cultivation methods, and sharing technical, financial, and human resources enable certifications at this stage of the supply chain. In the downstream stages of production, logistics, and retail, sustainability certificates are the most important tool for compliance with social and ecological sustainability standards. Contracts are a less commonly used mechanism at these stages of the supply chain and are only used to coordinate financial and economic aspects of strategically important business relationships. Due to the limited contractual ties and the usage of certificates, the changing of suppliers and service providers is easily achieved without sustainability losses. To additionally set incentives to increase sustainability, it is recommended that a leading company of the supply chain has informal business relationships with all partners in the supply chain. Actors with outstanding sustainability commitments could also be used as partners in other supply chains of the leading company in the future.

Quantitative Analysis

The propositions provide novel insights into which governance mechanisms should be used at different stages of food supply chains to enhance sustainability. It is striking that certain governance mechanisms are used preferentially to achieve certain sustainability goals, while other mechanisms are hardly used to improve in certain sustainability dimensions. Quantitative analysis helps clarify the particularly strong and weak effects of governance mechanisms on the individual sustainability dimensions. In addition to the quantitative data (Table 3), the results of the qualitative analysis are also taken into account during the analysis to be able to consider, for example, supply chain stage specifics.

Table 3. Quantitative analysis of the impact of governance mechanisms on sustainability dimensions.

Governance Mechanism/ Supply Chain Stage	Sustainability Dimension	Raw Material Prod.	Raw Material Import	Commodity Whole-sale	Production	Log. Service Provider	Transp. Service Provider	Trading Company	Food Whole-sale	Food Retail	Sum
Contracts	Economical	x		x	x	x	x	x	x	x	8
	Ecological	x	x	x			x				4
	Social	x	x				x				3
Certificates	Economical		x		x	x		x			5
	Ecological	x	x	x	x	x		x	x	x	8
	Social	x	x	x	x	x		x	x		7
Audits and Monitoring	Economical				x	x		x			3
	Ecological	x	x	x		x		x			5
	Social	x	x	x							3
Risk Sharing	Economical	x		x	x	x	x		x		6
	Ecological			x		x	x		x		4
	Social										0
Information and Knowledge Sharing	Economical	x	x	x		x	x	x	x	x	8
	Ecological	x	x	x				x	x	x	6
	Social	x	x	x					x	x	5
Shared Values	Economical					x		x		x	3
	Ecological		x	x		x	x	x	x	x	7
	Social		x	x		x	x	x	x	x	7
Trusting and close relationship	Economical	x	x	x		x	x	x	x		7
	Ecological	x	x	x			x	x		x	6
	Social		x							x	2

Quantitatively analyzing the collected data shows that *contracts*, *certificates* and *information and knowledge sharing* stand out due to their particularly strong influence on certain sustainability dimensions. Eight of the nine supply chain stages specifically use contracts to ensure economic sustainability in their business relations. Agreements on delivery quantities and prices can be made in contracts, which enables longer-term financial planning. The

financial planning security allows larger investments, for example, in new, more efficient equipment and facilities, which sustainably increases the economic performance.

The positive influences of certificates on sustainability are mainly on the ecological (eight stages) and the social dimension (seven stages). Through the use of certificates, partners are audited by independent certification bodies regarding their compliance with social and environmental sustainability standards. Without certificates, the actors could no longer be part of the business relationships, which motivates them to comply with the sustainability standards, promoting environmental and social sustainability (e.g., compliance with maximum working hours on farms, limitation of pesticides).

Information and knowledge sharing is used at eight out of nine stages to increase economic sustainability. In the first stages of the supply chain, for example, training on more efficient cultivation methods is given, enabling the farms to grow cocoa cost efficiently and in less time, making the farms more economical in the long term. At the later stages of the supply chain, data and information are exchanged to optimize operational exchanges. Through the exchange of operational data, the partners in transactions can be better coordinated (e.g., with regard to the expected delivery quantity), and thus processes can be designed more economically in the long term.

In addition to the governance mechanisms, which have a particularly positive influence on sustainability, the quantitative analysis also showed that *risk sharing* as well as a *trusting and close relationship* do not have a noteworthy influence on social sustainability. Further, the analysis showed that *shared values* have no significant impact on economic sustainability.

6. Conclusions, Limitations, and Future Research Agenda

Coordinating food supply chains is challenging and complex due to the perishable nature of the products and volatile yields of raw material production. Implementing sustainability standards in food supply chains is increasingly requested by customers but represents an additional challenge. The implementation of sustainability standards has so far mainly been examined at individual stages of supply chains (e.g., raw material production or manufacturer), without considering the holistic implementation of the standards [7]. However, sustainability standards should be introduced at all supply chain stages, from raw material producers to end retailers, to receive long-term sustainability. We used a single case study at all levels of a sustainable food supply chain to analyze the different GMs used to coordinate the implementation of sustainability standards throughout the whole supply chain. Thereby, we analyzed the effects of the used GMs and highlighted the intentions behind why certain GMs were applied. We show that the effective, holistic management of sustainability governance relies on different mechanisms at different supply chain stages. At the beginning of the supply chain, contracts are used to ensure economic sustainability, while information and knowledge sharing are specifically used to increase environmental and social sustainability. At the later stages of the supply chain, contracts and informal information sharing are used to increase economic sustainability, while social and environmental sustainability is ensured through certificates. Without the holistic management of the supply chain by the trading company, sustainability efforts at the individual stages would not be aligned. For example, the first stages of the supply chain would not seek to certify the cocoa, which would compromise the sustainability efforts of the downstream stages, which rely mainly on certificates. Therefore, we not only highlight the mechanisms used at the individual stages, but also emphasize the relevance of the trading company in its overarching coordinating function for the long-term enhancement of sustainability in the complete supply chain.

Even though the case study research was conducted carefully and with regard to several quality criteria, the results show several limitations, offering future research possibilities. While conducting a single case study enables the collection of very detailed data from each stage of the supply chain, it also limits the transferability and generalizability of the results. We placed a lot of emphasis on the representative character of the examined

supply chain, taking into account that the supply chain produces a common product (confectionaries) with usual ingredients (e.g., cocoa) and that each stage of the chain pursues activities to comply with economic, environmental and social sustainability standards. Additionally, the representative character of our research is fostered through the ability to comprehensively analyze each stage of the investigated supply chain, which makes it easier to transfer the results to other agricultural supply chains. However, Yin [40] states that case studies can be used to develop new theoretical constructs, but not to generalize their results to a broader 'population'. Therefore, we call for quantitative survey research to test our propositions and ensure their transferability to other supply chains. For example, it can be quantitatively discussed at what level in the supply chain certificates are the preferred mechanisms to enforce social and ecological standards. In addition, the role of contracts should be quantitatively investigated to examine whether they are also used in other supply chains to ensure economic and not social and ecological sustainability.

Next to a comprehensive quantitative analysis of governance mechanisms to enhance sustainability, we call for research that examines ways to measure the effects of governance mechanisms on the different sustainability dimensions. By being able to measure the effects of governance mechanisms, the effort/benefit ratio of the mechanisms can be better estimated and, accordingly, the sustainability goals can be achieved more efficiently.

Furthermore, it is remarkable that the sustainability efforts in the examined supply chain focus particularly on ecological and economical sustainability. The low consideration of social sustainability aspects is also a phenomenon that appears in the literature [55]. Future research should therefore focus more on the implementation of social sustainability goals in food supply chains through the specific usage of GMs.

In addition to the limitations, the current challenges mentioned during the interviews also result in future research needs. Especially in the logistics and production industry, price competition is very high, and there are hardly any industry-wide sustainability standards or certificates. We, therefore, call for the development of sustainability certificates that specifically address environmental and social sustainability in the manufacturing and logistics industry. Additionally, future research could investigate whether such industry-wide certificates can reduce cost pressures in the industry.

Further, few information technology tools were used to support GMs in the supply chain considered. Future research should focus on integrating technologies, such as blockchain technology, artificial intelligence, or the Internet of Things to enhance sustainability in food supply chains. Blockchain technology can be used, for example, to create credible transparency regarding the compliance with social and environmental sustainability standards in supply chains in which partners do not trust each other [56]. Therefore, future research could explore how from raw material production to retailers, blockchain technology can be used to increase credible transparency in food supply chains. Further, Wang [57] shows, for example, how Internet of Things and data mining can be used to collect data in the food industry and analyze them to enhance the quality of products. The systematic collection and analysis of data could also be used for sustainability-related goals, e.g., to avoid food waste by detecting overstocks at an early stage.

When exploring the potential use of new technologies in the food industry, comparing other industries would be useful to transfer existing concepts (e.g., blockchain governance [58]) to food industry supply chains.

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References

1. IPCC. Special Report; Climate Change and Land. Available online: https://www.ipcc.ch/srccl/ (accessed on 13 September 2021).
2. Griggs, D.; Stafford-Smith, M.; Gaffney, O.; Rockström, J.; Öhman, M.C.; Shyamsundar, P.; Steffen, W.; Glaser, G.; Kanie, N.; Noble, L. Sustainable development goals for people and planet. *Nature* **2013**, *495*, 305–307. [CrossRef] [PubMed]
3. Springmann, M.; Clark, M.; Mason-D'Croz, D.; Wiebe, K.; Bodirsky, B.L.; Lassaletta, L.; de Vries, W.; Vermeulen, S.J.; Herrero, M.; Carlson, K.M.; et al. Options for keeping the food system within environmental limits. *Nature* **2018**, *562*, 519–525. [CrossRef] [PubMed]
4. Khan, S.A.R.; Zkik, K.; Belhadi, A.; Kamble, S.S. Evaluating barriers and solutions for social sustainability adoption in multi-tier supply chains. *Int. J. Prod. Res.* **2021**, *59*, 3378–3397. [CrossRef]
5. Rueda, X.; Garrett, R.; Lambin, E.F. Corporate investments in supply chain sustainability: Selecting instruments in the agri-food industry. *J. Clean. Prod.* **2017**, *142*, 2480–2492. [CrossRef]
6. Grimm, J.H.; Hofstetter, J.S.; Sarkis, J. Exploring sub-suppliers' compliance with corporate sustainability standards. *J. Clean. Prod.* **2014**, *112*, 1971–1984. [CrossRef]
7. Grabs, J.; Carodenuto, S.L. Traders as sustainability governance actors in global food supply chains: A research agenda. *Bus. Strat. Environ.* **2021**, *30*, 1314–1332. [CrossRef]
8. Alvarez, G.; Pilbeam, C.; Wilding, R. Nestlé Nespresso AAA sustainable quality program: An investigation into the governance dynamics in a multi-stakeholder supply chain network. *Supply Chain Manag. Int. J.* **2010**, *15*, 165–182. [CrossRef]
9. Bryceson, K.P.; Ross, A. Habitus of informality in small scale society agrifood chains—Filling the knowledge gap using a socio-culturally focused value chain analysis tool. *J. Asia Pac. Econ.* **2019**, *25*, 545–570. [CrossRef]
10. Torquati, B.; Viganò, E.; Taglioni, C. Construction of alternative food networks for organic products: A case study of "Organized Groups of Supply and Demand". *New Medit.* **2016**, *15*, 53–62.
11. Touboulic, A.; Chicksand, D.; Walker, H. Managing Imbalanced Supply Chain Relationships for Sustainability: A Power Perspective. *Decis. Sci.* **2014**, *45*, 577–619. [CrossRef]
12. Schäfer, M. Establishing ethical organic poultry production: A question of successful cooperation management? *Agric. Hum. Values* **2019**, *36*, 315–327. [CrossRef]
13. Kazancoglu, Y.; Ozkan-Ozen, Y.D. Sustainable disassembly line balancing model based on triple bottom line. *Int. J. Prod. Res.* **2019**, *58*, 4246–4266. [CrossRef]
14. Bevir, M. *Governance: A Very Short Introduction*; OUP Oxford: Oxford, UK, 2012.
15. Li, Y.; Zhao, X.; Shi, D.; Li, X. Governance of sustainable supply chains in the fast fashion industry. *Eur. Manag. J.* **2014**, *32*, 823–836. [CrossRef]
16. Hammervoll, T. Governance of Value Creation in Supply Chain Relationships. *Supply Chain Forum Int. J.* **2011**, *12*, 116–126. [CrossRef]
17. Zhao, X.H.; Chen, L.W. Governance Mechanism of Relational Risks in Supply Chain. *Adv. Mater. Res.* **2013**, *711*, 779–783. [CrossRef]
18. Hoetker, G.; Mellewigt, T. Choice and performance of governance mechanisms: Matching alliance governance to asset type. *Strat. Manag. J.* **2009**, *30*, 1025–1044. [CrossRef]
19. Pilbeam, C.; Alvarez, G.; Wilson, H. The governance of supply networks: A systematic literature review. *Supply Chain Manag. Int. J.* **2012**, *17*, 358–376. [CrossRef]
20. Huang, M.-C.; Cheng, H.-L.; Tseng, C.-Y. Reexamining the direct and interactive effects of governance mechanisms upon buyer–supplier cooperative performance. *Ind. Mark. Manag.* **2014**, *43*, 704–716. [CrossRef]
21. Zhang, L.; Cheng, J.; Wang, D. The influence of informal governance mechanisms on knowledge integration within cross-functional project teams: A social capital perspective. *Knowl. Manag. Res. Pract.* **2015**, *13*, 508–516. [CrossRef]
22. Zheng, J.; Roehrich, J.K.; Lewis, M.A. The dynamics of contractual and relational governance: Evidence from long-term public–private procurement arrangements. *J. Purch. Supply Manag.* **2008**, *14*, 43–54. [CrossRef]
23. Poppo, L.; Zenger, T. Do formal contracts and relational governance function as substitutes or complements? *Strat. Manag. J.* **2002**, *23*, 707–725. [CrossRef]
24. Cao, Z.; Lumineau, F. Revisiting the interplay between contractual and relational governance: A qualitative and meta-analytic investigation. *J. Oper. Manag.* **2014**, *33–34*, 15–42. [CrossRef]
25. Behdani, B.; Fan, Y.; Bloemhof, J.M. Chapter 12—Cool chain and temperature-controlled transport: An overview of concepts, challenges, and technologies. In *Sustainable Food Supply Chains*; Accorsi, R., Manzini, R., Eds.; Academic Press: Cambridge, MA, USA, 2019; pp. 167–183.
26. Hughes, A.; Roe, E.; Hocknell, S. Food supply chains and the antimicrobial resistance challenge: On the framing, accomplishments and limitations of corporate responsibility. *Environ. Plan. A Econ. Space* **2021**, *53*, 1373–1390. [CrossRef]
27. Agnew, M.D.; E Thornes, J. The weather sensitivity of the UK food retail and distribution industry. *Meteorol. Appl.* **1995**, *2*, 137–147. [CrossRef]
28. Gharehgozli, A.; Iakovou, E.; Chang, Y.; Swaney, R. Trends in global E-food supply chain and implications for transport: Literature review and research directions. *Res. Transp. Bus. Manag.* **2017**, *25*, 2–14. [CrossRef]
29. Kamrath, C.; Wesana, J.; Bröring, S.; De Steur, H. What Do We Know About Chain Actors' Evaluation of New Food Technologies? A Systematic Review of Consumer and Farmer Studies. *Compr. Rev. Food Sci. Food Saf.* **2019**, *18*, 798–816. [CrossRef] [PubMed]

30. Corallo, A.; Latino, M.E.; Menegoli, M.; Pontrandolfo, P. A systematic literature review to explore traceability and lifecycle relationship. *Int. J. Prod. Res.* **2020**, *58*, 4789–4807. [CrossRef]
31. León-Bravo, V.; Caniato, F.; Caridi, M.; Johnsen, T. Collaboration for Sustainability in the Food Supply Chain: A Multi-Stage Study in Italy. *Sustainability* **2017**, *9*, 1253. [CrossRef]
32. Smith, P.A.C.; Sharicz, C. The shift needed for sustainability. *Learn. Organ.* **2011**, *18*, 73–86. [CrossRef]
33. Elkington, J.; Rowlands, I.H. Cannibals with Forks: Triple Bottom Line of 21st Century Business. *Altern. J.* **1999**, *25*, 42.
34. van der Vorst, J.G.A.J.; Tromp, S.-O.; van der Zee, D.-J. Simulation modelling for food supply chain redesign; integrated decision making on product quality, sustainability and logistics. *Int. J. Prod. Res.* **2009**, *47*, 6611–6631. [CrossRef]
35. Mehdi, M.; Ahsan, M.B.; Ahmad, B.; Sadozai, K.N.; Hameed, G.; Asif, M. Value Chain Development and Social Upgrading at Upstream of Mango Value in Pakistan. *Sarhad J. Agric.* **2020**, *36*, 574–585. [CrossRef]
36. Abatekassa, G.; Peterson, H.C. Market Access for Local Food through the Conventional Food Supply Chain. *Int. Food Agribus. Manag. Rev.* **2011**, *14*, 63–82.
37. Göbel, C.; Langen, N.; Blumenthal, A.; Teitscheid, P.; Ritter, G. Cutting Food Waste through Cooperation along the Food Supply Chain. *Sustainability* **2015**, *7*, 1429–1445. [CrossRef]
38. Bastian, J.; Zentes, J. Supply chain transparency as a key prerequisite for sustainable agri-food supply chain management. *Int. Rev. Retail. Distrib. Consum. Res.* **2013**, *23*, 553–570. [CrossRef]
39. Chkanikova, O.; Lehner, M. Private eco-brands and green market development: Towards new forms of sustainability governance in the food retailing. *J. Clean. Prod.* **2015**, *107*, 74–84. [CrossRef]
40. Yin, D.R.K. *Case Study Research and Applications: Design and Methods*, 6th ed.; SAGE Publications: Thousand Oaks, CA, USA, 2018.
41. Mayring, P. *Qualitative Content Analysis: Theoretical Foundation, Basic Procedures and Software Solution*; SSOAR: Klagenfurt, Austria, 2014.
42. Eisenhardt, K.M. Building Theories from Case Study Research. *Acad. Manag. Rev.* **1989**, *14*, 532–550. [CrossRef]
43. European Commission. Organic Production and Products. Available online: https://agriculture.ec.europa.eu/farming/organic-farming/organic-production-and-products_en (accessed on 9 August 2022).
44. European Commission. Control and Enforcement. Available online: https://agriculture.ec.europa.eu/farming/organic-farming/controls_en (accessed on 9 August 2022).
45. Amekawa, Y. Reflections on the Growing Influence of Good Agricultural Practices in the Global South. *J. Agric. Environ. Ethics* **2009**, *22*, 531–557. [CrossRef]
46. Ruben, R. Impact assessment of commodity standards: Towards inclusive value chains. *Enterp. Dev. Microfinance* **2017**, *28*, 82–97. [CrossRef]
47. Cui, L.; Guo, S.; Zhang, H. Coordinating a Green Agri-Food Supply Chain with Revenue-Sharing Contracts Considering Retailers' Green Marketing Efforts. *Sustainability* **2020**, *12*, 1289. [CrossRef]
48. Fu, H.; Teo, K.L.; Li, Y.; Wang, L. Weather Risk–Reward Contract for Sustainable Agri-Food Supply Chain with Loss-Averse Farmer. *Sustainability* **2018**, *10*, 4540. [CrossRef]
49. Kaipia, R.; Dukovska-Popovska, I.; Loikkanen, L. Creating sustainable fresh food supply chains through waste reduction. *Int. J. Phys. Distrib. Logist. Manag.* **2013**, *43*, 262–276. [CrossRef]
50. Lusiantoro, L.; Yates, N.; Mena, C.; Varga, L. A Refined Framework of Information Sharing in Perishable Product Supply Chains. 2018. Available online: https://www.emerald.com/insight/content/doi/10.1108/IJPDLM-08-2017-0250/full/html (accessed on 11 July 2022).
51. Chow, C.W.; Harrison, G.L.; McKinnon, J.L.; Wu, A. Cultural influences on informal information sharing in Chinese and Anglo-American organizations: An exploratory study. *Account. Organ. Soc.* **1999**, *24*, 561–582. [CrossRef]
52. Govindan, K. Sustainable consumption and production in the food supply chain: A conceptual framework. *Int. J. Prod. Econ.* **2018**, *195*, 419–431. [CrossRef]
53. van der Spiegel, M.; van der Fels-Klerx, H.; Sterrenburg, P.; van Ruth, S.; Scholtens-Toma, I.; Kok, E. Halal assurance in food supply chains: Verification of halal certificates using audits and laboratory analysis. *Trends Food Sci. Technol.* **2012**, *27*, 109–119. [CrossRef]
54. European Commission. Corporate Sustainability Due Diligence, European Commission—European Commission, 23 February. Available online: https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1145 (accessed on 11 July 2022).
55. Desiderio, E.; García-Herrero, L.; Hall, D.; Segrè, A.; Vittuari, M. Social sustainability tools and indicators for the food supply chain: A systematic literature review. *Sustain. Prod. Consum.* **2021**, *30*, 527–540. [CrossRef]
56. Saberi, S.; Kouhizadeh, M.; Sarkis, J.; Shen, L. Blockchain technology and its relationships to sustainable supply chain management. *Int. J. Prod. Res.* **2018**, *57*, 2117–2135. [CrossRef]
57. Wang, J.; Yue, H. Food safety pre-warning system based on data mining for a sustainable food supply chain. *Food Control* **2016**, *73*, 223–229. [CrossRef]
58. Lumineau, F.; Wang, W.; Schilke, O. Blockchain Governance—A New Way of Organizing Collaborations? *Organ. Sci.* **2021**, *32*, 500–521. [CrossRef]

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The Importance of Digitalization for the Sustainability of the Food Supply Chain

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Abstract: This paper aims to define the negative impact of various indicators on the sustainability and functioning of the traditional food supply chain (FSC) in the segment of wholesale and retail activities and to propose a set of measures and incentives for the digitalization of its business processes. After a systematic review of the literature, the most common indicators significant for the functioning of the FSC were defined, primarily in the segment of wholesale and retail activities. Empirical research examined the influence of given indicators on the FSC. The obtained results showed that indicators such as poor coordination and transfer of information among FSC participants, food loss, economic performance, transaction costs, external elements, chemical and microbial contamination, and control of raw material, food, and waste flows significantly complicate the sustainability and functioning of the FSC. Based on the obtained results, a set of measures and incentives is proposed that the management of the supply chain should undertake to digitalize business processes, primarily in the segment of wholesale and retail activities. This paper also lists shortcomings of the research and gives guidelines for future research.

Keywords: food supply chain; digitalization; sustainability; global market

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1. Introduction

In recent years, a significant number of academic studies have appeared with a focus on the functioning and sustainability of the Food Supply Chain (FSC), particularly those related to its segment of wholesale and retail activities [1–5]. The traditional FSC shows a lot of shortcomings, primarily in the segment of food safety and security [6], losses in the fruit and vegetable placement system [2], dysfunctionalities caused by the COVID-19 pandemic [3,4], inadequate food labeling [7], downtime in production, distribution and retail [8], etc. Two major global events have significantly changed the way the traditional FSC operates. The gap that appeared on the demand side for durable food products (rice, flour, canned food, etc.) as a result of the lockdown due to the coronavirus epidemic, pointed to the dysfunctionality of the FSC as well as its weak response to market needs and the lack of cooperation and timely transfer of information between participants [3,4,9]. Geopolitical turmoil and the Ukrainian conflict have shown the vulnerability of the FSC [10]. The influence of external elements led to a complete halt of the grain supply to the global market, and the safety of food and the safety of shipments were called into question.

The traditional FSC is not ready to mitigate all shocks and uncertainties that appear in the market [1,10]. Authors point out that the flow of information between participants is not at a level that will enable supply chain management to react in time in terms of adequately finding alternative supply channels for raw materials and final products [1,2,4,7,8,11]. The speed at which an uncertainty appears in the market is inversely proportional to the speed of FSC's reaction to eliminate the consequences of that uncertainty. The FSC is characterized by robustness, non-transparency, weak coordination of cross-channel activities, and lack of

digitalization [11,12]. All of this points to the need to transform the traditional FSC into a modern digitized chain based on modern IT technologies (blockchain, IoT, etc.).

The objective of this study is to define how critical indicators influence the sustainability and functioning of the traditional FSC and propose a set of measures and incentives for the digitalization of its business processes, primarily in the segment of wholesale and retail activities. The basic research objective is supported by three specific goals: (1) defining the impact of critical indicators on the sustainability and functioning of FSC; (2) defining how the implementation of the digitalization process affects the analyzed indicators; (3) defining the impact of the digitalization process on the sustainability and functioning of the FSC. Through a systematic review of the literature, the indicators that most strongly influence the sustainability and flexibility of the FSC in the segment of the wholesale and retail activities were indicated. The results of empirical research show the positive and negative sides of the influence of each indicator. Based on the results obtained in this way, a set of measures and guidelines are proposed for the gradual digitization of the FSC to eliminate and minimize negative impacts and make the supply chain more transparent and flexible.

2. Literature Review

The FSC is a complex system responsible for the circulation of food from the initial stage of production to the final stage of consumption [13]. The FSC should function as a single entity with full coordination and exchange of information between participants (producers, distributors, wholesalers, and retailers) [14]. The authors indicate that any deficiency in the unity of the FSC leads to the creation of a market gap and an inadequate response to consumer needs [11–14]. At the same time, the optimization of chain activities leads to greater profitability and business efficiency. Many studies advocate better control of business processes. A 2020 study by Patidar and Agrawal shows that 92% of total food marketing costs appear in the transportation of products from producers (agricultural processors) to retail outlets [15]. The authors complain that traditional FSCs are often disorganized [16] and show a lack of communication between agricultural farms and consumers [17]. They are subject to significant influence from middlemen who dictate the output prices of products [15]. In addition, there is an inadequate distribution of benefits, rewards, and risks among participants in the FSC [14], and there are increasing influences from external factors [10], food waste [18], etc. The importance of the good functioning of the FSC on the global market in the years to come is best illustrated by the data. Rezaei and Liu, in their 2017 study, state that by 2050, the world's population will reach 9.1 billion people, which will require a 70% increase in food availability [19]. As much as 30% of food produced for human consumption globally is lost or wasted within the FSC. The biggest problem of food delivery will occur in urban centers whose populations are continuously growing. This will lead to the creation of complex supply chains involving numerous participants, which will present challenges in the delivery of safe and quality food [19]. In addition, the conventional systems implemented in FSC are centralized, monopolistic, asymmetric, and nontransparent, and they may lead to a serious lack consumer confidence in food safety. That trust has been particularly damaged after a series of incidents over the last decades, such as mad cow disease, aflatoxin problems with milk, the horsemeat scandal, toxic milk powder, genetically modified food, etc. [13]. As the biggest problem of FSC, Lemma, Kitaw, and Gatew cite food losses of 20 to 60 percent of total production [20]. The same authors state that in the global market, approximately one-third of food produced for human consumption is lost or wasted, which amounts to approximately 1.3 billion tons per year. The reasons for food waste lie primarily in inconsistencies and inefficiencies in production, storage, handling, and transportation along the entire FSC [20].

Based on the presented subject of the paper, we conducted our research in two phases. In the first phase, it was necessary to define the indicators that affect the sustainability and functionality of FSC, primarily in the role of the supply chain in the segment of wholesale and retail activities. In the second phase, the impact of the digitalization process on the indicators underwent empirical examination. In the first phase, through a systematic

literature review based on the methodology set by Xiao and Watson [21], indicators that directly affect the sustainability, functioning, and traceability of the FSC were identified. According to this methodology, the literature review began with a search exclusively by the keywords and titles of publications, followed by a review of abstracts, and continues with the analysis of the entire texts; the final stage includes reporting on the obtained findings. All analyzed articles were retrieved from the Web of Science, Scopus, and SpringerLink databases. The search was performed using keywords relevant to the research subject: Food Supply Chain (FSC) AND Digitalization AND Sustainability; Food AND Supply Chain Management (SCM) AND Sustainability; Safety AND Food Supply Chain AND Security; Food Supply Chain AND Economic performance AND External elements; Traceability AND Food Supply Chain AND Functionality; Waste AND Food Supply Chain AND Costs. Only high-quality peer-reviewed papers were taken into consideration. The number of hits per database was 48 papers for WoS, 39 papers for Scopus, and 45 papers for SpringerLink. Based on their titles, abstracts, and keywords, a total of 58 papers that fit the research topic were selected for further analysis. Among them, 17 duplicates were observed and were excluded from further analysis. The remaining 41 papers were read in detail, out of which 10 papers were discarded because they could not contribute to the resolution of the set research subject. Out of all remaining papers, nine were general, meaning that they dealt with the issues of food placement, supply chain management, et cetera. The remaining 21 papers were entirely on the line of research; that is, they analyzed the importance of the digitalization process on the sustainability of FSC, especially in the segment of wholesale and retail activities [1–9,11,15–17,19,20,22–28]. As such, the last group served to identify the following indicators that directly affect the sustainability, functioning, and traceability of FSC.

Poor coordination and transfer of information among FSC participants–One of the biggest problems is the untimely exchange of information, both from upstream to downstream and vice versa, to FSC participants [1,2,4,5,7,8,11]. As a result of this, the chain reacts untimely and poorly to market demands, which results in the appearance of gaps, primarily on the demand side. We witnessed huge gaps on the demand side for durable food products and other essentials during the first months of the COVID-19 pandemic. Within this indicator, we should also point out the ubiquitous whiplash effect (amplification of demand from lower to higher channel members), which leads to significant inefficiencies along the FSC in the food distribution and retail segment, such as missed deliveries, poor customer service, excessive stocks, and wrong capacity plans. To adequately minimize the adverse effects of this problem, it is necessary to continuously monitor the performance of food distributors so that the flow of demand information, order delivery, transportation planning, and inventory management can be significantly improved [29].

The loss and/or waste of food is a problem that is frequently caused by the malfunctioning of food production processes and the inefficiency of the supply system [19,20]. The most common reasons are some managerial and technical limitations, such as the lack of suitable storage facilities, poor food storage and preservation conditions, cold chain, improper food handling practices, insufficiently developed infrastructure, inadequate packing and packaging, ineffective marketing systems, etc. The fact that the annual estimate of food loss on the global market is around 1 trillion US$ is worrying [19].

Economic performance (inflation and price of energy)—The global factor of inflation and the sharp increase in the price of energy significantly complicate the functioning of the FSC [15,22]. The decline in energy imports from Russia and economic sanctions against the Russian market caused an increase in the inflation rate in the EU and a sharp increase in the price of energy (about a 16% increase in the price of electricity in Germany, 8% increase in the price of gas in the EU, etc.). There is a direct correlation between the growth rate of these economic indicators and the growth of food prices.

Transaction costs–A problem for FSC is also the growth of transaction costs. These costs arise in the process of moving products from farmers to final consumers [15]. These are transport costs, trade costs (commission), profit margin, information costs, etc. It

is estimated that their growth rate rose 30% compared to 2019. It is precisely such an inefficient movement of food that leads to low profitability in the FSC [15].

External elements–The global instability and crisis caused by the COVID-19 pandemic and the Ukrainian conflict caused unfathomable consequences and uncertainty in the global food market [3,4,9,23]. The pandemic occurred suddenly and caused an enormous demand for essential products during the quarantine (lockdown) period. On the other hand, the Russian–Ukrainian conflict caused a halt in the supply of agricultural products and raw materials (cereals), fertilizers, energy, food, etc. While the economy is recovering from the consequences of the COVID-19 pandemic, new market instability and instability in the supply of resources seriously threaten the functioning of the FSC, threatening to cause hunger in rural regions with poorly developed supply chains (e.g., African countries).

Chemical and microbial contamination—Accidentally or intentionally, during the transfer of food and raw materials from the farm to the place of final consumption, various sources of contamination appear [6,24–26]. Such contaminations lead to food quality and safety incidents and attract increasing public attention [25]. First, easily perishable food and products, such as milk and dairy products, meat and meat products, fresh fruits and vegetables, fish, etc., are exposed to contamination. The biggest problems are microbial contamination (pathogenic microorganisms), problems related to chemical and physical contamination, as well as issues caused by inadequate control (e.g., allergens, industrial pollutants, microtoxins, small objects, chemical residues, false documentation, etc.). Although many companies have recently integrated food safety early warning systems in the FSC, and the number of incidents has decreased significantly, contaminants can still pose a significant risk to human health depending on their toxicity and exposure time.

Control of raw material, food, and waste flows in FSC—A frequent criticism of the traditional FSC is the lack of control at critical points in the FSC. This primarily refers to problems related to supply chain management (SCM), the coordination of activities of participants related to raw materials and final product flow, cooperation among members, chain flexibility, logistics operations, packaging, and waste management [15–17,26–28]. Without continuous control of critical points, it is not possible to achieve full functionality, efficiency, and sustainability in the FSC, especially in the segment of timely placement of food products in the market [28]. Potential solutions appear in the form of Vendor-Managed Inventory (VMI) implementation in FSC. VMI is a concept in which the producers manage the vendors' inventory. In this way, they take full responsibility for making decisions regarding the timing and extent of restocking. The essential prerequisites for VMI implementation in FSC are trust, long-term cooperation, integration, transparency, and information-sharing [30].

From the given presentation of critical indicators, we understand that insufficient control and records [28], external factors [23], economic challenges [22], lack of digitalization and standardization of processes [28], as well as the non-transparent exchange of data and information [11,31] are some of the most critical challenges facing the FSC, its segment in wholesale and retail activities first and foremost. The key research question that arises is whether these challenges can be eliminated and FSC made more flexible through the implementation of digitalization processes and the application of modern technologies based on IoT, BT, DLT (distributed ledger technology), TTI, RFID, etc. The originality of the paper is reflected in the precise definition of the impact of the above indicators on the sustainability and functioning of the FSC as well as the impact of modern technologies on minimizing their importance and improving the efficiency of the entire FSC. The given paper and the obtained results fill the gap of previous research conducted in the western Balkans region, as almost no academic study has dealt with the concrete consequences of FSC digitalization. Defining the influence of critical indicators is significant for taking adequate measures in order to minimize their negative effects through the implementation of modern technologies in the FSC as well as for improving working conditions and achieving the sustainability of food placed on the market.

3. Methodology

3.1. Hypotheses

Previous research indicated the problem of transparency and functioning of the FSC and emphasized the need for digitalization of its business in the segment of wholesale and retail activities [1–9,11,15–17,19,20,22–28]. However, no research has provided a comprehensive overview of the negative effects of individual indicators and the path to minimize those effects through the implementation of modern technologies (BT, IoT, DLT, etc.). Obtaining a complete picture of the importance of critical indicators and the usefulness of the implementation of the digitalization process in FSC first requires defining the impact of all indicators in a mutual comparison.

The first research hypothesis, H_1, was set as follows: H_1—critical indicators have a statistically significant impact on the sustainability and functioning of the FSC in the segment of wholesale and retail activities. By testing this hypothesis, the first specific goal of this research is achieved, and the individual influences of each of the analyzed indicators are clearly defined. The first research hypothesis must be supported by seven supporting hypotheses $H_{1(a)}$–$H_{1(g)}$, which test the individual influence of each of the critical indicators. The supporting hypotheses are: $H_{1(a)}$—poor coordination and transfer of information among FCS participants has a statistically significant impact on the sustainability and functioning of FSC in the segment of wholesale and retail activities; $H_{1(b)}$—food loss and/ or waste has a statistically significant effect on the sustainability and functioning of the FSC in the segment of wholesale and retail activities; $H_{1(c)}$—economic performance has a statistically significant effect on the sustainability and functioning of FSC in the segment of wholesale and retail activities; $H_{1(d)}$—transaction costs have a statistically significant effect on the sustainability and functioning of FSC in the segment of wholesale and retail activities; $H_{1(e)}$—external elements have a statistically significant influence on the sustainability and functioning of FSC in the segment of wholesale and retail activities; $H_{1(f)}$—chemical and microbial contamination have a statistically significant effect on the sustainability and functioning of the FSC in the segment of wholesale and retail activities; $H_{1(g)}$—control of raw material, food, and waste flows has a statistically significant effect on the sustainability and functioning of FSC in the segment of wholesale and retail activities.

Studies confirm that digitalization improves business processes that take place among FSC participants [1,11–13]. Implemented technologies such as BT, IoT, DLT, TTI, RFID, etc., minimize negative effects and make the FSC more functional and transparent, especially in the segment of wholesale and retail activities. In this context, and in accordance with the other specific objectives of this research through the following group of research hypotheses, we define the influence of the digitalization process on minimizing the negative impact of critical indicators. The second research hypothesis, H_2, states the following:

H_2—digitalization of business processes has a statistically significant effect on critical indicators in FSC in the segment of wholesale and retail activities. Testing this hypothesis determines if and in what way the implementation of BT, IoT, DLT, etc., minimizes the negative effect that critical indicators have on the sustainability and functioning of the FSC. As in the previous step, the second research hypothesis must be supported by seven supporting hypotheses $H_{2(a)}$–$H_{2(g)}$, which test the connection of the digitalization process with each of the analyzed critical indicators. The supporting hypotheses are: $H_{2(a)}$—the digitalization process has a statistically significant effect on the coordination and transfer of information among FSC participants in the segment of wholesale and retail activities; $H_{2(b)}$—food loss and/ or waste has a statistically significant effect on the sustainability and functioning of the FSC in the segment of wholesale and retail activities. $H_{2(c)}$—the digitalization process has a statistically significant effect on economic performance in the segment of wholesale and retail activities; $H_{2(d)}$—the digitalization process has a statistically significant effect on transaction costs appearing in the FSC in the segment of wholesale and retail activities; $H_{2(e)}$—the digitalization process has a statistically significant effect on external elements in the segment of wholesale and retail activities; $H_{2(f)}$—the digitalization process has a statistically significant effect on chemical and microbial contamination in the

FSC in the segment of wholesale and retail activities; $H_{2(g)}$—the digitalization process has a statistically significant effect on the control of raw material, food, and waste flows in the FSC in the segment of wholesale and retail activities.

Considering that the direct correlation between the implementation of modern technologies and the sustainability of FSC was confirmed in previous research, it is necessary to precisely define that influence with the third research hypothesis. The third research hypothesis, H_3, states:

H_3—the implementation of the digitalization process has a statistically significant effect on the sustainability and functioning of the FSC in the segment of wholesale and retail activities. By testing the third hypothesis, the last specific goal of the research is achieved, and it is defined whether the implementation of modern technologies by minimizing the negative effects of critical indicators significantly affects the sustainability, transparency, and flexibility of the FSC.

The presented research objectives and hypotheses are illustrated in the following research model (Figure 1).

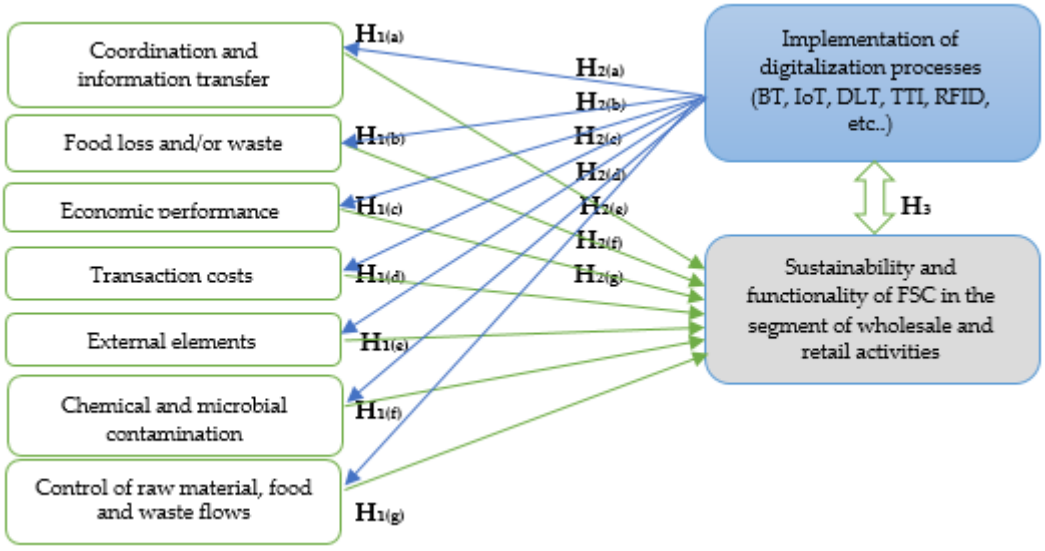

Figure 1. Presentation of the research model.

3.2. Variables

The mentioned research involved the realization of the research based on several dependent and independent variables. Due to the nature of the research subject, the procedure was implemented in three parts. The first part examined the influence of critical indicators on the sustainability and functionality of the FSC in the segment of wholesale and retail activities. The functioning of the FSC appears as a dependent variable, whereas seven critical indicators that appear in the functioning of the FSC were chosen as the independent variables of the interval type of measurement. These variables are the coordination and transfer of information; loss and/ or waste of food; economic performance; transaction costs; external elements; safety and security of food; control of raw materials, food, and waste flows [1,2,4,5,7,8,11,15,22,23]. The impacts of the given indicators on the sustainability and functioning of the FSC in the segment of wholesale and retail activities were evaluated based on a Likert scale (0—no impact; 5—very high impact). In the second segment, the impact of the implementation of modern technologies on critical indicators in FSC was examined. The implementation of BT, IoT, DLT, TTI, RFID, etc., appears as an independent variable of the interval type of measurement, whereas the dependent variables are all of the analyzed indicators. The impact of digitalization on the critical indicators was also assessed using a Likert scale. In the last part of the research, the sustainability and functioning of the FSC appear as a dependent variable, which is evaluated based on the impact of the digitalization process, the independent variable. The ratings were determined

based on a Likert scale. In all segments of the conducted research, FSC participants in the segment of wholesale and retail activities (physical distributors, wholesale, and retail), and the managerial positions of respondents (top management, mid-level management, and operational management) were chosen as independent grouping variables.

3.3. Research Sample

As many as 242 managers in the physical distribution, wholesale, and retail sectors participated in the survey. The representativeness of the selected sample stems from the fact that the respondents are FSC managers who are directly responsible for food marketing, who know best the dependence of marketing on the mentioned indicators, and who have experience with the implementation of digitalization processes in the FSC. This type of sample belongs to the group of large statistical samples and is suitable for testing set hypotheses and achieving the research goal. In addition, the sample was uniform in terms of the number of FSC participants, the managerial position of the respondents, and their demographic characteristics, which contributed to obtaining representative data. The research sample is presented in Table 1.

Table 1. Research sample.

Gender	***n***	**Structure (%)**
Female	104	41.6%
Male	138	58.4%
FSC Sector	*n*	Structure (%)
Physical distribution	77	31.8%
Wholesale	78	32.2%
Retail	87	36.0%
Managerial level	*n*	Structure (%)
Top management	55	20.8%
Mid-level management	86	35.5%
Operational management	101	41.7%

Source: Author's calculations.

The reliability of the conducted testing and the correctness of the selected scales were confirmed using standard statistical coefficients: Cronbach's alpha, skewness, and kurtosis (Table 2). From the tabular presentation, there are no statistically significant deviations for the skewness and kurtosis coefficients, whereas Cronbach's alpha coefficient for all variables has values that are above 0.750. The obtained coefficient values confirm that the selected questions describe an identical problem and can be used to examine the opinions and attitudes of FSC managers on the impact of critical indicators on its sustainability and functionality as well as on the possibilities of implementing modern technology in business processes related to food marketing.

Table 2. Cronbach's alpha, skewness, and kurtosis coefficients.

Indicators	**Cronbach's Alpha**	**Skewness**	**Kurtosis**
Coordination and information transfer	0.852	0.069	−1.020
Food loss and/or waste	0.939	−0.228	−0.118
Economic performance	0.774	−0.442	−0.883
Transaction costs	0.903	−0.527	−1.151
External elements	0.752	−0.212	−1.236
Chemical and microbial contamination	0.843	0.079	−1.307
Control of raw material, food, and waste flows	0.812	−0.338	−0.525
Digitalization	0.804	0.473	−0.663

Source: Author's calculation.

3.4. Procedure and Data Analysis

The online questionnaire was sent to all FSC participants in the period from August–September 2022. Wholesalers, independent carriers, and retailers, as well as the largest agricultural holdings, transport and logistics centers, and retail chains in the territory of the western Balkans (Serbia, Croatia, B&H, Montenegro, North Macedonia), are equally represented in the sample. The sample consists of business entities that primarily deal with fast-moving consumer goods, except for fresh fruits and vegetables, fresh meat, fish, and other products that are marketed unpackaged or in bulk.

The questionnaire consisted of 22 questions that were structured based on similar questionnaires and research conducted in some earlier studies [14,16,18,28]. The questionnaire had three parts. After collecting general demographic information about the respondents (gender, age, and position), in the first part of the questionnaire, respondents were asked to evaluate the impact of each of the offered indicators on the functioning of the FSC. The indicators were evaluated based on three Likert-type items (0–5 scale). After that, in the second part, respondents ranked how implemented modern technologies (digitalization) minimized the negative impact of critical indicators. Digitalization was also operationalized through three items: (1) application of information technology: BT, IoT, DLT, etc.; (2) application of sensor and identification technology: WSN, TTI, Barcode, RFID, etc.; (3) application of location-based technology: RS, GPS, RTLS, etc. In the last part of the questionnaire, the direct impact of digitalization on the sustainability and functioning of the FSC was also assessed through three Likert-type items.

The total number of sent questionnaires was 600, which shows a return rate of filled questionnaires of 33.7% (242/640). The collected data were analyzed and used to test research hypotheses. The method of descriptive statistics was used to present the most significant characteristics of the sample, whereas the basic and supporting research hypotheses were tested using the statistical method of structural modeling (SEM) or path analysis.

IBM SPSS Amos 23 structural equation modeling software was used for data design and analysis. Path coefficients (R*ij*) were calculated programmatically based on the following pattern:

$$\mathrm{R}ij = \mathrm{P}ij + \sum(\mathrm{R}\ ik \times \mathrm{P}\ kj) \quad (1)$$

wherein:

R*ij*—the mutual connection between independent indicators (i) and dependent variables (j) measured by the correlation coefficient (r),

P*ij*—the component that shows the direct influence (effect) of independent indicators (i) on the dependent variable (j) measured by the path coefficient,

$\sum$(R *ik* × P *kj*)—the sum of the components of the indirect influence of a given independent indicator (i) on a given dependent variable (j) through independent characters (k).

The residual effect is determined based on the formula $\sqrt{1 - \mathrm{R}_2}$, where—$\mathrm{R}_2 = \sum(\mathrm{R}ij \times \mathrm{P}\ ij)$.

To evaluate the model, that is, whether there is enough information to calculate unknown parameters in SEM, the following coefficients were used: NFI—Bentler-Bonett Normed Fit Index, RFI—Relative Fit Index, IFI—Incremental Fit Index, CFI—Comparative fit index, TLI—Tucker-Lewis index, RMSEA—Root Mean Square Error of Approximation, and CMIN/DF—Chi-square value/degree of freedom.

Other used statistical indicators were: Standard Error (SE = SD/$\sqrt{\mathrm{n}}$, where SD is the standard deviation and n is the number of elements in the sample), Standard Deviation (SD = $\sqrt{1/\mathrm{N}\sum(\mathrm{xi} - \mu)^2}$, where N is the number of elements in the sample, xi is the ith member of the sample, and μ is the arithmetic mean), Coefficient Beta (β = ($\mathrm{S_x}/\mathrm{S_y}$)b, where $\mathrm{S_x}$ is the standard deviation of variable x, $\mathrm{S_y}$ is the standard deviation variables y, and b is the standard regression coefficient), T value (t = ($\bar{\mathrm{x}}$ − μ)/(SD − $\sqrt{\mathrm{n}}$), where $\bar{\mathrm{x}}$ is the arithmetic mean of the sample, μ is the arithmetic mean of the population, SD is the standard deviation of the sample, and n is the sample size).

4. Research Results

The average scores (M) of the respondents' agreements with statements that critical indicators and the digitalization process significantly influence the sustainability and functionality of the FSC in the segment of wholesale and retail activities are presented in Table 3. In addition to the average rank, for each of the tested indicators, the most important indicators of descriptive statistics are listed (Min., Max., SE, and SD).

Table 3. Descriptive statistics.

Order No.	Indicators	Min.	Max.	Mean (M)	Standard Error (SE)	Standard Deviation (SD)
1	**2**	**3**	**4**	**5**	**6**	**7**
1	Coordination and information transfer	2.00	5.00	4.71	0.0804	0.8604
2	Food loss and/or waste	2.00	5.00	3.74	0.0628	0.9380
3	Economic performance	1.00	5.00	4.24	0.0783	0.8014
4	Transaction costs	1.00	4.00	3.17	0.0472	0.9116
5	External elements	2.00	5.00	4.25	0.0700	0.9314
6	Chemical and microbial contamination	1.00	4.00	3.87	0.0731	1.2408
7	Control of raw material, food, and waste flows	2.00	5.00	4.17	0.0665	1.0537
8	Digitalization	2.00	5.00	4.20	0.2167	0.8390

Source: Author's calculation.

The above table shows that the respondents agree that coordination and information transfer (M = 4.71) is the most important indicator that influences FSC in the segment of wholesale and retail activities. In other words, respondents believe that the lack of coordination and untimely transfer of information among FSC participants has the greatest negative impact on its sustainability and flexibility. The degree of agreement among respondents with this statement is significant and amounts to SD = 0.8604. Such a result is expected because inadequate exchange of information within the FSC results in an untimely and weak reaction to the demands and needs of the market [1,2,4,5,7,8,11]. Second place is shared by external elements (M = 4.25) and economic performance (M = 4.24). It is particularly interesting to observe that the respondents in their answers are most in agreement about the negative impact that economic performance can have on FSC (SD = 0.8014). Having in mind the volatility and unpredictability of the global market and its impact on supply chains, these are expected responses. Out of the critical indicators, the control of raw material, food, and waste flows (M = 4.17), chemical and microbial contamination (M = 3.87), and food loss and/ or waste (M = 3.74) follow. Transaction costs (M = 3.17) are in last place in importance for the functionality of FSC, which is possibly attributed to the fact that FSC managers consider that they take more care and more efficiently monitor the expenses that appear on the journey of the product from the farmer to the final consumer. It is interesting to note that the process of digitalization and its impact on the entire FSC was assessed with a high average score of 4.20, with high agreement among respondents on this statement (SD = 0.8390). This confirms the awareness among FSC managers of the necessity of introducing modern technologies in FSC business operations.

The SEM method will be used to precisely test the impact of critical indicators on the sustainability and functionality of FSC in the segment of wholesale and retail activities (hypothesis group $H_{1(a)}$–$H_{1(g)}$). Before actual testing, it was necessary to determine the degree of correlation between the analyzed indicators and the functionality of the FSC. For this purpose, multiple regression analysis was applied, i.e., the Enter method, which combines all independent variables (critical indicators) to predict the dependent variable (sustainability and functionality of FSC). The obtained regression model is statistically significant ($F(200;6) = 6.97$, $p < 0.01$), which means that the set of critical indicators is statistically significant in predicting the sustainability and functionality of FSC. The resulting

model describes 66.3% of the criterion variance. The contribution of each indicator is presented in Table 4.

Table 4. Contribution of critical indicators.

Indicators	Stand. Coefficient		*t*	*Sig.*
	Beta	St. Error		
(const.)	0.786	1.181	3.457	0.000
Coordination and information transfer	0.774 **	0.673	0.813	0.009
Food loss and/or waste	0.633	0.604	1.031	0.087
Economic performance	0.627 **	0.721	1.136	0.004
Transaction costs	−0.557	0.780	0.495	0.117
External elements	0.756 **	0.678	1.350	0.000
Chemical and microbial contamination	0.448 *	0.793	0.603	0.040
Control of raw material, food, and waste flows	0.561 *	0.844	0.790	0.034

Note: ** Correlation is significant at the 1%level; * correlation is significant at the 5% level. Source: Author's calculation.

Testing the impact of critical indicators on the sustainability and functionality of the FSC was implemented using the SEM method, or the path analysis method. The essence of the SEM method is that the influence of each critical indicator on the sustainability and functioning of the FSC can be defined based on the established paths or directions of influence. The obtained model is statistically significant (NFI = 0.984; RFI = 0.926; IFI = 0.957; TLI = 0.950; CFI = 0.950; RMSEA = 0.048, CMIN/DF = 1.495). The results of testing the first group of research hypotheses $H_{1(a)}$–$H_{1(g)}$ and the display of statistically significant mutual influences between the analyzed indicators are presented in Table 5.

Table 5. Path analysis.

Ord. No.	Path	Path Coefficient	*t* Value	Result
1	Coordination and information transfer » Sustainability and functionality of FSC	0.861	14.331	Support
2	Food loss and/or waste » Sustainability and functionality of FSC	0.066	4.088	Reject
3	Economic performance » Sustainability and functionality of FSC	0.628	11.030	Support
4	Transaction costs » Sustainability and functionality of FSC	0.117	1.924	Reject
5	External elements » Sustainability and functionality of FSC	0.801	11.240	Support
6	Chemical and microbial contamination » Sustainability and functionality of FSC	0.420	1.627	Support
7	Control of raw material, food, and waste flows » Sustainability and functionality of FSC	0.266	3.227	Support
8	Coordination and information transfer » Food loss and/or waste	0.648	9.033	Support
9	Coordination and information transfer » Transaction costs	0.474	3.549	Support
10	Coordination and information transfer» Control of raw material, food, and waste flows	0.548	8.212	Support
11	Economic performance » Loss and/ or waste of food	0.554	0.887	Support
12	Economic performance » Transaction costs	0.732	3.549	Support
13	Transaction costs » Loss and/ or waste of food	0.772	8.212	Support
14	External elements » Economic performance	0.831	10.611	Support
15	External elements » Chemical and microbial contamination	0.730	4.088	Support
16	Control of raw material, food, and waste flows » Chemical and microbial contamination	0.661	9.033	Support
17	Digitalization of FSC » Coordination and information transfer	0.758	14.221	Support
18	Digitalization of FSC » Food loss and/or waste	0.426	4.088	Support
19	Digitalization of FSC » Economic performance	0.310	11.030	Reject
20	Digitalization of FSC » Transaction costs	0.228	1.924	Support
21	Digitalization of FSC » External elements	0.055	11.030	Reject
22	Digitalization of FSC » Chemical and microbial contamination	0.517	1.627	Support
23	Digitalization of FSC » Control of raw material, food, and waste flows	0.376	3.227	Support

Source: Author's calculation.

The obtained results show that critical indicators such as coordination and transfer of information, economic performance, external elements, chemical and microbial contamination, and control of raw material, food, and waste flows affect in a statistically significant way the sustainability and functionality of the FSC in the segment of wholesale and retail activities. That confirms research hypotheses $H_{1(a)}$, $H_{1(c)}$, H_{1I}, $H_{1(I)}$ i $H_{1(g)}$, i.e., considering that these are critical indicators, any increase in the intensity of the given indicators and failures in control, information flows, and security and the like, has a direct negative impact on the flexibility of the FSC. In the case of the remaining two indicators, no statistically significant influence can be read, and we conclude that hypotheses $H_{1(b)}$ and $H_{1(d)}$ are not accepted. Based on the conducted testing, the conclusion is that the first research hypothesis H_1 is partially accepted and that critical indicators in most cases have a statistically significant effect on the sustainability and functionality of FSC in the segment of wholesale and retail activities. Figure 2 (structural model) presents the influence paths of critical indicators on the sustainability and functionality of FSC.

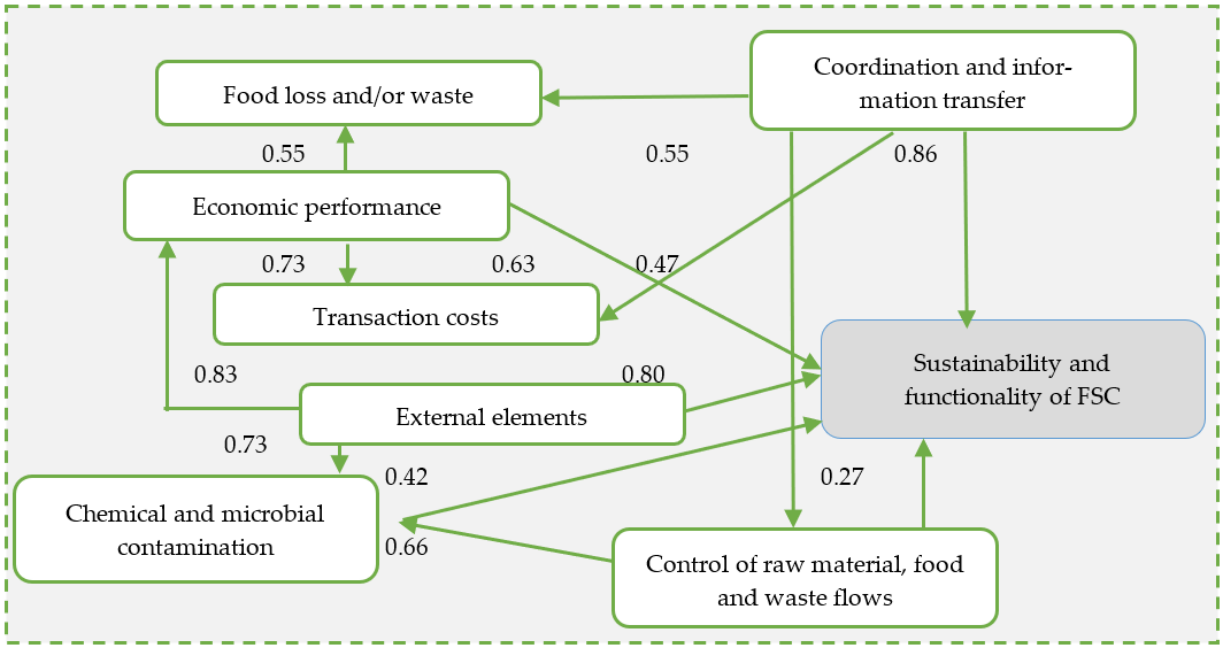

Figure 2. Structural model.

In the second part of the questionnaire, respondents assessed the impact of digitalization; that is, a ranking was made to establish if the application of modern information technologies, location-based technologies, and sensor and identification technologies (BT, IoT, DLT, WSN, TTI, Barcode, RFID, RS, GPS, RTL, etc.) minimizes the negative impacts of the critical indicators defined in the first segment of the research. The average scores (M) of respondents' agreements with the statement that the digitalization process significantly affects critical indicators are presented in Table 6. In addition to the average rank, the most important indicators of descriptive statistics (Min., Max., SE, and SD) are listed.

Table 6. Descriptive statistics for the impact of the digitization process on critical indicators.

		Indicators of Descriptive Statistics	Coordination and Information Transfer	Food Loss and/or Waste	Economic Performance	Transaction Costs	External Elements	Chemical and Microbial Contamination	Flows of Raw Materials, Food and Waste
1	Digitalization nof FSC	Min.	2.00	1.00	1.00	2.00	1.00	2.00	1.00
2		Max.	5.00	5.00	5.00	5.00	4.00	5.00	5.00
3		M	4.84	4.22	3.21	4.14	3.21	4.02	4.36
4		SE	0.0715	0.1241	0.0684	0.0474	0.0700	0.0574	0.2410
5		SD	0.8057	0.9914	1.0541	1.2112	0.9758	0.8824	0.8110

Source: Author's calculation.

From the given tabular representation, it is noticeable that the respondents believe that the digitalization process most influences and shapes the coordination and transfer of information in the FSC (M = 4.84) and the control of raw material, food, and waste flows (M = 4.36). Together, these answers show the highest degrees of mutual agreement between the respondents' views (SD = 0.8057; SD = 0.8110). These answers are expected, bearing in mind that improving the flow of information, products, and services through the FSC is impossible without modern technologies [1,11–13,28]. Slightly less importance was attributed to the impact of digitalization on food loss and/or waste (M = 4.22), transaction costs (M = 4.14), and chemical and microbial contamination (M = 4.02). With all of these indicators, it is noticeable that with an increase in the degree of control and better monitoring of information, their negative effects are eliminated. The least importance was given to the impact of digitalization on economic performance (M = 3.45) and external elements (M = 3.21). The respondents' opinion is that these last two indicators are the most dependent on external factors that come from outside the FSC, and that, therefore, digitalization cannot have a direct impact on them.

For testing the second group of research hypotheses $H_{2(a)}$–$H_{2(g)}$, the SEM method was also be used; that is, the impact path analysis. Previously, using the Enter method, it was determined that the obtained regression model is statistically significant ($F(200;1) = 6339$, $p < 0.01$), which means that the digitalization process significantly predicts the influence of each of the critical indicators. The resulting model describes 71.3% of the criterion variance. Using the SEM method, we defined the direction of the influence of the digitalization process on each of the critical indicators. The obtained model is statistically significant (NFI = 0.977, RFI = 0.962, IFI = 0.945, TLI = 0.971, CFI = 0.977, RMSEA = 0.028, and CMIN/DF = 1.266). The results from testing the second group of research hypotheses $H_{2(a)}$–$H_{2(g)}$ are presented in Table 5.

The results show that implementing modern technological solutions in the FSC significantly affects the coordination and transfer of information, loss and/or waste of food, transaction costs, food security and safety, and raw materials, food, and waste flows in the FSC in the segment of wholesale and retail activities. These results confirm the research hypotheses $H_{2(a)}$, $H_{2(b)}$, $H_{2(d)}$, $H_{2(f)}$ i $H_{2(g)}$; that is, the growth of the intensity of the digitalization process is directly reflected in the minimization of the negative impacts of the mentioned critical indicators on the sustainability and functioning of the FSC. In the case of the remaining two indicators, no statistically significant influence can be read, and we conclude that hypotheses $\mathbf{H_{1(c)}}$ i $\mathbf{H_{1(e)}}$ are not accepted. In other words, FSC digitalization has no impact on economic performance (inflation rate and energy prices) or external effects (global instability, crises, etc.).

Based on the conducted testing, the conclusion is that the second research hypothesis H_2 was partially accepted, and that the implementation of modern technologies in most cases statistically significantly affects and minimizes the critical indicators that appear in the business operations of FSC in the segment of wholesale and retail activities. Figure 3 (structural model) presents the paths of influence of the digitalization process on critical indicators as well as the mutually statistically significant influence between the critical indicators.

In the last segment of the research, the respondents made a final judgment on whether the digitalization process affects the sustainability and functionality of the FSC in the segment of wholesale and retail activities. The average ranking of respondents' answers and the most important indicators of descriptive statistics on this issue are presented in Table 7.

The average rank of M = 4.20 shows that the respondents believe that the implementation of modern technologies through the impact on critical indicators directly contributes to greater flexibility and transparency in the FSC, that is, its sustainability and functionality. It is noticeable that the respondents are quite unanimous on this statement (SD = 0.839). This result gains additional importance because most respondents from the sample have already implemented various modern information and technological solutions in their business processes; thus, their answers are based on real data. As in the case of the previous research hypotheses, when testing $\mathbf{H_3}$ by employing the SEM method, the direction of the influence of

the digitalization process on the sustainability and functionality of the FSC was defined. The obtained model is statistically significant (NFI = 0.965, RFI = 0.974, IFI = 0.961, TLI = 0.975, CFI = 0.966, RMSEA = 0.044, and CMIN/DF = 1.342). The results of testing the third research hypothesis $\mathbf{H_3}$ are presented in Table 8.

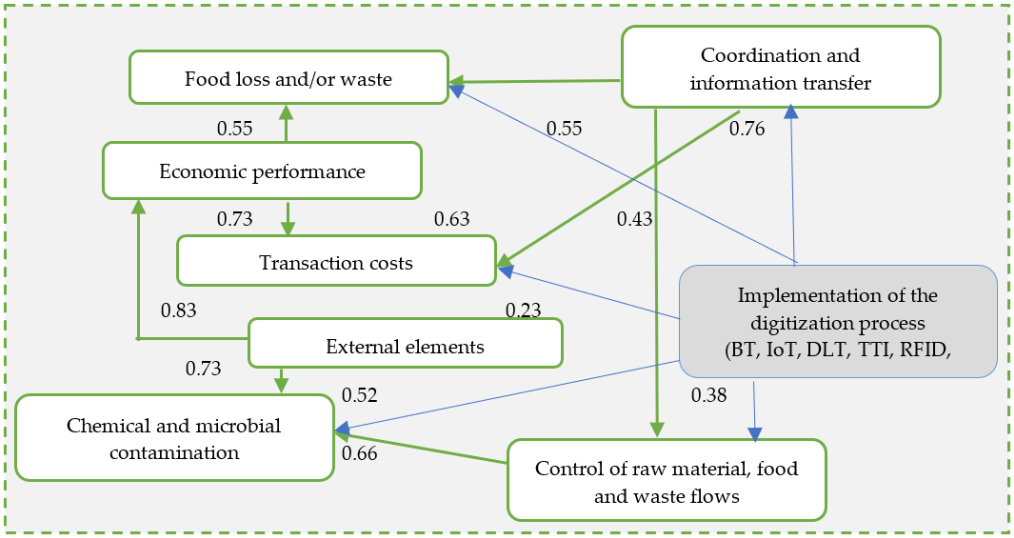

Figure 3. Structural model.

Table 7. Descriptive statistics.

Order No.	Indicators	Min.	Max.	Mean (M)	Standard Error (SE)	Standard Deviation (SD)
1	**2**	**3**	**4**	**5**	**6**	**7**
1	Digitalization of FSC in the segment of wholesale and retail activities	2.00	5.00	4.20	0.2167	0.8390

Source: Author's calculation.

Table 8. Path analysis.

Ord. No.	Path	Path Coefficient	*t* Value	Result
1	Digitalization » Sustainability and functionality of FSC	0.863	8.212	Support

Source: Author's calculation.

The result shows that the digitization of FSC, that is, the implementation of information technologies, location-based technologies, and sensor and identification technologies (BT, IoT, DLT, WSN, TTI, Barcode, RFID, RS, GPS, RTL, etc.), affects the sustainability and functionality of FSC in the segment of wholesale and retail activities. That confirms the third research hypothesis $\mathbf{H_3}$, that is, the growth of the intensity of the digitalization process and the greater inclusion of modern technologies in the business processes of the FSC directly reflects on the sustainability, transparency, and functioning of the FSC. The direction of influence is quite clear and simple (Figure 4).

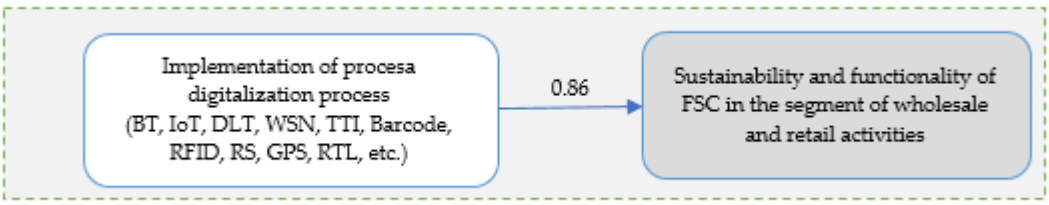

Figure 4. Structural model.

5. Discussion

The results of the conducted research show that various indicators, called critical indicators in the literature, significantly influence the sustainability and functionality of FSC in the segment of wholesale and retail activities. The research confirmed the results of previous studies that inadequate exchange of data and information [1,2,4,5,7,8,11], failures in the control of flows of raw materials, food, and waste [15–17,27,28], external factors [3,4,9,23], economic challenges [15,22], food loss and waste [19,20], and the lack of digitalization and standardization of business processes are the most critical challenges for FSC sustainability, primarily in the segment of wholesale and retail activities [11–13]. The introduction of modern technological solutions such as information technologies (BT, IoT, DLT, etc.), sensor and identification technologies (WSN, TTI, Barcode, RFID, etc.), location-based technologies (RS, GPS, RTLS, etc.), Internet technology (web applications), etc., significantly minimizes the negative impacts of critical indicators. It eliminates their negative effects and, with complete digitalization, turns them into positive inputs that contribute to the efficient functioning of the FSC. The findings of the study confirm the results of recent research. Kittipanya-Ngam and Tan conclude that digitalization enables food supply chains to be flexible, highly connected, and efficient, responding on time to customer needs and regulatory requirements [32]. Annosi, Brunetta, Bimbo, and Kostoula point out that FSCs are increasingly relying on advanced technological solutions for big data management to encourage collaboration along the entire supply chain and improve its business performance, especially in the segment of waste, food recovery, losses, et cetera [33]. Similarly, the conclusions of the Amentae and Gebresenbet study show that the implementation of digital technologies such as blockchain, IoT, big data analytics, artificial intelligence (AI), and related IT and communication technologies enable greater traceability, sustainability, and resistance of FSC to crises and unexpected market fluctuations on one hand and the reduction of waste, losses, and wastage of food on the other [34]. In addition, the study of Michel-Villarreal, Vilalta-Perdomo, Canavari, and Hingley testifies to the great importance of the digitalization process, which points out that even cheap digital technologies such as free software and social media significantly support the flexibility, visibility, collaboration, and agility of the FSC [35]. Bearing in mind these aspects, it is necessary to propose measures and incentives so that the FSC management effectively digitalizes its business processes and activities, minimizes the negative effects of critical indicators, and increases the functionality and transparency of the food market. The proposed measures can be divided into two groups: economic and financial measures and incentives; organizational and technical measures.

Economic and financial measures and incentives—The introduction of modern technological solutions requires significant investments, including investments in equipment and infrastructure [28]. Chambers of commerce, relevant ministries, secretariats and institutions, business associations, commercial banks, etc., should help all FSC participants to feel economically secure, reduce the financial risks of investing in digitalization processes, and, at the same time, provide the necessary funds (incentives, loans, co-financing, joint ventures, etc.) to transform their business activities. This implies a whole range of measures and incentives such as (a) direct investments for FSCs that digitize their business processes; (b) credit relief for the purchase of modern IT equipment; (c) special credit lines for the implementation of advanced technology (longer repayment period, low interest rates); (d) the possibility of paying for equipment on a deferred basis; (e) tax benefits such as reductions in income tax, property tax, etc., for the most vulnerable FSC participants (small agricultural producers and processors, independent transporters and retailers); (f) incentive measures for participation in programs for co-financing the development of information infrastructure (e.g., IPA EU funds and national funds); (g) exemption from VAT on devices and equipment for the implementation of modern information technologies, etc.

Organizational and technical measures—These aim at training FSC employees for the effective application of advanced technology on one hand and building and developing an adequate infrastructure capable of accepting a new business model on the other [30]. In the

segment of human resources, these measures include the implementation of special courses and training programs for employees who work with new technologies, encouraging the retraining of employees in the IT sector, subsidies for FSC participants who employ workers to work with modern technologies, strengthening the concept of lifelong learning, organizing seminars, conferences, and counseling centers as forms of additional education for employees, etc. These measures should be encouraged by FSC managers based on the transfer of knowledge and experience from systems that have already integrated advanced technologies into their business processes. When it comes to infrastructure, in the segment of wholesale and retail activities, the following technical measures must be taken: (1) introduction of blockchain technology and implementation of big data analytics (BDA); (2) introduction of modern IT solutions for more efficient monitoring of processes, products, and services (TT indicators, RFID, biosensors, and IoT); (3) implementation of clear standards, measures, supervision, and procedures for digitalization of business processes; (4) strengthening the system for electronic food placement (e.g., electronic ordering and food delivery) and increasing its participation to a minimum of 15–20% in total placement; (5) transition from traditional to new processes, electronic stores, etc.

Only with the full implementation of the recommended measures and incentives is it possible to influence the FSC's management to start implementing the digitalization process. Bearing in mind that the geopolitical situation is changing drastically on the global market, that food prices have started to rise rapidly, and that in some places, food shortage is already felt, only through the application of advanced technologies will the FSC be able to effectively perform its primary function, which entails the continuous supply of food products to the market. All of the above measures, if applied, will enable the FSC to meet the basic needs of the market in a timely and efficient manner; that is, it will make the supply chain more flexible, and the final consumers will be more satisfied and more confident in the quality and safety of food. The assumption is that only those FSC participants who digitize their business processes in time and adapt to the new business reality will succeed.

Shortcomings of research. During the work on this study, several shortcomings were identified that do not diminish the quality of the results obtained and the confirmed findings but that should be mentioned to marginalize them in subsequent research. First of all, the research dealt exclusively with the segment of wholesale and retail activities. The reasons for the selection of this part of the FSC are the author's familiarity with the problems of distribution, wholesale, and retail, as well as the excessive scope of research, which, if producers and processors were involved, would require significant investments in financial and personnel terms. Next, the research focused on the region of the western Balkans. The objective reason for this geographical limitation is the author's familiarity with the ways and problems in the functioning of regional FSCs as well as easier access to data. Second, a large number of unfilled questionnaires (return rate 33.7%) is noticeable, which speaks of insufficient promotion and explanation of the need to conduct such a survey among FSC employees. Thirdly, the structure of the questionnaire consisted mostly of questions with pre-given answers (Likert-type items) that might have misled respondents to give certain attitudes and answers. It is recommended that a larger number of open questions be included in subsequent examinations.

Guidelines for future research. As the most important suggestions for future research, we recommend the following: (1) include FSCs from the region of southeast and/or central Europe in the research sample and make a comparison of the impact of critical indicators and digitization processes on the sustainability of the FSC between EU and non-EU countries; (2) include all FSC participants in the research, primarily processors, producers, agricultural holdings, etc.; (3) expand the number of respondents in the survey sample to include administrative workers, workers in warehouses, transportation, workers in retail, etc.; (4) expand the questionnaire with a larger number of open-ended questions where respondents are expected to enter the answers themselves; (5) expand analysis and

testing to a larger number of critical indicators, or examine their subcategories in more detail within the existing indicators.

6. Conclusions

The results of the research and the testing of the set hypotheses showed that there are indicators that can have significant negative effects on the sustainability and functionality of the FSC in the segment of wholesale and retail activities. These are, in descending order of impact, the coordination and transfer of information (r = 0.861), economic performance (r = 0.628), external elements (r = 0.801), chemical and microbial contamination (r = 0.420), and control of flows of raw materials, food, and waste (r = 0.266). In addition, this research proved that the digitization process significantly affects critical indicators, except for external factors. The results showed that digitization of the FSC in the segment of wholesale and retail activities minimizes negative effects and improves the coordination and transfer of information (r = 0.758), food loss and/or waste (r = 0.426), chemical and microbial contamination (r = 0.517), transaction costs (r = 0.228), and control of flows of raw materials, food, and waste (r = 0.376). Thereby, the digitalization process directly contributes (r = 0.863) to greater sustainability and flexibility within the FSC. This answered the research question in that. through the implementation of the digitization process and the application of modern technologies based on IoT, BT, DLT, TTI, RFID, etc., the challenges of food placement can be eliminated, and the FSC can be made more flexible. Based on the findings of this study, this paper proposes a whole set of economic, financial, organizational, and technical measures and incentives that should be applied by FSC management in the segment of wholesale and retail activities to effectively digitize its business processes, minimize the negative effects of critical indicators, and increase the functionality and transparency of the food market.

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References

1. NegruÈ, C. Digital transformation and sustainable entreprenuership in Food Supply Chain. *Bus. Excell. Manag.* **2022**, *12*, 46–54. [CrossRef]
2. Bancal, V.; Ray, R.C. Overview of Food Loss and Waste in Fruits and Vegetables: From Issue to Resources. In *Fruits and Vegetable Wastes*; Ray, R.C., Ed.; Springer: Singapore, 2022; pp. 3–29. [CrossRef]
3. Wang, Q.; Zhang, M.; Li, R. Bridging the research-practice gap in supply chain risks induced by the COVID-19. *Benchmarking Int. J.* **2022**. [CrossRef]
4. Rizou, M.; Galanakis, I.M.; Aldawoud, T.M.; Galanakis, C.M. Safety of foods, food supply chain and environment within the COVID-19 pandemic. *Trends Food Sci. Technol.* **2020**, *102*, 293–299. [CrossRef]
5. Thilmany, D.; Canales, E.; Low, S.A.; Boys, K. Local food supply chain dynamics and resilience during COVID-19. *Applied Economic Perspectives and Policy* **2021**, *43*, 86–104. [CrossRef]
6. Karimi, F. Safety of Food throughout the Supply Chain. *Logist. Eng.* 2022.
7. Aung, M.M.; Chang, Y.S. Traceability in a food supply chain: Safety and quality perspectives. *Food Control* **2014**, *39*, 172–184. [CrossRef]
8. Angarita-Zapata, J.S.; Alonso-Vicario, A.; Masegosa, A.D.; Legarda, J. A taxonomy of food supply chain problems from a computational intelligence perspective. *Sensors* **2021**, *21*, 6910. [CrossRef]
9. Murphy, A.; Bozorgmehr, K.; Habicht, T.; Bogdanov, S.; Perone, S.A. 7. B. Workshop: Labor migration, the food supply chain and the COVID-19 syndemic: Germany, Netherlands, and the USA. *Eur. J. Public Health* **2022**, *32*, 3.

10. Li, J.; Song, Z. Dynamic Impacts of External Uncertainties on the Stability of the Food Supply Chain: Evidence from China. *Foods* **2022**, *11*, 2552. [CrossRef]
11. Talal, M.; Kazmi, R.; Joyia, G.J.; Naz, T. Improving Traceability Using Blockchain and Internet of Things (IoT) in the Food Supply Chain. In *International Conference on Engineering Software for Modern Challenges*; Springer: Cham, Germany, 2021; pp. 16–25. [CrossRef]
12. Naz, T. Improving Traceability Using Blockchain and Internet of Things (IoT) in the Food Supply Chain. In *Engineering Software for Modern Challenges: First International Conference, ESMoC 2021, Johor, Malaysia, October 20–21, 2021, Revised Selected Papers*; Springer Nature: Berlin/Heidelberg, Germany, 2021; p. 16.
13. Zhao, G.; Liu, S.; Lopez, C.; Lu, H.; Elgueta, S.; Chen, H.; Boshkoska, B.M. Blockchain technology in agri-food value chain management: A synthesis of applications, challenges and future research directions. *Comput. Ind.* **2019**, *109*, 83–99. [CrossRef]
14. Abate-Kassa, G.; Peterson, H.C. Market access for local food through the conventional food supply chain. *Int. Food Agribus. Manag. Rev.* **2011**, *14*, 63–82. [CrossRef]
15. Patidar, R.; Agrawal, S. A mathematical model formulation to design a traditional Indian agri-fresh food supply chain: A case study problem. *Benchmarking: Int. J.* **2020**, *27*, 2341–2363. [CrossRef]
16. Gokarn, S.; Kuthambalayan, T.S. Creating sustainable fresh produce supply chains by managing uncertainties. *J. Clean. Prod.* **2019**, *207*, 908–919. [CrossRef]
17. Raut, R.D.; Gardas, B.B.; Kharat, M.; Narkhede, B. Modeling the drivers of post-harvest losses-MCDM approach. *Comput. Electron. Agric.* **2018**, *154*, 426–433. [CrossRef]
18. Ciccullo, F.; Cagliano, R.; Bartezzaghi, G.; Perego, A. Implementing the circular economy paradigm in the agri-food supply chain: The role of food waste prevention technologies. *Resour. Conserv. Recycl.* **2021**, *164*, 105114. [CrossRef]
19. Rezaei, M.; Liu, B. Food loss and waste in the food supply chain. *Int. Nut. Dried Fruit Counc. Reus* **2017**, *7*, 26–27. Available online: https://www.fao.org/3/bt300e/BT300E.pdf (accessed on 25 November 2022).
20. Lemma, Y.; Kitaw, D.; Gatew, G. Loss in perishable food supply chain: An optimization approach literature review. *Int. J. Sci. Eng. Res.* **2014**, *5*, 302–311.
21. Xiao, Y.; Watson, M. Guidance on Conducting a Systematic Literature Review. *J. Plan. Educ. Res.* **2019**, *39*, 93–112. [CrossRef]
22. Parker, M. Global Inflation: The Role of Food, Housing and Energy Prices. *ECB Work Pap.* 2017. Available online: https://ideas.repec.org/p/ecb/ecbwps/20172024.html (accessed on 30 November 2022).
23. Limonova, E.M. Consequences of Russia's invasion on Ukrainian territory for the world food and energy market. *o Bo oooo o* **2022**, *1*, 1–2. [CrossRef]
24. Montgomery, H.; Haughey, S.A.; Elliott, C.T. Recent food safety and fraud issues within the dairy supply chain (2015–2019). *Glob. Food Secur.* **2020**, *26*, 100447. [CrossRef]
25. Wang, J.; Yue, H. Food safety pre-warning system based on data mining for a sustainable food supply chain. *Food Control* **2017**, *73*, 223–229. [CrossRef]
26. Pearson, S.; May, D.; Leontidis, G.; Swainson, M.; Brewer, S.; Bidaut, L.; Zisman, A. Are distributed ledger technologies the panacea for food traceability? *Glob. Food Secur.* **2019**, *20*, 145–149. [CrossRef]
27. Sufiyan, M.; Haleem, A.; Khan, S.; Khan, M.I. Analysing attributes of food supply chain management: A comparative study. In *Advances in Industrial and Production Engineering*; Shanker, K., Shankar, R., Sindhwani, R., Eds.; Springer: Singapore, 2019; pp. 515–523. [CrossRef]
28. Rejeb, A.; Rejeb, K.; Appolloni, A.; Iranmanesh, M.; Treiblmaier, H.; Jagtap, S. Exploring Food Supply Chain Trends in the COVID-19 Era: A Bibliometric Review. *Sustainability* **2022**, *14*, 12437. [CrossRef]
29. Ortiz-Barrios, M.; Miranda-De la Hoz, C.; López-Meza, P.; Petrillo, A.; De Felice, F. A case of food supply chain management with AHP, DEMATEL, and TOPSIS. *J. Multi-Criteria Decis. Anal.* **2020**, *27*, 104–128. [CrossRef]
30. Casino, F.; Dasaklis, T.K.; Patsakis, C. Enhanced Vendor-managed Inventory through Blockchain. In Proceedings of the 2019 4th South-East Europe Design Automation, Computer Engineering, Computer Networks and Social Media Conference (SEEDA-CECNSM), Piraeus, Greece, 20–22 September 2019; pp. 1–8. [CrossRef]
31. Wahbeh, S.; Anastasiadis, F.; Sundarakani, B.; Manikas, I. Exploration of Food Security Challenges towards More Sustainable Food Production: A Systematic Literature Review of the Major Drivers and Policies. *Foods* **2022**, *11*, 3804. [CrossRef] [PubMed]
32. Kittipanya-Ngam, P.; Tan, K.H. A framework for food supply chain digitalization: Lessons from Thailand. *Prod. Plan. Control* **2020**, *31*, 158–172. [CrossRef]
33. Annosi, M.C.; Brunetta, F.; Bimbo, F.; Kostoula, M. Digitalization within food supply chains to prevent food waste. Drivers, barriers and collaboration practices. *Ind. Mark. Manag.* **2021**, *93*, 208–220. [CrossRef]
34. Amentae, T.K.; Gebresenbet, G. Digitalization and future agro-food supply chain management: A literature-based implications. *Sustainability* **2021**, *13*, 12181. [CrossRef]
35. Michel-Villarreal, R.; Vilalta-Perdomo, E.L.; Canavari, M.; Hingley, M. Resilience and digitalization in short food supply chains: A case study approach. *Sustainability* **2021**, *13*, 5913. [CrossRef]

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Sustainability in Logistics Service Quality: Evidence from Agri-Food Supply Chain in Ukraine

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Abstract: The purpose of this paper is to explore which attributes of logistics service quality (LSQ) are associated with the superior LSQ in rural territories of the developing economy of Ukraine. The data were collected from 52 Ukrainian agrarian companies. Ukraine was chosen because of the high potential of its agricultural sector, which has been one of the world's largest exporters of agricultural goods for years. This paper investigates LSQ from the perspective of agri-businesses and addresses sustainability. The primary data were obtained in a survey of clustered samples of agri-businesses in rural Ukraine. An exploratory factor analysis (EFA) was conducted with the Stata 16 software to test one hypothesis. This study builds on the expectancy–disconfirmation paradigm in service management research and the related service quality in order to compare the perceived and expected quality of social and environmental sustainability-related aspects of LSQ to test two hypotheses. The findings revealed that service quality in agricultural logistics is a five-dimensional construct. Its five dimensions are reliability, digital transformation, corporate image, environmental sustainability, and quality of customer focus. Furthermore, the study delivers evidence that the perceived and expected quality of the social sustainability-related aspects of LSQ are substantially different. As the study's data collection process was interrupted by the Russian–Ukrainian war, the proposed model was only tested with 52 enterprises in an agri-food supply chain in rural Ukraine. Such a small sample is one of the study's limitations. The research has great managerial implications as managers can use the explored attributes as a basis for customer satisfaction analyses or benchmarking in agricultural logistics. This is the first work exploring LSQ in rural Ukraine. The major contributions of this paper are the explored dimensions of LSQ with EFA. The study presents the first and most current data about LSQ from four united territorial communities in the rural center of Ukraine.

Keywords: logistics service quality; Ukraine; agricultural logistics; agri-food supply chain

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1. Introduction

For most of the past decade, the world has been consuming more food than it has been producing it, and the impacts of COVID-19 have further increased global food insecurity [1]. These further enhanced the importance of reliable and efficient logistics. Logistics is an essential part of "agri-business" [2] (p. 2) and agri-food supply chains, and it plays a crucial role in decreasing costs, achieving time reductions, increasing value co-creation and flexibility, as well as securing competitive abilities. Ramos et al. [3] proposed twelve factors in the context of a system for measuring the agri-food supply chains' performance in a developing country: planning, supplier performance, finance, production, demand, inventory, transportation, warehousing, flexibility, quality, innovation, and customer service. This paper answers their call for an in-depth investigation of the metrics related to the different aspects of LSQ.

Other studies in the evolving research field of agricultural supply chains [4] propose breaking down logistics into logistics infrastructure and organization [5] or planning of logistics operations [6] without a concrete proposal for how to measure shippers' expectations. Thus, with the exception of halal food [7], studying logistics in agri-food supply

chain settings lacks the customer perspective. This paper aims to fill this research gap with some evidence from an emerging economy.

Following the International Monetary Fund's classification [8] (pp. 89–92), many recent research publications discuss LSQ in the so-called advanced economies [9–12] or in emerging markets or economies in transition in Asia [13–20], while only a few focus on LSQ in Latin America [21] or Europe [22]. This publication fills the gap about expectations and levels of logistics quality in emerging and developing European economies, collecting evidence in rural Ukraine.

Ukraine has been the world's leading exporter of sunflower oil for many years and one of the leading global exporters of grains such as corn, wheat, barley, and sunflower seeds [23]. The success of its agriculture sector is highly dependent on transportation systems and logistics competence. A poor transportation system and the absence of storage facilities are some of the challenges hampering agri-food supply chains. Logistics competence and improving logistics infrastructure can improve the agricultural supply chain. Hence, this paper focuses on agri-logistics and is based on empirical data, collected from agri-businesses in the geographical center of the country. To the best of the author's knowledge, there are no publications on LSQ in rural Ukraine.

In filling the above-mentioned gaps, this paper focuses on the development of metrics on logistics-related factors in the agri-food supply chain and collects evidence about expectations and levels of logistics quality, thus adding to the scant literature on emerging and developing European economies. Last but not least, this paper investigates LSQ from the perspective of agri-businesses using scales that address sustainability.

This paper aims to test the pre-defined conceptual model of the dimensions of LSQ in the agri-food supply chain in the developing economy of Ukraine and to test whether there is a substantial difference between the expected and perceived factors affecting LSQ with regard to social and environmental sustainability.

The paper is structured as follows: The introduction is given in Section 1. The statistical methodology, hypotheses, sample profile, and data collection are outlined in Section 2. Section 3 encompasses a literature review and the conceptual model. Analysis and discussion are given in Section 4. The paper is rounded off with conclusions in Section 5.

2. Method

2.1. Statistical Methodology and Hypotheses

This study builds on the expectancy–disconfirmation paradigm in service management research and the related service quality (SERVQUAL) approach. There are numerous studies on the approaches such as SERVQUAL [24], SERVPERF [25], or the Kano model [26] with scales and dimensions to assess LSQ in particular, largely contributed by Bienstock et al. [27] and Mentzer et al. [28] and further revised by other scholars (for example, [29–31]). Compared with the existing literature on LSQ, this study builds on the expectancy–disconfirmation paradigm [32] and proposes a model of LSQ similar to the research conducted by Thai [33]. The pre-defined conceptual model consists of six dimensions and 26 explanatory attributes: quality or reliability of customer focus, digital transformation, physical distribution service quality, corporate image, sustainability, and timeliness.

In order to examine which measures can describe and quantify LSQ in Ukraine's developing economy, the pre-defined factor structure will be re-explored with EFA to test the proposed allocation of explanatory attributes to six dimensions:

H1: *Quality of logistics service is a construct of 26 identified attributes associated with the six dimensions of reliability, digital transformation, physical distribution quality, corporate image, sustainability, and timeliness.*

According to SERVQUAL, LSQ can be measured as the difference between customers' expectations and customers' perceptions of the received service. For this purpose, respondents were asked to select on a 5-point Likert scale the perceived level and their expected

level for LSQ based on 26 attribute-related statements in accordance with the pre-defined conceptual model. The comparison of perceived and expected quality for each attribute shows the need for improvement with regard to that attribute and tests the following hypothesis:

H2: *There is a substantial difference between the expected and perceived social attributes of LSQ.*

H3: *There is a substantial difference between the expected and perceived environmental attributes of LSQ.*

2.2. Sample Profile and Data Collection

The data for this study to measure LSQ attributes were collected from agricultural enterprises in four united territorial communities (UTCs) in the Uman district of the Cherkassy region in Ukraine from 1–23 February 2022. The UTCs were established as a result of adopting the law on the voluntary association of territorial communities in 2015. This law granted UTCs the same power as cities of regional significance and improved their budget allocation in proportion to their area and population. Table 1 shows some general information about these UTCs and the sample profile for each UTC. In all UTCs, the share of agricultural land is high and the economy of all four UTCs has an agrarian specialization. As Table 1 shows, the entire population of agricultural enterprises equals 205 companies. Initially, 119 enterprises were selected randomly with a comparable share of farms to the total agri-businesses in each UTC.

Table 1. Determined sample frame of enterprises in four rural UTCs.

United Territorial Community (UTC)	Mankivka	Ladyzhynka	Palanka	Dmytrushky
Year established	2020	2018	2017	2019
Number of settlements	19	11	18	12
Area, km^2	478,234	322,955	488,497	309,698
Agricultural land, %	92.1	83.3	76.1	77.8
Number of agricultural enterprises (surveyed, %)	106 (7)	23 (16)	44 (21)	32 (8)
Farms, % (surveyed, %)	90 (71)	57 (63)	64 (39)	69 (50)

Source: Author's desk research [34–36] (pp. 6, 8), [37] (pp. 12, 14).

In three of the four UTCs, the share of farms in the sample is half or higher. Respondents were asked to complete the survey questionnaire per email. They were not motivated by any rewards for completing the survey. The respondents' profile is shown in Table 2: 50% of respondents are farms. A high share of farms (67%) is typical for the agricultural enterprises in Ukraine at the national level [38]. The analysis of responses showed that 63.5% of respondents' companies has fewer than 50 workers.

The questionnaire was written in Ukrainian. The translation into Ukrainian was amended by Ukrainian experts. Some rewordings of logistics-related terms and outsourcing-related services took place. Finally, the heads of four communities were invited to give their suggestions. The questionnaire with an introductory letter employed closed questions and was rounded off with instructions for a structured interview (in case a company was selected for an in-depth interview).

Table 2. Respondents' profile.

Category	Responses	Frequency	%	Cumulative %
Firm type				
	Farm	26	50.0	50.0
	Limited Liability Company	15	28.8	78.8
	Private enterprise	8	15.4	94.2
	Production cooperative	1	1.9	96.2
	Others	2	3.8	100.0
Position	Executive	30	57.7	57.7
	Management	22	42.3	100.0
	Firm size			
Firm size	≤50	33	63.5	63.5
	51–100	14	26.9	90.4
	101–500	5	9.6	100.0

Some respondents were contacted by email and invited for an in-depth structured interview. Three weeks after sending the first mail, a reminder was not possible because of the Russian aggression with projectiles hitting Uman. The beginning of the war was defined as the cut-off date. The survey resulted in 32 responses over a period of three weeks. Thus, the response rate was around 27% (119 contacted enterprises/32 completed questionnaires). In parallel, 20 in-depth structured interviews took place. The qualitative data collected using structured interviews helped to triangulate quantitative data collected with a questionnaire in order to gain a better understanding of a typical agri-food supply chain and the characteristics of its logistics. This kind of triangulation is known as "between (or across) methods" for cross-validation when two distinct methods are found to be congruent and yield comparable data [39]. The overall response rate of the population contacted per email and interviewed personally equals 43.7%. In order to increase the response rate [40], the local university's support for the survey was gained, and UTCs' and settlements' heads. These organizations are familiar to the population (e.g., their former university or their local head). Furthermore, the cover letter was personalized and appealing, giving an optional possibility to receive a report on the study's results.

3. Literature Review and Conceptual Model

Recent literature reviews on the published works on LSQ have been conducted by Michalski and Montes-Botella [21] and Arabelen and Kaya [9]. Siddh et al. [41] investigated the LSQ of an agri-food supply chain. The pre-defined conceptual model consists of six dimensions and 26 explanatory variables as shown in Table 3. The six dimensions are quality or reliability of customer focus (REL1–REL4), digital transformation (DIG5–DIG8), physical distribution service quality (DSQ9–DSQ13), corporate image (COR14–COR17), sustainability (SUS18–SUS23), and timeliness (TIM24–TIM26). The description of each dimension will be given below.

To measure the quality or reliability of customer focus, the research uses the original SERVQUAL questionnaire. This group of attributes is necessary for focusing on customers in addition to the focus on the attributes of the service itself, as it was proposed in the original questionnaire. These attributes reduce the risk of emphasizing logistics attributes that might not be consistent with what customers really value [21,42,43].

Table 3. A pre-defined conceptual model of LSQ.

Factor	Variable	Measurement
Quality/reliability of customer focus [21,42,43]	REL1	When logistics company/department promises to do something within a certain period of time, it fulfills the promise.
	REL2	When a customer has a problem, logistics company/department shows a sincere interest in solving the problem.
	REL3	Logistics company/department provides the adequate services from the first time onwards.
	REL4	Logistics company/department insists on flawless service.
Digital transformation [27,33]	DIG5	Logistics company/department applies IT and electronic data interchange (EDI) in customer service.
	DIG6	Logistics company/department applies innovative IT in customer service.
	DIG7	Logistics company/department uses IT to make order information available.
	DIG8	Logistics company/department is capable of tracing shipments using IT.
Physical distribution service quality [27,33,44]	DSQ9	Logistics company/department uses modern logistics equipment and facilities.
	DSQ10	Logistics company/department delivers at proper place.
	DSQ11	Logistics company/department delivers at proper time.
	DSQ12	Logistics company/department delivers intact and without loss or damage.
	DSQ13	Logistics company/department has an error-free documentation.
Corporate image [33,45]	COR14	Logistics company/department has a reputation for reliability in the market.
	COR15	Logistics company/department has a record of professionalism and consistency in satisfying customers.
	COR16	Logistics company/department has a reputation for matching words with actions.
	COR17	Logistics company/department pays attention to its ethical image.
Sustainability [31,46]	SUS18	Logistics company/department is engaged in community activities.
	SUS19	Logistics company/department has a performance statement and a vision for community responsibility.
	SUS20	Logistics company's/department's behavior is socially responsible and concerned about human safety.
	SUS21	Logistics company/department fulfills logistics with minimal environmental pollution.
	SUS22	Operations of logistics company/department are environmentally safe.
	SUS23	Logistics company/department offers training to employees.
Timeliness [33,47]	TIM24	Logistics company/department picks up and delivers on time.
	TIM25	Logistics company/department delivers within a proper transportation time.
	TIM26	Logistics company/department provides services at the promised time.

The digital transformation factor aligns with the general definition of digitalization. It commonly encompasses two components: digital implementation of communication and digital conversion of data. Both components are considered to be important for integrating information flows between supply chain stages using particular technologies such as RFID [48], cloud-based solutions such as e-platforms [49], standards such as Electronic Data Interchange (EDI) for Administration, E-Commerce and Transport (EDIFACT), and capabilities to follow the path or current location of a delivery from the starting point to wherever the object currently is in real time. The latter can significantly influence satisfaction as Gil Saura et al. [47] showed in their investigation of the perception of LSQ among 194 Spanish manufacturing companies in a supply chain with high levels of ICT. Furthermore, the use of information and communication technologies (ICT) maximizes farmers' profit and minimizes the product price for consumers [50]. Previous research has shown that the quality of information sharing affects the supply chain food quality performance [51] and that the level of digital transformation is an important competence for coping with dynamic business environments such as COVID-19 [52].

Physical distribution service quality addresses physically observable operational attributes, composed of aspects relating to timeliness, availability, and condition [44]. A favorable and attractive corporate image is central in Grönroos's [45] service quality model. As proposed by Thai [33], it relates to the customers' overall perception of logistics service providers (LSPs) as the company's reputation for reliability in the market, its professionalism and consistency in satisfying customers, its reputation, and its ethical image.

The sustainability factor addresses the social and environmental criteria. A comparison of six reporting initiatives on sustainability [46] shows that efficient use of resources and climate change mitigation are most frequently included in the environmental dimension. The proposed model does not encompass measures for the economic dimension, but environmentally friendly supply chain practices are relevant to the operational and financial performance, as the analysis of 232 LSPs shows [53]. Social sustainability is measured through labor practices in all six initiatives [46] such as employees' training and human safety, and social responsibility. Furthermore, engagement in community activities, the availability of a performance statement, and a vision for community responsibility address the stakeholder concept [31] and round off the sustainability factor.

The timeliness factor encompasses three time-related issues including timeliness of shipment pickup and delivery, transportation time, and the reliability of the total order cycle time. The timeliness factor is the most significant dimension for LSQ in many logistics studies [33,47].

4. Analysis and Discussion

First, the dataset was checked for nonsensical answers. For this purpose, two additional statements, 27 and 28, were included to the category "Perceived level of logistics services": "Logistics company/department does not use IT to provide order information" and "Operations of logistics company/department are not environmentally safe". These variables were reverse-coded to be compared with statements DIG7 and SUS22 from Table 3. A closer review of the two pairs of reverse-coded factors revealed no nonsensical answers.

In order to detect the existence of non-response bias, two techniques were used: extrapolation [54] and a comparison of respondents' characteristics known a priori with those of the population [55]. In order to determine the probable direction of bias, the last five returns were compared with the first five returns, assuming that late respondents are most similar to non-respondents because their replies took longest. The answers of the earliest five returns did not differ substantially from those of the latest five returns. Furthermore, respondents' characteristics such as shares of specialization types or shares of the organizational and legal form of ownership did not differ considerably from those of the population. Thus, it is assumed that non-response bias is unlikely to be an issue in the study.

In order to examine which measures can describe and measure LSQ in the developing economy of Ukraine, the factor structure was viewed using Varimax rotation with a Kaiser normalization approach. The initial correlation matrix was singular following the Bartlett's test of sphericity and Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy because mean values of several variables were in the high 4 to 5 range and almost perfectly correlated with each other. Having extracted these variables from the model, the KMO measure (0.6496) was greater than the minimum value of 0.60 normally suggested by Hair et al. [56].

The last run of EFA on the 22 measurement variables identified five factors with eigenvalues above 1. As Table 4 shows, these five factors explained 96.15 % of the variance. Three measurement variables were excluded because all respondents stated the same expectation level (5.0) for logistics service regarding these criteria (DSQ10, DSQ12, and DSQ13). For the first run of the factor analysis, one variable (TIM24—pick-up and delivery on time) does not load highly (>0.3) on any of the identified factors. This variable was excluded from the existing measurement scale. Table 4 shows a rotated orthogonal varimax component matrix which demonstrates how each variable item is loaded on each of the factors.

Table 4. General perception of LSQ by agricultural enterprises.

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
REL1	0.9984				
REL2	0.9984				
REL3	0.6861				0.7231
REL4	0.9984				
DIG5		0.9027			
DIG6		0.8547			
DIG7		0.8861			
DIG8		0.8031			
DSQ9		0.6740			
DSQ11	0.9984				
COR14	0.3186		0.4261		
COR15			0.4907		
COR16					0.9944
COR17			0.7802		
SUS18			0.8083		
SUS19			0.8059		
SUS20			0.6748	0.3960	
SUS21				0.9065	
SUS22				0.9012	
SUS23			0.5261	0.4264	
TIM25	0.9984				
TIM26	0.9984				
AVE	0.99	0.686	0.44	0.82	0.76
CR	0.99	0.92	0.84	0.9	0.86
Eigenvalue	6.8584	4.8008	3.1073	1.5822	1.1711
Cumulative variance	0.3764	0.6399	0.8104	0.8972	0.9615

Source: Author's illustration. Note: blanks represent abs loading <3.

Composite reliability (CR) and average variance extracted (AVE) were assessed to check the reliability of the model measurement. The internal reliability of all the observed variables in their measurement of each latent construct was assessed by CR, demonstrating that the observed variables have adequate internal consistency. A CR value of 0.6 or more was recommended by Fornell and Larcker [57] (p. 45). It could be concluded that all factors were based on reliably observed items with CR values in the range of 0.84–0.99, as can be seen in Table 4. Thus, the observed variables are adequate for representing the respective factors. AVE measures the amount of variance in the measured variables. It should be greater than 0.5 [57]. As depicted in Table 4, the AVE was only lower than 0.5 in Factor 3 (0.44). Nevertheless, it was accepted, because its composite reliability is greater than 0.6 and the convergent validity of the construct can be considered as adequate [57] (p. 46).

Factor 1 consists of six variables, namely, REL1 (staff's attitude and behavior to satisfy customers' needs), REL2 (responsiveness to customers' needs and requirements), REL4 (flawless service), DSQ11 (reliability of service (delivery at the proper time)), TIM25 (reliability of service (within a proper transportation time)), and TIM26 (reliability of service (at the promised time)). These last three variables belong to different factors in the pre-

defined model. Basically, these six measures in combination depict the reliability of LSQ. Factor 1 can be renamed "Reliability".

Factor 2 consists of five variables: DIG5 (application of IT and EDI in customer service), DIG6 (application of innovative IT in customer service), DIG7 (availability of order information using IT), DIG8 (shipment tracing using IT), and DSQ9 (availability and condition of equipment and facilities). The first four variables were initially assigned to "Digital transformation". Although the last variable is from "Physical distribution service quality", it also addresses the use of technologies in logistics operations relating to equipment and facilities. Thus, this factor keeps the original heading "Digital transformation".

There are seven variables loaded highly on Factor 3, namely, COR14 (company's reputation for reliability in the market), COR15 (record of professionalism and consistency in satisfying customers), COR17 (concerned about its ethical image), SUS18 (record of engagement in community activities), SUS19 (performance statement and vision for community responsibility), SUS20 (socially responsible behavior and concerns for human safety), and SUS23 (company offers employees training). Although half the variables belong to different factors in the initial model, they all indicate in one way or another the extent of a company's image as a reliable and professional partner, whether it is ethically responsible, and whether it is a caring employer and "a good company" in its community. The new dimension "Corporate social responsibility" should house these seven variables.

As Table 4 illustrates, Factor 4 includes two variables: SUS21 (logistics operations with minimal environmental pollution) and SUS22 (environmentally safe operations). Both variables were assigned to the dimension "Sustainability" in the initial conceptual model. These variables are the only two focusing on environmental sustainability and should be grouped to a new dimension "Environmental sustainability".

Finally, Factor 5 also encompasses two variables: REL2 (responsiveness to customers' needs and requirements) and COR16 (company's reputation for matching words with actions). In the initial conceptual model, the first variable was related to "Quality/reliability of customer focus", while the second variable belongs to "Corporate image". Their common ground is that they address the logistics company's efforts to understand customers' needs and requirements and satisfy them in a trustable and reliable way. Factor 5 is therefore named "Quality of customer focus".

Thus, the EFA results show a different number of dimensions (five instead of six) and a different allocation of explanatory attributes for LSQ in the developing economy of Ukraine. H1 is not supported. Nevertheless, the EFA shows that LSQ is a construct of 22 explanatory attributes which were partly re-assigned to the following five dimensions: reliability, digital transformation, corporate social responsibility, environmental sustainability, and quality of customer focus.

Finally, in order to test whether there is a substantial difference between the expected and perceived quality of logistics service, the mean score of respondents' answers about the expected level of sustainability-related LSQ attributes was compared with the mean score of respondents' answers about their perceived level of sustainability-related LSQ attributes. For this purpose, seven explanatory variables for the explored dimension "Corporate social responsibility" and two explanatory variables for the explored dimension "Environmental sustainability" were considered from the EFA results gained in the previous step. Mean score differences and their rank in the total list of 22 attributes are shown in Table 5. The lower the difference in mean scores, the higher the respondents' satisfaction. In other words, any positive difference in the mean scores indicates that the expectation is higher than the perceived level of the particular factor for LSQ on the one hand, and that a respective improvement will better match respondents' expectation level on the other hand.

Table 5. Difference between expected and perceived level of sustainability-related LSQ factors.

Variable	Factors for Corporate Social Responsibility	Expected, Average Mean	Perceived, Average Mean	Mean Score Difference	Rank
SUS20	Logistics company's/department's behavior is socially responsible and concerned about human safety.	4.575	3.462	1.113	1
SUS19	Logistics company/department has a performance statement and a vision for community responsibility.	3.846	3.115	0.731	2
COR17	Logistics company/department pays attention to its ethical image.	4.577	3.865	0.712	3
SUS18	Logistics company/department is engaged in community activities.	3.712	3.269	0.443	11
COR15	Logistics company/department has a record of professionalism and consistency in satisfying customers.	4.885	4.462	0.423	14
COR14	Logistics company/department has a reputation for reliability in the market.	4.846	4.462	0.384	18
SUS23	Logistics company/department offers training to employees.	3.962	3.596	0.366	19
	Factors for environmental responsibility				
SUS22	Operations of logistics company/department are environmentally safe.	4.519	4.468	0.051	21
SUS21	Logistics company/department fulfills logistics with minimal environmental pollution.	4.462	4.468	−0.006	22

Source: Author's illustration.

The mean score differences of the attributes for corporate social responsibility show a substantial difference between expected and perceived quality. The average expectation level of the respective seven attributes in Table 5 was stated to be either absolutely essential or very important (average mean score from 4.885 to 3.712), but the perceived quality of these social sustainability attributes of LSQ was substantially lower. The social sustainability attributes of LSQ seem to be upgradable and important for satisfaction with LSQ. The top ranked attributes SUS20, SUS19, and SUS17 offer the greatest potential from all 22 attributes to increase satisfaction among agricultural enterprises in Ukraine. On this basis, it may be concluded that the findings provide support for hypothesis H2.

Environmentally safe operations (SUS22) and logistics operations with minimal environmental pollution (SUS21) were stated as absolutely essential (average mean score of 4.519 and 4.462, respectively) and the perceived quality was approximately the same or slightly higher than expected (average mean score of 4.468). Moreover, these two environmentally related attributes of LSQ are at the bottom of the ranked list, offering the smallest potential to further increase the extent of perceived quality. Thus, there is no substantial difference between the expected and perceived environmental-related attributes of logistics service quality. H3 is not supported.

5. Conclusions

This study relies on the expectancy–disconfirmation paradigm in service management research and the related service quality (SERVQUAL) approach. According to this approach, LSQ can be described by comparing customers' expectations with customers' perceptions of the service received. The pre-defined conceptual model of the attributes of LSQ which are associated with superior LSQ in rural Ukraine was explored with EFA as a construct comprising five dimensions and 22 attributes. Last but not least, this paper investigates LSQ from the perspective of agri-businesses using scales that address sustainability. Customers'

expectations in terms of social sustainability-related attributes of LSQ are substantially higher than customers' perceptions. Customers' perceptions of environmentally-related attributes of LSQ are comparable with their expectations.

This study fills the following research gaps: it explores the metrics of factors related to logistics in the agri-food supply chain and collects evidence about expectations and perceived levels of sustainability-related LSQ attributes in emerging and developing European economies, which have previously been underrepresented in the literature. It delivers evidence about LSQ previously not given in the literature.

The findings support those of other studies that consider the factor of reliability as one of most important dimensions of LSQ [11], either in a developing country [18,20] or in Europe [22], as well as the quality of customer focus in an emerging logistics industry as a further important dimension of LSQ [13,16,21]. Moreover, this study delivers evidence that the emphasis on environmental and social sustainability in logistics operations is becoming more significant than found in previous research by Thai [33].

Logistics operations managers can use the explored attributes for evaluating their service quality and also for benchmarking or a gap analysis regarding their most important competitors in Ukraine. Furthermore, logistics operations managers should focus on the reliability and quality of their customer focus since these dimensions are considered to be most critical to increasing perceived LSQ. The expectations for corporate social responsibility are substantially higher than the perceived levels and that is why it is expandable. Factors such as social responsibility and human safety (SUS20), performance statement and a vision for community responsibility (SUS19), and ethical image (SUS17) offer the greatest potential among all 22 attributes to increase satisfaction among agricultural enterprises in Ukraine.

The validity and reliability of the proposed attributes can be further tested in the context of other emerging European economies. The role of LSQ can be tested at a different stage of an agri-food supply chain, e.g., the stage of the end consumer, investigating its effect on the perceived quality of the product and ultimate consumer satisfaction.

Finally, this study has the following limitations. Data collection was interrupted by the Russian–Ukraine war and data were only collected in selected UTCs in Ukraine so that the study's results cannot be generalized without additional testing in other territorial units of Ukraine. Moreover, this exploratory study analyzed expected and perceived logistics quality, which will very probably have changed after the Russian–Ukraine war, but can be used for future comparisons.

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References

1. World Bank. Food Security and COVID-19. 2021. Available online: https://www.worldbank.org/en/topic/agriculture/brief/food-security-and-covid-19 (accessed on 30 January 2022).
2. Davis, J.H.; Goldberg, R.A. *A Concept of Agribusiness*; Harvard University: Boston, MA, USA, 1957.
3. Ramos, E.; Coles, P.S.; Chavez, M.; Hazen, B. Measuring agri-food supply chain performance: Insights from the Peruvian kiwicha industry. *Benchmarking Int. J.* **2021**, *29*, 1484–1512. [CrossRef]
4. Sharma, R.; Shishodia, A.; Kamble, S.; Gunasekaran, A.; Belhadi, A. Agriculture supply chain risks and COVID-19: Mitigation strategies and implications for the practitioners. *Logist. Res. Appl.* **2020**, 1–27. [CrossRef]

5. Kumari, S.; Venkatesh, V.; Deakins, E.; Mani, V.; Kamble, S. Agriculture value chain sustainability during COVID-19: An emerging economy perspective. *Int. J. Logist. Manag.* **2021**. *ahead-of-print*. [CrossRef]
6. Tsolakis, N.K.; Keramydas, C.A.; Toka, A.K.; Aidonis, D.A.; Iakovou, E.T. Agrifood supply chain management: A comprehensive hierarchical decision-making framework and a critical taxonomy. *Biosyst. Eng.* **2014**, *120*, 47–64. [CrossRef]
7. Zailani, S.; Jafarzadeh, S.; Iranmanesh, M.; Nikbin, D.; Selim, N.I.I. Halal logistics service quality: Conceptual model and empirical evidence. *Br. Food J.* **2018**, *120*, 2599–2614. [CrossRef]
8. International Monetary Fund. World Economic Outlook: Recovery during a Pandemic. 2021. Available online: https://www.imf.org/en/Publications/WEO/Issues/2021/10/12/world-economic-outlook-october-2021 (accessed on 27 January 2022).
9. Arabelen, G.; Kaya, H.T. Assessment of logistics service quality dimensions: A qualitative approach. *J. Shipp. Trade* **2021**, *6*, 1–13. [CrossRef]
10. Kaswengi, J.; Lambey-Checchin, C. How logistics service quality and product quality matter in the retailer–customer relationship of food drive-throughs. *Int. J. Phys. Distrib. Logist. Manag.* **2019**, *50*, 535–555. [CrossRef]
11. Tang, L.-L.; Chen, S.-H.; Lin, C.-C. Integrating FMEA and the Kano Model to Improve the Service Quality of Logistics Centers. *Processes* **2020**, *9*, 51. [CrossRef]
12. Uvet, H. Importance of Logistics Service Quality in Customer Satisfaction: An Empirical Study. *Oper. Supply Chain Manag. Int. J.* **2020**, *13*, 1–10. [CrossRef]
13. Huma, S.; Ahmed, W.; Ikram, M.; Khawaja, M.I. The effect of logistics service quality on customer loyalty: Case of logistics service industry. *South Asian J. Bus. Stud.* **2019**, *9*, 43–61. [CrossRef]
14. Iqbal, T. Investigating logistics issues in service quality of SMEs in Saudi Arabia. *Uncertain Supply Chain Manag.* **2020**, *8*, 875–886. [CrossRef]
15. Chen, M.-C.; Hsu, C.-L.; Lee, L.-H. Investigating pharmaceutical logistics service quality with refined Kano's model. *J. Retail. Consum. Serv.* **2020**, *57*, 102231. [CrossRef]
16. Weli, A.N.; Idris, S.; Yaakob, A.R. Level of Satisfaction Among Industrial Customers in Relation to Logistics Service Provider in Sabah. *Glob. Bus. Manag. Res. Int. J.* **2020**, *12*, 466–476.
17. Le, D.N.; Nguyen, H.T.; Truong, P.H. Port logistics service quality and customer satisfaction: Empirical evidence from Vietnam. *Asian J. Shipp. Logist.* **2019**, *36*, 89–103. [CrossRef]
18. Vu, T.P.; Grant, D.B.; Menachof, D.A. Exploring logistics service quality in Hai Phong, Vietnam. *Asian J. Shipp. Logist.* **2019**, *36*, 54–64. [CrossRef]
19. Van Hong, P.; Nguyen, T.-T. Factors affecting marketing strategy of logistics business—Case of Vietnam. *Asian J. Shipp. Logist.* **2020**, *36*, 224–234. [CrossRef]
20. Mathong, P.; Sureeyatanapas, P.; Arunyanart, S.; Niyamosoth, T. The assessment of service quality for third-party logistics providers in the beverage industry. *Cogent Eng.* **2020**, *7*, 1785214. [CrossRef]
21. Michalski, M.; Montes-Botella, J.L. Logistics service quality in an emergent market in Latin America. *Int. J. Logist. Manag.* **2021**, *33*, 79–101. [CrossRef]
22. Knop, K. Evaluation of quality of services provided by transport & logistics operator from pharmaceutical industry for improvement purposes. *Transp. Res. Procedia* **2019**, *40*, 1080–1087. [CrossRef]
23. Statista. Export Volume of Sunflower Seed Oil Worldwide in 2015–2021. 2022. Available online: https://www.statista.com/statistics/620317/sunflowerseed-oil-export-volume-worldwide-by-country/ (accessed on 6 July 2022).
24. Parasuraman, A.; Zeithaml, V.A.; Berry, L.L. SERVQUAL: A Multiple-Item Scale for Measuring Consumer Perceptions of Service Quality. *J. Retail.* **1988**, *64*, 12–40.
25. Cronin, J.J.; Taylor, S.A. Measuring Service Quality: A Reexamination and Extension. *J. Mark.* **1992**, *56*, 55–68. [CrossRef]
26. Kano, N.; Seraku, N.; Takahashi, F.; Tshuji, S. *Attractive Quality and Must-Be Quality. The Best on Quality: Targets, Improvements, Systems*; Hromi, J.D., Ed.; ASQC Quality: Milwaukee, MI, USA, 1996; Volume 7, pp. 165–186.
27. Bienstock, C.C.; Royne, M.B.; Sherrell, D.; Stafford, T.F. An expanded model of logistics service quality: Incorporating logistics information technology. *Int. J. Prod. Econ.* **2008**, *113*, 205–222. [CrossRef]
28. Mentzer, J.T.; Flint, D.J.; Kent, J.L. Developing a logistics service quality scale. *J. Bus. Logist.* **1999**, *20*, 9–32.
29. Franceschini, F.; Rafele, C. Quality evaluation in logistic services. *Int. J. Agil. Manag. Syst.* **2000**, *2*, 49–54. [CrossRef]
30. Grant, D.B. UK and US management styles in logistics: Different strokes for different folks? *Int. J. Logist. Res. Appl.* **2004**, *7*, 181–197. [CrossRef]
31. Thai, V.V. Service quality in maritime transport: Conceptual model and empirical evidence. *Asia Pac. J. Mark. Logist.* **2008**, *20*, 493–518. [CrossRef]
32. Oliver, R.L. A Cognitive Model of the Antecedents and Consequences of Satisfaction Decisions. *J. Mark. Res.* **1980**, *17*, 460. [CrossRef]
33. Thai, V.V. Logistics service quality: Conceptual model and empirical evidence. *Int. J. Logist. Res. Appl.* **2013**, *16*, 114–131. [CrossRef]
34. Mankivka Territorial Community. ooa. 2022. Available online: https://mankivska-gromada.gov.ua (accessed on 6 July 2022).
35. Ladyzhynka Territorial Community. Prohrama Rozvytku Zemel'Nykh Vidnosyn na Terytoriyi Ladyzhyns'koyi sil's'koyi Rady na 2019–2023 Roky. 2021. Available online: https://bit.ly/3yhxv7f (accessed on 6 July 2022).

36. Palanka Territorial Community. Prohrama Sotsial′no-Ekonomichnoho Rozvytku Palans′koyi sil′s′koyi Terytorial′noyi Hromady na 2021–2025 Roky. 2022. Available online: https://bit.ly/3NOrkxd (accessed on 6 July 2022).
37. Dmytrushky UTC, D. Stratehiya Rozvytku Dmytrushkivs′koyi Hromady na Period do 2027 Roku. 2022. Available online: https://dmytrushkivska-gromada.gov.ua/news/1615450440/ (accessed on 6 July 2022).
38. Ministry of Agrarian Policy and Food of Ukraine. Fermerstvo. 2022. Available online: https://minagro.gov.ua/napryamki/fermerstvo-i-kooperaciya/fermerstvo-ta-kooperaciya (accessed on 6 July 2022).
39. Jick, T.D. Mixing Qualitative and Quantitative Methods: Triangulation in Action. *Adm. Sci. Q.* **1979**, *24*, 602. [CrossRef]
40. Diamantopoulos, A.; Schlegelmilch, B.B. Determinants of industrial mail survey response: A survey-on-surveys analysis of researchers' and managers' views. *J. Mark. Manag.* **1996**, *12*, 505–531. [CrossRef]
41. Siddh, M.M.; Soni, G.; Jain, R.; Sharma, M.K.; Yadav, V. Agri-fresh food supply chain quality (AFSCQ): A literature review. *Ind. Manag. Data Syst.* **2017**, *117*, 2015–2044. [CrossRef]
42. Mentzer, J.T.; Rutner, S.M.; Matsuno, K. Application of the means-end value hierarchy model to understanding logistics service value. *Int. J. Phys. Distrib. Logist. Manag.* **1997**, *27*, 630–643. [CrossRef]
43. Kilibarda, M.; Nikolicic, S.; Andrejic, M. Measurement of logistics service quality in freight forwarding companies a case study of the Serbian market. *Int. J. Logist. Manag.* **2016**, *27*, 770–794. [CrossRef]
44. Bienstock, C.C.; Mentzer, J.T.; Bird, M.M. Measuring physical distribution service quality. *J. Acad. Mark. Sci.* **1997**, *25*, 31–44. [CrossRef]
45. Gronroos, C. A Service-Orientated Approach to Marketing of Services. *Eur. J. Mark.* **1978**, *12*, 588–601. [CrossRef]
46. Dovbischuk, I. Sustainable Firm Performance of Logistics Service Providers along Maritime Supply Chain. *Sustainability* **2021**, *13*, 8040. [CrossRef]
47. Gil Saura, I.; Francés, D.S.; Contrí, G.B.; Blasco, M.F. Logistics service quality: A new way to loyalty. *Ind. Manag. Data Syst.* **2008**, *108*, 650–668. [CrossRef]
48. Zhang, M.; Li, P. RFID Application Strategy in Agri-Food Supply Chain Based on Safety and Benefit Analysis. *Phys. Procedia* **2012**, *25*, 636–642. [CrossRef]
49. Ali, J.; Kumar, S. Information and communication technologies (ICTs) and farmers' decision-making across the agricultural supply chain. *Int. J. Inf. Manag.* **2011**, *31*, 149–159. [CrossRef]
50. Agrawal, S.; Singh, V.; Upadhyay, Y. Structural model of information quality framework to e-agri supply chain. *J. Adv. Manag. Res.* **2021**, *18*, 609–634. [CrossRef]
51. Ding, M.J.; Jie, F.; Parton, K.A.; Matanda, M.J. Relationships between quality of information sharing and supply chain food quality in the Australian beef processing industry. *Int. J. Logist. Manag.* **2014**, *25*, 85–108. [CrossRef]
52. Dovbischuk, I. Innovation-oriented dynamic capabilities of logistics service providers, dynamic resilience and firm performance during the COVID-19 pandemic. *Int. J. Logist. Manag.* **2022**, *33*, 499–519. [CrossRef]
53. Stekelorum, R.; Laguir, I.; Gupta, S.; Kumar, S. Green supply chain management practices and third-party logistics providers' performances: A fuzzy-set approach. *Int. J. Prod. Econ.* **2021**, *235*, 108093. [CrossRef]
54. Armstrong, J.S.; Overton, T.S. Estimating Nonrespone Bias in Mail Surveys. *J. Mark. Res.* **1977**, *14*, 396–402. [CrossRef]
55. Mentzer, J.T.; Flint, D.J. Validity in logistics research. *J. Bus. Logist.* **1997**, *18*, 199–216.
56. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E. *Multivariate Data Analysis*; Pearson: Harlow, UK, 2014.
57. Fornell, C.; Larcker, D.F. Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *J. Mark. Res.* **1981**, *18*, 39–50. [CrossRef]

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The 2020 Maize Production Failure in Ghana: A Case Study of Ejura-Sekyedumase Municipality

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Abstract: This paper examines the causes of widespread maize production failure in Ghana during the 2020 minor growing season. A mixed-methods approach was used to study smallholder maize farmers in the Ejura-Sekyedumase Municipality to provide a holistic understanding of the factors behind the maize production failure and to inform policy interventions. The results show that the decline in maize grain yield was caused by the failure of the minor season rains and, more importantly, the destruction of maize plants by fall armyworms. Other factors including poor soils and inadequate farm inputs contributed minimally to the observed maize failures. The agronomic practices adopted by the farmers to mitigate crop failures were undermined by their inability to master the onset and cessation of rainfall, the ineffectiveness of pesticides to control the fall armyworms and financial challenges. It is recommended that the government promotes and supports rainwater harvesting to address the impacts of drought and pests on food crop production. Furthermore, to ensure sustainable food production, a combination of indigenous knowledge and scientific farm practices are crucial to accurately forecast the weather and to control the fall armyworms.

Keywords: agronomic changes; climate change; fall armyworm; farmers' resilience; safety nets; Ghana

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1. Introduction

Sub-Saharan Africa (SSA) is at the center of the threats posed by climate change to agriculture due to production challenges such as low uses of technology and irrigation, slow progress in drought risk management, and land degradation. The poor economic performance and prospects of many countries in the sub-region are related to the constraints to agricultural production [1]. These challenges have a huge impact on agricultural productivity [2]. Food insecurity caused by crop failures is growing rapidly in many SSA countries, leading to famine, and environmental and financial crises, which can undermine the region's commitment to achieving the UN Sustainable Development Goals (SDGs) by 2030, especially SDG 1: End poverty in all its forms everywhere and SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture [3].

Similar to many countries in SSA, agriculture is the main source of livelihood for millions of people in Ghana, providing the food and economic needs of rural and urban households. Agricultural production is predominantly structured on a smallholding basis, characterized by low input and low technology use, high rain-dependence and a low adoption of irrigation. The total arable land under irrigation in Ghana is reported to be less than 2% [4]. Thus, the over-dependence on rainfall for agriculture in Ghana exposes production to rainfall and its variability.

Maize (*Zea mays*, L.) is an important crop grown in Ghana, occupying over one million hectares, and constituting 50–60% of the country's cereal production. Maize is grown in almost every part of the country, but the major growing regions are the Forest–Savannah transition zone, accounting for more than 80% of the total maize grains produced in Ghana [5]. Maize grains are a major staple for many households, an ingredient for poultry

feed and an important industrial commodity in Ghana. While its production provides the economic livelihood for millions of smallholder farmers in the country [6], the crop is frequently affected by rainfall variability. Frequent maize crop failures could potentially affect farmers' incomes, make them vulnerable to poverty, and worsen nationwide food insecurity.

Given the enormous importance of maize to Ghana's economy, both government and non-governmental interventions have been implemented over the last three decades to improve maize grain production. Examples of government programs to improve maize yield include fertilizer subsidies, mechanization, and buffer stock schemes, as well as increased tariffs on the importation of maize grains. From 1979 to 1997, and 2000 to 2008, the Ghana Grains Development Project and the Food Crops Development Project, respectively, introduced and encouraged the cultivation of early maturing, drought-tolerant and high-yielding maize varieties. In addition to the government's efforts, non-governmental organizations such as Masara N'Arzikialso provided inputs into credit and extension services to improve yield.

Despite the efforts to improve maize yield, challenges such as fall armyworm (*Spodoptera frugiperda*) infestation and extreme rainfall events have debilitated productivity in recent years. For instance, in 2016, a severe El Niño led to a drastic reduction in maize yield [7]. Similarly, between late 2020 and the middle of 2021, Ghana went through a serious maize grain crisis emanating from the 2020 minor season crop failure. The phenomenon led to shortages and spikes in the prices of maize grains and maize-based animal feeds. Moreover, the shortage led to an increase in maize grain prices on the local market, which affected household food security and the national economy at large. What we know is that extreme weather events may be the underlying cause of maize crop failure, but the frequency and severity of the impacts are unclear. This study sought to answer the following questions: (i) Why are crop failures becoming so frequent in recent years? (ii) What can be done to build the resilience of smallholder maize farmers in Ghana? The study aims to better understand the drivers of frequent maize production failures, which will be an important step towards establishing robust interventions to mitigate future crop failures in Ghana.

2. Methodology

2.1. Study Area

The study was conducted in three communities in the Ejura-Sekyedumase Municipality (longitudes 1°5 W and 1°39 W and latitudes 7°9 N and 7°36 N), located in the Forest–Savanna transition zone of mid-Ghana. The communities were Ejura, which is the municipal capital, Kasei and Anyinasu (Figure 1). The communities were selected in collaboration with the Municipal Agriculture Directorate to obtain a wider geographical spread covering major maize production hubs. The transitional agroecological zone coincides with Zone C in the Ghana Meteorological Agency's (GMet) agroecological classification scheme. The municipality has a land area of about 1782.2 square kilometers.

Vegetation in the Ejura-Sekyedumase Municipality is predominantly characterized by semi-deciduous forest. Mean annual rainfall totals range from 1200 to 1500 mm and decrease from south to north following the general rainfall distribution in Ghana. Rainfall in the municipality has a bi-modal pattern. The major rainy season spans late March/early April and mid-July, which is interspersed by a short dry spell from mid-July to mid-August, followed by the minor rainy season in September/October. The long dry season, also called the "harmattan", runs from November through March. The bi-modal rainfall pattern allows two growing seasons, especially for cereals and legumes under rain-fed agriculture, which is widely practiced in the transition zone. The mean monthly temperature ranges from 21 to 30 °C. The months of January through April are the warmest whereas July and August are the coolest. During the rainy season, humidity is relatively high, peaking at 90% in June and dropping to roughly 55% in February.

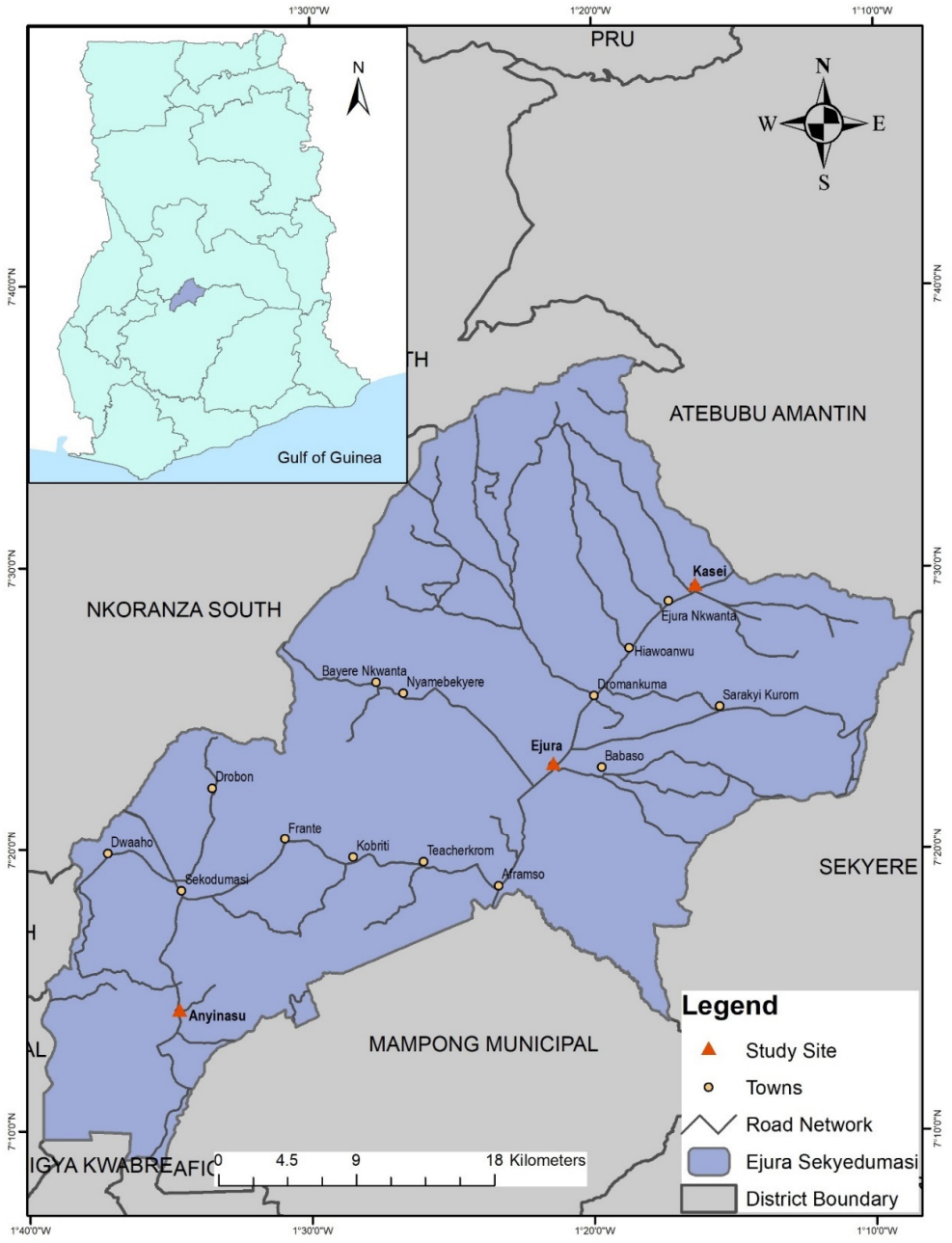

Figure 1. Map showing the study communities. Source: Authors' construct.

Soils in the Ejura-Sekyedumase Municipality fall under the Forest and Savanna ochrosols. Characteristically, the soils have a deep profile, are light in color, are well aerated with a moderate supply of organic matter and plant nutrients, and have good water-holding capacity. The climatic conditions together with vegetation and soil offer suitable conditions for agriculture, especially maize production. According to Cossar, et al. [8], maize production accounts for about 41% of the total cropped area in the municipality. The high contribution of the municipality to maize grain production in Ghana makes it suitable for studies on maize failures.

The municipality had a population of about 121,765 in the year 2020. Agriculture employs about 60% of the labor force and serves as the main source of livelihood for most people in the municipality. Furthermore, agriculture in Ejura-Sekyedumase Municipality is predominantly smallholding and includes crop production and livestock rearing. Besides maize, farmers in the municipality produce cowpea (*Vigna unguiculata*, (L.) Walp), groundnuts (*Arachis hypogaea*, L.), rice (*Oryza sativa*, L.), cassava (*Manihot esculenta*, Crantz), yam

(*Dioscorea* spp.) and vegetables mostly for commercial purposes. The most common farm animals raised include cattle, goats, sheep and poultry.

2.2. Data Collection

A mixed-methods approach, involving the collection of both quantitative and qualitative data, was used in this study. The data were sequentially collected through focus group discussions (FGDs), questionnaire surveys, and stakeholder interviews. Due to the lack of official data on the number of maize farmers in the communities, the researchers relied on information provided by key contact persons who were identified in each community. These key contacts also assisted the researchers in the selection of key maize farmers in their respective communities. To ensure the spatial representation of the populations in the communities, the key maize farmers were selected from different neighborhoods in the communities. The farmers identified were grouped into male and female groups for focus group discussions (FGD). Each group comprised 9 to 12 participants, who had mixed socio-economic characteristics such as age, education, and farm characteristics. The mixed characteristics ensured a representative sample of the study population. Furthermore, the gender-based and small-sized focus groups allowed active participation during the interviews. In total, four male and four female FGDs were conducted in the study communities (Ejura, 4; Kasei, 2; and Anyinasu, 2), with a total of 82 participants.

In addition to the FGDs, questionnaires were administered to approximately half of the farmers who participated in the FGDs. A similar approach to that described by Obour, et al. [9] was used in selecting the respondents of the questionnaire. Thus, the respondents targeted in each study community were those who were more experienced and knowledgeable about the 2020 minor season maize failure than the average farmer and were willing to participate. In total, 40 questionnaires were administered (Ejura: 19; Kasei: 9; Anyinasu: 12).

Finally, key informant interviews (KIIs) were held with personnel from the Municipal Ministry of Food and Agriculture (MoFA) Directorate, local agricultural extension officers in whose jurisdictions the study communities were located. The interviews were held either in English or Akan (Twi) depending on the preference of the respondents. The FGDs and KIIs were recorded and later transcribed. All data were collected following strict COVID-19 protocols, such as social distancing and the wearing of face masks. The primary data collected consisted of the stakeholders' observation of changes in climate variables, particularly rainfall and temperature, respondents' accounts of maize production in terms of changes in yield, especially during the 2020 minor season, and their narration of the probable causes of the 2020 minor season maize failure. Further, data on the farmers' practices and their opinions on how to mitigate future maize production failures were solicited. Finally, information on government preparedness to prevent the future occurrence of crop failures in the country was solicited from agricultural extension officers and personnel from the Municipal MoFA Directorate.

To corroborate the information obtained from the respondents, daily rainfall and minimum temperature data for the municipality covering the period 2015 to 2020 were obtained from the GMet. In addition, data on the grain yield of maize for the municipality covering 2012 to 2020 were also obtained from the Municipal MoFA Directorate. The climate and yield data were used to analyze trends over the past half decade, particularly in 2020, which is the focus of the study.

2.3. Data Analyses

The recorded interviews were transcribed verbatim into English. The questionnaires were cleaned, coded, and subsequently inputted into a statistical computer software, SPSS (version 20.0), for analysis. Crosstabulations were performed to examine the relationship between variables across the study communities. To determine uniformity between respondents in the different study communities, a Chi-square (χ^2) test of homogeneity analysis was performed. $p < 0.05$ was used as a criterion for statistical significance. The Friedman

Test was performed to compare the mean rank of the factors responsible for the 2020 minor season's maize production failure in the communities. When the test showed overall statistical significance, a post hoc test, a Wilcoxon signed-rank test with Bonferroni-corrected alpha level, i.e., an alpha level divided by the number of comparisons, was used to isolate factors that were significantly different. Relevant quotes extracted from the transcripts are used to emphasize key quantitative descriptions in the results and discussion sections. Rainfall, temperature, and maize grain yield data were analyzed in Microsoft Excel. The frequencies of the length of the dry spell and the longest dry spell in the major and minor rainy seasons were computed using Instat+ version 3.36. The dry spell was defined as four or more consecutive days without rain or with precipitation of less than 1 mm. The longest dry spell was computed according to Gbangou, et al. [10] as the largest number of consecutive days during which rainfall was less than 1 mm in the season. For each year, the major season was defined as April–July, and the minor season was September–October.

3. Results and Discussion

3.1. Socio-Demographic and Farm Characteristics

This section presents some key characteristics of the subset of respondents who participated in the questionnaire survey. Of the 40 respondents, 62% were females and 38% males. The ages of the respondents ranged from 20 to 75 years. More than 50% of the respondents have some form of formal education, with junior high school/middle school being the most common form of education completed by the respondents. In general, the respondents have large household sizes, with an average of seven people. The total farm size of the respondents in the last five years ranged from <2 to more than 6 ha. Average maize farm size in the last five years ranged from <2 to 4 ha. Except for vegetable production, where irrigation is practiced, the growing of crops, including maize, is done under rain-fed conditions. This probably explains why most of the farmers (88%) indicated that they do not practice irrigation farming (Table 1). The results show that, in general, there were no significant differences between the study communities in terms of the demographic and farm characteristics of the farmers interviewed. The identical demographic and farm characteristics offered an excellent platform to better understand the 2020 minor season maize production failures, impacts, and agronomic adaptations.

3.2. Maize Production and Failures

The Ejura-Sekyedumase Municipality is an important maize growing area in Ghana [11]. Production is the main source of income for farmers. In total, 53% of the farmers reported that over 60% of their income is from the sale of maize grains (Table 1). The plowing and harvesting of maize fields are often done mechanically using tractors, while sowing and weed clearance is done manually and using weedicide. Maize is grown two times a year, during the major and minor growing seasons. Major season maize is usually planted in April, during the onset of the major rainy season, and harvested in August. The minor season maize is cultivated from late August to early September when the minor season rain is expected to start, and harvested in December. The interviews revealed that the farmers use diverse agro-chemicals for controlling weeds and pests, and for replenishing soil nutrients. The most common agro-chemicals applied by the farmers included weedicides ("Condemn", Samphosate, "Round-up", "Adwumawura", "King Kong", Atrazine), insecticides (Lambda Super 2.5, "Diband and Samprifos", Lindane), and mineral fertilizers (Urea, NPK15-15-15, NPK 23-10-5, and ammonia).

Interviews with the farmers and the key informants confirmed their observations of declined maize yields in the last five years, and notably during the 2020 minor season. About 68% of the farmers reported that their maize yield during the 2020 minor growing season decreased between 40 and 70% compared to what they harvested in the previous years.

The observations of the respondents were validated by empirical data on maize production. Figure 2 shows that the cultivated area of maize slightly decreased in 2019 and 2020 compared with 2018. The maize grain yield sharply increased from 2017, and the

highest was recorded in 2018. Figure 2 further shows that, compared with 2018, maize yield dropped by about 14% and 8% in 2019 and 2020, respectively, suggesting a slow recovery in 2020, which to a large extent corroborates the narrative of yield decline. However, given the lack of seasonal maize yield data, it was not possible to isolate the minor season yield to match the qualitative reports of the respondents.

Table 1. Demographic characteristics of respondents.

Characteristics	Communities			χ^2 Value	df	*p*-Value
	Ejura (*n* = 19) %	Kasei (*n* = 9) %	Anyinasu (*n* = 12) %			
Gender						
Female	34	13	15	1.999	2	0.368
Male	13	10	15			
Age						
20–45 years	13	5	10	9.584	10	0.478
46–65 years	25	13	18			
66+ years	10	5	3			
Level of educational attainment						
No formal education	38	5	5	23.969	8	0.02
Primary school	8	0	0			
Junior high/middle school	3	15	23			
Senior high school	0	3	3			
Household size						
1–5 people	10	10	3	4.966	6	0.548
6–10 people	25	8	18			
>11 people	13	5	10			
<2 hectares	18	10	0	14.374	8	0.073
2–6 hectares	20	10	15			
>6 hectares	10	5	15			
Average maize farm size in the last 5 years						
<2 hectares	28	13	8	6.422	6	0.378
2–4 hectares	15	8	13			
>4 hectares	5	3	10			
Practice irrigation						
Yes	3	5	5	1.878	2	0.391
No	45	18	25			
Proportion of income from maize grains in the last five years						
20–40%	8	8	10	11.393	8	0.180
41–60%	5	10	8			
>61%	35	5	13			

3.3. Drivers of Maize Production Failure in 2020

To understand the local knowledge of the factors responsible for the 2020 maize production failures, the impacts, and the lessons learned, the farmers were asked to identify and rank the factors responsible for the minor season maize production failures in 2020. Rainfall, pests and diseases were ranked as the major distinctive factors in all the study communities (Table 2). According to the respondents, the minor season rains in 2020 set in too late, and lasted for a much shorter time than usual. Consequently, many farmers missed the timing of the rains. Farmers who either planted early and expected the rain to come, or who planted late and expected that the rains were going to continue, experienced plant

withering due to dry soil conditions. The few farmers who got the timing right suffered severe fall armyworms attacks, leading to plant damage and subsequent crop failures.

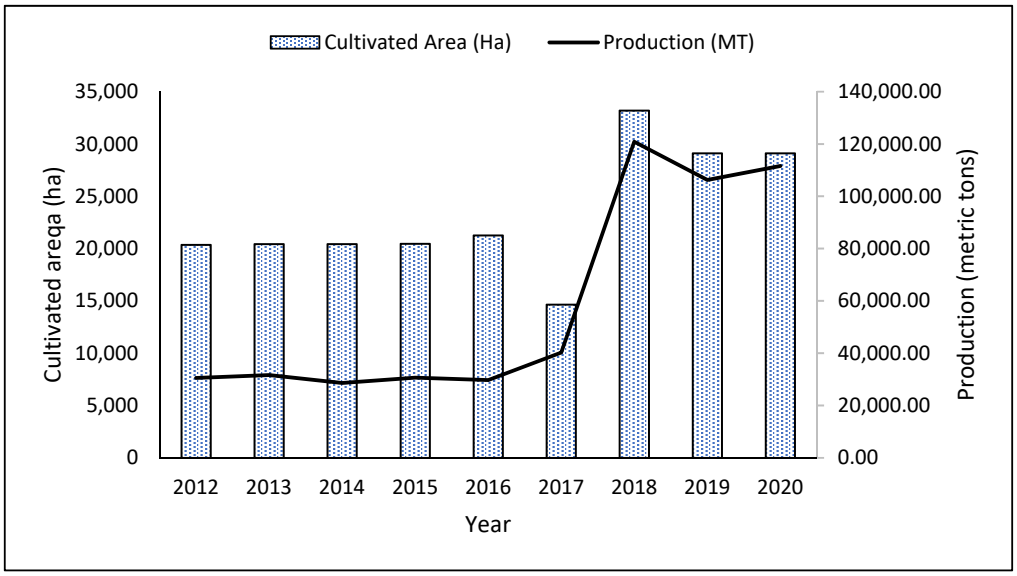

Figure 2. Maize cultivated area and production from 2012 to 2020 for Ejura-Sekyedumase Municipality.

Table 2. Ranking of factors responsible for the 2020 minor season maize production failure in Ejura-Sekyedumase municipality by farmers.

	Communities					
	Ejura (*n* = 19)		**Kasei (*n* = 9)**		**Anyinasu (*n* = 12)**	
	Rank of Factors	**Median**	**Rank of Factors**	**Median**	**Rank of Factors**	**Median**
Most important	Rainfall	10.0 ^{a}	Rainfall	10.0 ^{a}	Rainfall	10.0 ^{a}
	Pests and diseases	8.0 ^{a}	Pests and diseases	9.0 ^{a}	Pests and diseases	9.0 ^{a}
	Farm inputs	7.0 ^{ab}	Temperature	7.0 ^{a}	Soil and land degradation	7.0 ^{a}
	Temperature	6.0 ^{bc}	Soil and land degradation	4.0 ^{b}	Temperature	4.5 ^{b}
	Soil and land degradation	4.5 ^{bc}	Bush fires	4.0 ^{b}	Farm inputs	4.5 ^{b}
	Poor seeds	4.0 ^{bc}	Poor seeds	4.0 ^{b}	Poor seeds	4.3 ^{b}
	Bush fires	3.5 ^{bc}	Farm inputs	4.0 ^{b}	Bush fires	3.8 ^{b}
	Agric machinery	3.5 ^{bc}	Agric machinery	4.0 ^{b}	Agric machinery	3.5 ^{b}
	Financial	3.5 ^{bc}	Financial	4.0 ^{b}	Financial	3.5 ^{b}
Least important	Land scarcity and access	3.5 ^{bc}	Land scarcity and access	4.0 ^{b}	Land scarcity and access	3.5 ^{b}
	Friedman Test	χ^2 = 97.486, df = 9, *p*-value < 0.0001	Friedman Test	χ^2 = 46.716, df = 9, *p*-value < 0.0001	Friedman Test	χ^2 = 76.019, df = 9, *p*-value < 0.0001

Note: For each column, median values with different letters significantly differ at $p < 0.05$

Rainfall data for the municipality show fluctuations in the total monthly rainfall quantity from 2015 to 2016. It can be seen from Figure 3 that total monthly rainfall in the minor season (September–October) in 2020, in general, decreased compared to the preceding four years. To further assess the farmers' narratives about prolonged dry days in 2020, the frequency and longest days of dry spells were computed (Figure 4). For the major season, the number of dry days slightly decreased toward 2020, while the opposite was generally the case for the minor season. Furthermore, the minor season in 2020 experienced a longer dry spell (about 4–5 days more) compared to the other years. The frequency and longevity of the dry spells corroborate the qualitative accounts of the respondents of

prolonged drought. According to the IPCC [12], climate change is projected to intensify rainfall variability and extreme weather events, such as dry spells, which will affect crop production. Gbangou, Ludwig, van Slobbe, Greuell and Kranjac-Berisavljevic [10] and Usman and Reason [13] indicated that the timing of dry spells relative to the cropping calendar rather than total seasonal rainfall is fundamental to crop viability and production. The authors argued that cumulative rainfall does not fully explain how rainfall variability can limit agricultural production. The reason for this is that a few heavy rainfall events may lead to the erroneous impression that the soil moisture conditions during the growing season were favorable. In other words, crops are more likely to do well under uniformly distributed "light rain" conditions over a long period compared to few "heavy" rainfall events interspersed by recurring dry spells. Owusu, Ayisi, Musah-Surugu and Yankson [7] reported that, because in Ghana maize is often cultivated under rain-fed conditions, it is extremely vulnerable to climate extremes such as prolonged droughts. Evidence from the present study shows that increased dry spells, in terms of either longevity or frequency, pose a major risk to maize production in the transition zone of Ghana, and thus threaten its status as the breadbasket of the nation. In western and southern regions of Zambia, Siatwiinda, et al. [14] found that the risk of maize failure is heightened by recurring dry conditions leading to heat stresses, but noted that production losses in the region are largely threatened by flooding conditions. In the case of Ejura-Sekyedumase Municipality, maize production losses were largely due to water stresses, but not flooding conditions.

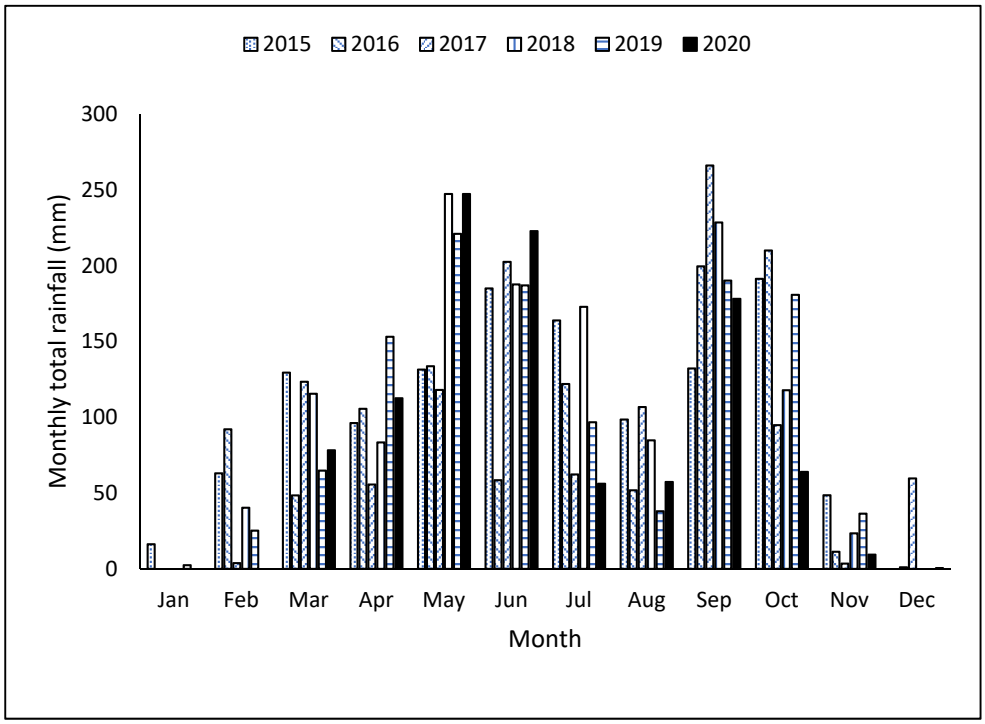

Figure 3. Monthly total rainfall in Ejura-Sekyedumase Municipality for the period from 2015 to 2020.

Minimum temperatures for the major and minor seasons for the period 2015–2020 are shown in Figure S1 (Supplementary Figure). As expected, the minimum temperature for 2015–2020 was identical, averaging ~25 °C. For lack of data on maximum temperature, the trend for the maximum temperature could not be shown.

Four main pests of maize were reported in the study communities, namely, grasshopper, stemborers, aphids and fall armyworms. However, the fall armyworm was reported as the most destructive to the maize. The farmers revealed, per their observations, that the fall armyworms become prevalent in dry and warm conditions. This is probably why the incidence of these pests was high during the drought-prone minor season of 2020. The

interviews also revealed that the first fall armyworm outbreak recorded in the communities was in 2017. This was highlighted by a male respondent in Ejura as follows:

> I heard about what the fall armyworm can do to crops in other parts of Ghana in late 2016. However, it was not until late 2017 that this little but very destructive creature made its journey to Ejura and its environs. It was not a major concern initially as the damage was minimal, but it is now problematic because of the destruction, especially to young maize plants. Multiplication of the pest has been very rapid since 2020. The pest can devour several square meters of maize farm within a short time . . . Like all other farmers in the Ejura area, I have observed that the insect seems to multiply faster when the weather is dry and warm, which explains why the situation was worse in 2020 minor season because the rain did not come in time and good quantity . . . (Male maize farmer in Ejura).

The foregoing viewpoint is consistent with one researcher's account that the fall armyworm emerged in many parts of the country in 2017. Koffi, et al. [15] argues that the ability of the fall armyworms to feed in large quantities and fly over a long distance can seriously affect agricultural production, and thus poses a food security threat to the nation at large. As Bariw, et al. [16] also identified, the impact of the fall armyworm transcends the physical environment, to household social and physical resources and assets. Several factors contribute to the declining maize yield in Ghana [17]. In the case of Ejura-Sekyedumase, the results reveal that, besides rainfall and pests, other environmental and socio-economic factors, such as poor seeds, soil degradation and a lack of farm-based inputs, were reported to have contributed to the 2020 minor season maize production failures. Table 2 indicates that the rankings of these other factors limiting production somewhat differed between the communities, which could be attributed to local conditions. For example, the farmers in Ejura ranked farm inputs higher compared with those in Kasei and Anyinasu. The reason cited was that there is mostly a general scarcity of farm inputs in Ejura due to high demand during peak seasons. On the other hand, soil degradation was ranked highest in Anyinasu compared with Ejura and Kasei, because of the general report of poor soils in the community.

3.4. Alternative Income and Safety Nets for Farmers

Information on alternative sources of income and safety nets the farmers depended on during the 2020 minor season maize yield loss was solicited. Table 3 shows that the farmers relied on diverse economic activities to cushion the financial burden that arose from maize production losses. In Ejura, most of the farmers (79%) relied on the sale of animals such as goat, sheep, chicken, and cattle to earn money for household needs, while in Kasei and Anyinasu, the farmers (78 and 75%, respectively) notably engaged in non-farm activities, such as trading and the running of commercial transport. Further, in Kasei and Anyinasu, a cross section of the farmers reported that they depended on income from the sale of other crops, such as cassava and vegetables. However, there were a few of the farmers in the study communities (22% Anyinasu, 17% in Kasei and 16% in Ejura) who reported that they did nothing during the maize production failure.

In terms of social safety nets, the results show that most respondents (average of ~60%) indicated that they had none. For those who depended on safety nets, the prominent ones were support and remittances from family members and friends living in or outside the communities. Others depended on maize grains stored and income saved from the previous years. Dapilah, et al. [18] reported that diverse activities and social networks foster climate change adaptation in northern Ghana through the diversification of livelihood activities. In the present study, it was also found that family support and remittances played a valuable role in minimizing the adverse impacts of maize production failure on farmers and their households. The study also revealed that the initiatives of individual farmers and farm management practices, particularly livestock rearing, the storage of maize grains, and income from the previous years' harvest, equally played a crucial role in reducing the negative impacts of the 2020 minor season crop failure on the farmers' livelihoods.

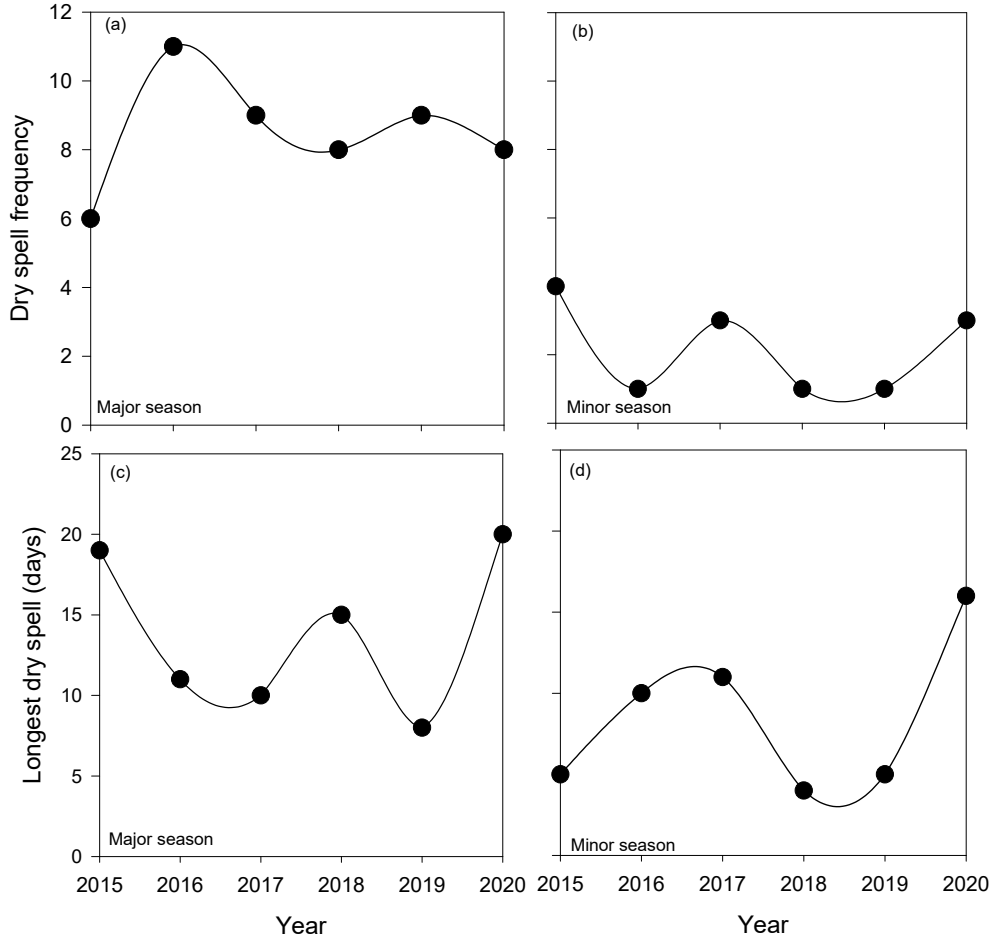

Figure 4. Frequency of dry spells for the (**a**) major and (**b**) minor cropping seasons for the period 2015–2020, and longest dry spell in days for (**c**) major and (**d**) minor cropping seasons for the period 2015–2020. A dry spell is defined as a sequence of four consecutive days or more during which precipitation is less than 1 mm.

3.5. Changes in Agronomic Practices in Response to the 2020 Maize Production Failure

The study sought information on how the experiences and lessons from the 2020 minor season maize production failure have shaped the farmers' agronomic practices. Table 4 showed that the experience from the 2020 minor season crop failure has indeed brought about some agronomic changes in maize cultivation. According to the farmers and the key informants, agronomic changes have become necessary to avert running into the same challenges experienced in 2020. Due to the difficulty for the farmers to master the onset and cessation of the minor season rain, of late, some of the farmers preferred doing early sowing of maize to take advantage of potential early rains. On the contrary, a cross section of the farmers preferred late sowing to make sure the rains are stable before planting (Table 4). However, both options are not without drawbacks because according to the Municipal Agriculture Extension Officer, in recent years, the minor season rains seemed to delay and last for a very short time when it comes. Either way it affects early and late sowing:

> The minor season rain is increasingly becoming very difficult for farmers to predict its onset and cessation. This implies that opting for only early or late sowing increases the risk of maize failure. A viable way to go is we (Extension Officers) advise farmers to do split sowing of maize so that they do not put their eggs in one basket . . . to avoid total crop failure in case the rains did not come as expected (Key informant at Ejura).

As mentioned previously, besides climate change, fall armyworms were reported to have significantly contributed to the maize production failures. In response, the farmers (53%, 44% and 58% in Ejura, Kasei and Anyinasu, respectively) reported that they have increased the use of pesticides in a bid to control the pests. The interviews revealed that the farmers have been experimenting (trial and error) with different pesticides to control the pest. The farmers reported having used at least five different insecticides, such as Lambda Super 2.5, Diband and Samprifos, ashes, Lindane, etc., in the last year in an attempt to control the fall armyworm, yet no significant impacts have been observed. Adzawla and Alhassan [19] pointed out that farmers' adaptation to climate change is important at the local level, as it helps to enhance sustainable food production. The authors reported that maize farmers in Northern Ghana are adapting to climate change by practicing row planting, mixed cropping, intercropping, and changing planting dates. The results from the present study show that the farmers are using local knowledge and farming experience to adapt to climate change, particularly unpredictable rainfall during the minor season, and to control the fall armyworm. Furthermore, the farmers in Ejura-Sekyedumase Municipality are also tackling poor nutrient status and soil degradation by using fertilizers and practicing maize rotation with leguminous crops for soil nutrient replenishment, and this way improving soil quality for crop production.

Table 3. Alternative economic activities and safety nets of respondents (multiple responses).

Variable	Communities		
	Ejura (*n* = 19) %	**Kasei (*n* = 9) %**	**Anyinasu (*n* = 12) %**
Alternative economic activities			
Rearing and sale of animals	79	56	0
Engaged in non-farm activities (e.g., trading, running commercial transport, mechanic)	53	78	75
Nothing	16	22	17
Worked as a farm laborer	16	0	25
Cultivated and sold other crops, e.g., cassava and vegetables	0	33	42
Social safety net			
Nothing	63	56	67
Depended on remittances	37	33	0
Depended on bank loans	0	0	42
Sold stock of maize in storage	26	0	25
Depended on savings from the previous years	26	0	0
Depended on proceeds from other non-maize crops	5	22	0
Depended on support from family members	0	22	42

3.6. Building Farmers' Resilience to Maize Production Failures

Farmers' abilities to respond to changes and take appropriate actions define their resilience and adaptive capacity to climatic and non-climatic changes. Therefore, understanding farmers' indigenous practices and knowledge actions are important for timely interventions that enhance their livelihoods and food security in developing countries [20]. The present study explored ways to build the resilience of maize farmers in the study communities. According to key informants, the resilience of smallholder farmers is crucial to ensuring sustainable food production. Multiple recommendations were made by the farmers (Table 5). Many of the farmers (79% in Ejura, 67% in Anyinasu and 56% in Kasei) reported that financial constraints affect their production, and suggested making loans available and easing the modalities for acquiring loans from financial institutions in the municipality is necessary to

reduce the financial burden on farmers. It was reiterated that the interest rates offered by financial institutions at the time of the fieldwork were very high. According to the farmers, some financial institutions were charging between 25% and 28% interest on loans. Besides the high interest rate, the conditions for acquiring loans were reported to be very cumbersome, which discouraged the farmers from applying for loans. The results here are consistent with previous findings by Klutse, et al. [21], who argued that the difficulty farmers face in accessing loans from a financial institution to pay for labor and purchase farm inputs have adverse impacts on food crop production in Ejura-Sekyedumase and Wenchi Municipalities. The present study has further revealed that the farmers were also reluctant to acquire loans from financial institutions largely because of the fear of defaulting, which could put them in jail. The interviews revealed that the farmers were also not interested in subscribing to farm insurance policies. At Ejura, one farmer reported that three years ago, farmers in the community tried doing business with an insurance company, but were exploited by the company leading, to the loss of their investments.

Table 4. Specific agronomic changes in response to maize production failure (in multiple responses).

Agronomic Changes	Specific Practices	Farmer's Description of How Agronomic Changes Build Resilience	Communities		
			Ejura (n = 19) %	Kasei (n = 9) %	Anyinasu (n = 12) %
Early planting	Sow maize when rain is expected to come or just after the first rainy day in the growing season	Helps respond to rainfall shifts—early sowing helps take advantage of early rains	53	44	58
Late planting	Waited until there are three to four consecutive rain events before sowing maize	Waiting until there are consecutive rainfall events ensures sufficient soil moisture	42	67	42
Nothing	-	-	26	11	8
Increase use of pesticides	Apply different pesticides at different periods	Helps control fall armyworms	26	11	0
Increase use of fertilizers	Apply a wide range of fertilizers	Ensures fast growth and gives high yields when there are rains	26	33	25
Practice crop rotation	Rotate maize with legumes, mainly groundnuts and beans	Helps conserve soil water and improve soil quality	16	22	0
Apply ashes mixed with chemicals	Apply ash solution sometimes mixed with other pesticides	Helps to control fall armyworms	0	0	8
Mixed farming	Plant both crops and rear animals like sheep, goat and chicken	Provides double benefits from crops and animals	5	0	0
Practice agroforestry	Intercrop maize plant with economic trees such as cashew and mango	Agroforestry provides shade and helps to conserve soil moisture	5	0	0
Improve soil quality	Apply organic amendments, mainly residues of groundnut and beans from the previous harvest	Enhances crop growth	0	0	17

The use of agrochemicals for agricultural production in the district has become a regular practice among farmers in the municipality in response to poor soil nutrient status, disease infestation, and the fall armyworm attack. As part of the Government of Ghana's initiatives aimed at promoting agricultural production, price subsidies on mineral fertilizers have been rolled out nationwide [11,17]. The farmers acknowledged that the subsidy has helped to reduce the price of fertilizers. Nevertheless, it was reported that high demands, particularly during the peak growing season, often led to hoarding and price increases for fertilizers. The farmers also proposed that the subsidy program be extended to include essential products, such as pesticides and weedicides, as their availability will help farmers to improve maize production. Nabavi-Pelesaraei, et al. [22] reported that the use of inputs such as biocides and farmyard manure differentiated between efficient and inefficient

watermelon farmers in Iran. The authors found that there is a misconception that a high use of, for example, fertilizers can lead to inefficient production. Moreover, the low cost and inappropriate use of fertilizers can have adverse effects on crop performance and the environment [22,23]. We suggest that subsidies on prices of agro-chemicals in Ghana be accompanied by regular agronomic information on best agricultural practices to build the resilience of smallholder farmers and avert environmental externalities caused by mal-agronomic practices.

Table 5. Measures to build the capacity of maize farmers against the drivers of crop production failure (multiple responses).

Measures	Communities		
	Ejura (*n* = 19) %	**Kasei (*n* = 9) %**	**Anyinasu (*n* = 12) %**
Soft loans for farmers from financial institutions	79	56	67
Subsidize prices of agro-chemicals further	79	56	50
Development of irrigation facilities for farmers	53	67	67
Regulate the market price of maize and enforce standardization to prevent middlemen from cheating farmers	26	44	33
Promote local manufacturing of agro-chemicals to make them available	26	33	42
Manufacturing pesticides that effectively kill the fall armyworm	26	33	17
Support farmers with agricultural machinery	10	7	7
Crediting the sale of agro-chemicals	6	5	5

The interviews showed that irrigation facilities were non-existent in the municipality, and according to the farmers, developing such facilities will help reduce their dependency on rainfall for food production. They suggested that the government should consider extending the One Village One Dam (1V1D) program to their municipality. The 1V1D is a Government of Ghana flagship program initiated in 2017 to aid rainwater harvesting for domestic use and farming, especially during the harmattan season. The program is intended to increase the access to a reliable source of water for livestock watering, domestic activities, and dry season farming, all of which is intended to alleviate poverty and address the inequalities in rural and deprived communities [24]. According to the farmers, implementing the program in the Ejura-Sekyedumase Municipality will promote irrigation and reduce the risk of maize production failures.

In all the communities, the farmers expressed concern about how they are being cheated by the middlemen who buy maize grains. There was a general feeling that the unscrupulous practices of the middlemen seriously affect the incomes of farmers. It was reported that the middlemen come to the community with their prices, and these are often too low. For instance, at the peak of maize grain shortage in early 2021, a bag of maize was sold for about GHC 650.00 (Based on OANDO exchange rate as of January 14: USD 1 is GHC 6.1) in Accra and Kumasi, yet the middlemen bought from the farmers for between GHC 350.00 and 400.00. Additionally, it was revealed that the bags used by the buyers are often too large, compared to the approved 100 kg bag for maize grains. The farmers reported that middlemen repack the grains in standard bags before reselling them to consumers at the urban markets, which means extra grains are gained per bag. This is a modus operandi of the middlemen to make more profits at the expense of the farmers. The farmers suggested that the government should set out price regulations for maize grains and enforce the standardization of maize grains measurement across the country.

Further probing revealed that some of the middlemen prefer going into contract maize production with farmers, particularly those who are financially constrained. Often, the middlemen, i.e., the buyers support the farmers financially and in kind, such as by supplying agro-chemicals that may be needed throughout the cultivation season. In return, the farmers are bonded to sell the maize produced at the end of the season to their prospective buyers. Despite the poor pricing offered by the buyers, contract farming seems to be generally working well so far, as the farmers were able to produce enough to meet the terms of the contractual agreement. However, issues arise when maize output is insufficient to meet the demands of buyers. It was reported that the 2020 minor season maize production failure rendered several farmers indebted to middlemen. According to a male farmer in Kasei:

> At the beginning of the 2020 minor growing season, a buyer came to me from Accra ... We agreed she was going to support me financially and in kind to grow maize. Given the size of my farm, I was confident that I could supply her with at least 100 bags of maize at the end of the season. Unfortunately, nothing worked that season, the rain was a huge disappointment. On top of that, the fall armyworms devoured the maize plant ... I could not even harvest 30 bags of maize to make the buyer somehow happy ... To sum up, I am still indebted to her (the buyer).

The farmers also expressed concerns over the inability of existing pesticides on the market to fully control the fall armyworms, and suggested that the Ministry of Food and Agriculture should collaborate with research institutions in the country to explore using local materials, such as ashes, and solutions made of neem (*Azadirachta indica*, A Juss) bark or leaf to manufacture pesticides. According to the farmers, trial-and-error methods, such as using ashes, neem leaf or bark extract, or a combination of them all, seemed to reduce the rate at which the insect breeds. Guodaar, et al. [25] and Shaiba, et al. [26] found that farmers in northern Ghana used neem leaf extract in an attempt to control the spread of crop pests, particularly the fall armyworm, yet these indigenous practices have not been as effective as expected. The farmers in Ejura-Sekyedumase Municipality also face challenges, such as those related to determining the required dosage and application timing to attain optimum results. The farmers believe that integrating scientific knowledge with their indigenous practices could improve the efficiency of the locally used materials in order to effectively control the pest. Derbile, et al. [27] pointed out that, despite the importance of local knowledge in climate change adaptation in Africa, it has potential limitations. Guodaar, Bardsley and Suh [25] reported that the risks and impacts posed by climate change are complex, and therefore, there is an urgent need for climate change adaptation to support the integration of farmers' indigenous knowledge and modern scientific knowledge, and thus build the farmers' resilience.

The farmers also suggested that there is a need for the government, through the MoFA, to promote and support mechanized maize farming so as to reduce the dependency on manual labor, and thus ensure timely cultivation. Finally, a few of the farmers (8%, 6% and 6% in Ejura, Kasei and Anyinasu, respectively) proposed that agro-chemical retailers in their respective communities could supply the farmers with agro-chemicals on credit, which they could repay at the end of the growing season.

4. Conclusions and Recommendations

Although extreme weather events such as El Niño in Ghana have been linked to the failure of crops such as maize, which provides an important source of nutrition for humans and animals and contributes to the national economy, it is unclear what factors were behind the 2020 minor season maize production failure that led to a massive shortage in and price increase of maize grains. Accordingly, this study sought to advance existing knowledge by examining the factors behind the 2020 minor season crop failure at Ejura-Sekyedumase Municipality, a major maize production area in the transitional agroecological zone of

Ghana. In addition, the constraints to building smallholder farmers' resilience to crop failures, food insecurity and rural poverty were investigated.

The respondents' views and the empirical meteorological data showed the recurrence of drought during the 2020 minor growing season, which resulted in the withering and failure of the maize plant. The prevalence of fall armyworm attacks on maize plants, which was also linked to the dry and warm conditions during the growing period, contributed substantially to the 2020 minor maize production failures. According to the farmers, other factors such as poor soils, a general lack of inputs and under-resourced mechanization, may have contributed, albeit minimally, to the observed maize failure during the 2020 minor growing season.

Multiple agronomic changes are being adopted by the smallholder farmers to reduce the risk of maize production failures. The notable agronomic changes reported included administering multiple pesticides to control pests (especially the fall arm worms), taking advantage of early rains to sow, sowing later when the rainfall is stable, increasing the use of fertilizers, crop rotation, and the planting of leguminous crops to improve soil quality. However, the inability of the farmers to master the onset and cessation of rainfall, the general ineffectiveness of pesticides, financial burdens, the general high prices of agrochemicals, and the unregulated farm-gate prices of maize are constraining maize production. From the point of view of the farmers and key informants, there is a need to build farmers' capacity and resilience through, for example, making loans more accessible, extending government policy on subsidizing fertilizers to other farm inputs such as pesticides and weedicides, developing irrigation (rainwater harvesting) facilities for farmers, regulating market prices, and implementing the standardization of maize grain measurement to benefit farmers.

Based on these findings, it is recommended that the government promotes and supports rainwater harvesting through, for instance, extending the government flagship program on 1V1D to the municipality to address prolonged droughts and help reduce pest outbreaks. There is an urgent need to marry farmers' indigenous knowledge of climate forecasting and controlling the fall armyworm outbreaks with science. In the case of the former, effective collaboration between the Ministry of Food and Agriculture and the Ghana Meteorological Agency is necessary to link climate information with agronomic practice, so that seasonal climate information can be relayed to the farmers in a timely manner. There is also a need for research and field trials of existing commercial pesticides and locally used materials in order to control the fall armyworm. When doing this, the farmers' indigenous knowledge should be considered to ensure easy adoption.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su14063514/s1, Figure S1: Average monthly min temperature of Ejura-Sekyedumase for the period 2015–2020.

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References

1. Boon, E.K.; Anuga, S.W. Circular economy and its relevance for improving food and nutrition security in Sub-Saharan Africa: The Case of Ghana. *Mater. Circ. Econ.* **2020**, *2*, 5. [CrossRef]
2. Masih, I.; Maskey, S.; Mussá, F.E.F.; Trambauer, P. A review of droughts on the African continent: A geospatial and long-term perspective. *Hydrol. Earth Syst. Sci.* **2014**, *18*, 3635–3649. [CrossRef]
3. United Nations. Transforming Our World: The 2030 Agenda for Sustainable Development. Available online: https://www.un.org/ga/search/view_doc.asp?symbol\protect$\relax\protect{\begingroup1\endgroup\@@over4}$A/RES/70/1&Lang\protect$\relax\protect{\begingroup1\endgroup\@@over4}$E (accessed on 22 February 2022).
4. Worqlul, A.W.; Dile, Y.T.; Jeong, J.; Adimassu, Z.; Lefore, N.; Gerik, T.; Srinivasan, R.; Clarke, N. Effect of climate change on land suitability for surface irrigation and irrigation potential of the shallow groundwater in Ghana. *Comput. Electron. Agric.* **2019**, *157*, 110–125. [CrossRef]
5. Wongnaa, C.A.; Awunyo-Vitor, D.; Mensah, A.; Adams, F. Profit efficiency among maize farmers and implications for poverty alleviation and food security in Ghana. *Sci. Afr.* **2019**, *6*, e00206. [CrossRef]
6. Adu, G.B.; Badu-Apraku, B.; Akromah, R.; Amegbor, I.K.; Adogoba, D.S.; Haruna, A.; Manigben, K.A.; Aboyadana, P.A.; Wiredu, A.N. Trait profile of maize varieties preferred by farmers and value chain actors in northern Ghana. *Agron. Sustain. Dev.* **2021**, *41*, 50. [CrossRef]
7. Owusu, K.; Ayisi, K.E.; Musah-Surugu, I.J.; Yankson, P.W.K. The effects of 2015 El Nino on smallholder maize production in the transitional ecological zone of Ghana. *Int. J. Clim. Change Strateg. Manag.* **2019**, *11*, 609–621. [CrossRef]
8. Cossar, F.; Houssou, N.; Asante-Addo, C. *Development of Agricultural Mechanization in Ghana: Network, Actors, and Institutions: A Case Study of Ejura-Sekyedumase District*; International Food Policy Research Institute: Washington, DC, USA, 2016.
9. Obour, P.B.; Dadzie, F.A.; Arthur, E.; Munkholm, L.J.; Saba, C.K.S.; Rubæk, G.H.; Owusu, K. Integration of farmers' knowledge and science-based assessment of soil quality for peri-urban vegetable production in GhanaRenew. *Agric. Food Syst.* **2020**, *35*, 128–139. [CrossRef]
10. Gbangou, T.; Ludwig, F.; van Slobbe, E.; Greuell, W.; Kranjac-Berisavljevic, G. Rainfall and dry spell occurrence in Ghana: Trends and seasonal predictions with a dynamical and a statistical model. *Theor. Appl. Climatol.* **2020**, *141*, 371–387. [CrossRef]
11. Ministry of Finance. Republic of Ghana Composite Budget for 2021–2024 Programme Based Budget Estimates for 2021Ejura-Sekyedumase Municipal Assembly. Available online: https://mofep.gov.gh/sites/default/files/composite-budget/2021/AR/Ejura_Sekyedumase.pdf (accessed on 17 January 2022).
12. IPCC. IPCC (2018) Summary for policymakers. In *Global Warming of 1.5 °C*; An IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty; Masson-Delmotte, V., Zhai, P., Pörtner, H.-O., Roberts, D., Skea, J., Shukla, P.R., Pirani, A., Moufouma-Okia, W., Péan, C., Pidcock, R., et al., Eds.; World Meteorological Organization: Geneva, Switzerland, 2018.
13. Usman, M.T.; Reason, C.J.C. Dry spell frequencies and their variability over Southern Africa. *Clim. Res.* **2004**, *26*, 199–211. [CrossRef]
14. Siatwiinda, S.M.; Supit, I.; Hove, B.v.; Yerokun, O.; Ros, G.H.; Vries, W.d. Climate change impacts on rainfed maize yields in Zambia under conventional and optimized crop management. *Clim. Change* **2021**, *167*, 39. [CrossRef]
15. Koffi, D.; Kyerematen, R.; Eziah, V.Y.; Osei-Mensah, Y.O.; Afreh-Nuamah, K.; Aboagye, E.; Osae, M.; Meagher, R.L. Assessment of impacts of fall armyworm, Spodoptera frugiperda (Lepidoptera: Noctuidae) on maize production in Ghana. *J. Integr. Pest Manag.* **2020**, *11*, 1–7. [CrossRef]
16. Bariw, S.A.; Kudadze, S.; Adzawla, W. Prevalence, effects and management of fall army worm in the Nkoranza South Municipality, Bono East region of Ghana. *Cogent Food Agr.* **2020**, *6*, 1800239. [CrossRef]
17. Ragasa, C.; Chapoto, A. Moving in the right direction? The role of price subsidies in fertilizer use and maize productivity in Ghana. *Food Secur.* **2017**, *9*, 329–353. [CrossRef]
18. Dapilah, F.; Nielsen, J.Ø.; Friis, C. The role of social networks in building adaptive capacity and resilience to climate change: A case study from northern Ghana. *Clim. Dev.* **2020**, *12*, 42–56. [CrossRef]
19. Adzawla, W.; Alhassan, H. Effects of climate adaptation on technical efficiency of maize production in Northern Ghana. *Agric. Food Econ.* **2021**, *9*, 14. [CrossRef]
20. Chaudhury, M.; Kristjanson, P.; Kyagazze, F.; Naab, J.B.; Neelormi, S. *Participatory Gender-Sensitive Approaches for Addressing Key Climate Change- Related Research Issues: Evidence from Bangladesh, Ghana, and Uganda*; Working Paper 19; CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS): Copenhagen, Denmark, 2012.
21. Klutse, N.A.B.; Owusu, K.; Adukpo, D.C.; Nkrumah, F.; Quagraine, K.A.; Owusu, A.; Gutowski, W.J. Farme's observation on climate change impacts on maize (*Zea mays*) production in a selected agro-ecological zone in Ghana. *RJAEM* **2013**, *2*, 394–402.
22. Nabavi-Pelesaraei, A.; Abdi, R.; Rafiee, S.; Bagheri, I. Determination of efficient and inefficient units for watermelon production-a case study: Guilan province of Iran. *J. Saudi Soc. Agric. Sci.* **2016**, *15*, 162–170. [CrossRef]

23. Nabavi-Pelesaraei, A.; Azadi, H.; Van Passel, S.; Saber, Z.; Hosseini-Fashami, F.; Mostashari-Rad, F.; Ghasemi-Mobtaker, H. Prospects of solar systems in production chain of sunflower oil using cold press method with concentrating energy and life cycle assessment. *Energy* **2021**, *223*, 120117. [CrossRef]
24. Ministry of Monitoring and Evaluation. Rapid Evaluation of One Village, One Dam Project Under IPEP. Available online: http://mome.gov.gh/rapid-evaluation-of-one-village-one-dam-project-under-ipep/ (accessed on 5 January 2022).
25. Guodaar, L.; Bardsley, D.K.; Suh, J. Integrating local perceptions with scientific evidence to understand climate change variability in northern Ghana: A mixed-methods approach. *Applied Geogr.* **2021**, *130*, 102440. [CrossRef]
26. Shaiba, Z.; Amoore, B.; Amoore, I.; Renne, E. Assessing the impact of neem on fall armyworm damage to maize crops: A field-based study in Nabdam District, UER, Ghana. *J. Sustain. Agric.* **2019**, *12*, 185–201.
27. Derbile, E.K.; File, D.J.M.; Dongzagla, A. The double tragedy of agriculture vulnerability to climate variability in Africa: How vulnerable is smallholder agriculture to rainfall variability in Ghana? *Jamba J. Disaster Risk Stud.* **2016**, *8*, 249. [CrossRef] [PubMed]

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Review

Review of Strategic Agility: A Holistic Framework for Fresh Produce Supply Chain Disruptions

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Abstract: The influence of the rapidly changing business environment due to the COVID-19 global pandemic presents an important organizational challenge to fresh produce export supply chains in developing countries such as Ghana. Such an inimical supply chain problem highlights the relevance of supply chain agility as a potent methodological framework to measure, monitor and evaluate these challenges in stable as well as turbulent times. This review paper focuses on the applicability of a framework for Supply Chain Agility as a methodological framework in stable (pre-COVID-19) versus turbulent (COVID-19) business environments. We argue and propose that Supply Chain Agility Framework is a holistic framework which is efficacious in both stable and unstable supply chain environments. This is amply supported by the central plank of our proposition that the Supply Chain Agility Framework offers an adaptable tool that can serve as a panacea to fresh produce supply chain challenges not only in a stable (pre-COVID-19) business environment but also effective and applicable in a turbulent business environment, such as experienced during the COVID-19 pandemic. The implications of this proposition for the fresh produce export supply chain industry and relevant stakeholders are duly presented.

Keywords: fresh produce supply chain; ombudsman agility framework; stable business environment; COVID-19 turbulent environment

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1. Introduction

The COVID-19 pandemic has disrupted global supply chains and negatively impacted national economies around the world [1]. This has revealed vulnerabilities in global food supply chains that are critical for human survival. Gao et al. [2] (p. 832) define supply chain disruptions as events such as fire or machine breakdown in a production facility, an unexpected surge in demand or a reduction in supply, natural disasters, or customs delays in a node of the supply chain. Food industry players in developing countries have been encouraged to explore global markets for their produce [3] to grow and further develop their businesses [4]. Such a strategy will enable them to take advantage of the potential benefits of participating in the global economy [5,6]. However, global food supply chains have been largely affected and brought under scrutiny during this pandemic as countries respond to measures and regulations to combat the pandemic [7–9]. Indeed, food production, transporting and shipping have been disrupted to different degrees and in different instances [10,11]. These have caused unprecedented disruptions at various operational levels in these supply chains and participating organisations. [8,11–13] The attendant disruptions in the demand patterns from international to the local have called into question the paradigm anchored in overreliance on global supply chains in times such as the current pandemic as against alternative parallel development of "local food" channels for these global export food chains [14,15], especially those with linkages to Sub-Saharan African food supply chains [16].

Ghana, a Sub-Saharan African lower middle-income country has been supported by global organisations to develop alternate exports, which are mainly for food products and termed as Non-Traditional Exports (NTEs) [17,18]. In Ghana, one of the main NTEs is the export of fresh pineapples. Typically, food export supply chains have been developed based on the paradigm of participating in world trade [3,6,19] with the hope of building competitiveness [20]. However, these food export supply chains, especially the fresh pineapple export chains have on many occasions suffered major incidents/shocks of changes in market regulation and in demand patterns that have bankrupted a significant number of chain actors (companies) seeking to export in the recent past [21–23]. Admittedly, the COVID-19 pandemic is by all measures a major global challenge which has severely impacted the export food chains. These shocks especially by this pandemic are more devastating as almost all food exporters in developing countries such as Ghana, do not have alternative competitive "local food" product outlets to rely on in times of such global pandemics [5,16]. Therefore, where almost all national country borders were closed to human and goods traffic for food exporters at some point during the pandemic as part of measures to manage the pandemic, this did create critical challenges. These issues cascade into other issues of safeguarding small and medium businesses to protecting local economies. However, these incidences and shocks encountered by actors in the fresh fruits export supply chain would have to serve as learning opportunities to build strategic agility in these chains [4,24–26]. This is to improve competitiveness in these chains and enable them to withstand shocks in their connection to international food supply chains [4,10,24,26,27].

In this review paper, therefore, we use a developing country fresh fruit export supply chain (i.e., Ghanaian Pineapple Exports Supply Chain) as a case study to illustrate the pre-COVID and during COVID scenarios of developing country fresh fruit supply chains, to explore the current supply chain paradigm, the alternatives to building agility and competitiveness, and the paradigm of creating alternative "local food" channels in fresh fruit supply chains. The review is grounded in the domain of alternative methodological framework used for the evaluation and monitoring of strategic agility in horticultural export supply chains and their context of development [5] to make the following contributions: First, present the competitiveness and agile efficacy imperatives of the Ghanaian Fresh Pineapple Exports supply chain before the COVID-19 pandemic. Secondly, we present the competitive advantage and strategic agile efficacy imperatives of the Ghanaian Fresh Pineapple Exports supply chain during COVID-19 pandemic.

It is our position that the need has arisen for a second look at paradigms for the development of fresh fruit supply chains, especially in Sub-Saharan African countries to build competitiveness through strategic agility to ensure corresponding resilience. Based on a critical review focused on the applicability of Supply chain agility as a methodological framework in a stable (pre-COVID-19) versus turbulent (COVID-19) business environment, we argue that strategic agility framework offers an adaptable tool as a panacea to fresh produce supply chain challenges in both stable and turbulent fresh produce export supply chain environments.

The rest of the paper is organized as follows: the theoretical foundations of agility in supply chains; horticulture exports supply chain and the COVID-19 pandemic; horticulture exports supply chain monitoring and evaluation and the theoretical lens for supply chain agility. Then, the scenarios for comparing the applicability of strategic agility under stable and turbulent COVID-19 business environments are presented. Followed by the background of the Ghanaian fresh pineapple supply chain to Europe; supply chain agility as a methodological framework in a stable (pre-COVID-19) and turbulent (COVID-19) business environments; propositions; and concluding remarks and contributions. The paper concludes with the implications for research.

2. Theoretical Foundations of Agility in Supply Chains

The literature describes strategic agility as the "ability of management to constantly and rapidly sense and respond to a changing environment by intentionally making strategic

moves and consequently adopting the necessary organizational configuration for successful implementation" (Weber and Tarba, [28] (p. 7)). Therefore, strategic agility examines processes, actions, structures, culture, attributes, skills and relationships designed to ensure the organization remains flexible when it faces uncertainties [28]. This is important as De Groote [29] defines flexibility as a hedge against the diversity of the environment. Additionally, Shukla et al. [30] defined it as the ability to change with little penalty in time effort, cost or performance' across four dimensions: temporal, range, intention and focus. Strategic agility gained prominence as current theoretical approaches such as "strategic planning", "competitive advantage" and "resource-based view" were found inadequate and vague for strategic options in the complex business environment and market disruptions [28,31]. The introduction of the concept of the agile enterprise was driven by the emergence of rapid change in the business environment is accelerating and overtaking the abilities of many organisations to adapt [32]. Thus, as enabling, many organisations gained leverage from the strategic agility concept [33]. From the literature, the main thrust of strategic agility is flexibility notably the capacity of the actors and or entities to rapidly sense and seize opportunities, change direction and avoid collusion or failure [30,34–36]. However, the ability and potency to remain sufficiently agile in order to manage and adjust to change caused by strategic discontinuities, business environments and disruptions remain the main crust of the strategic agility philosophy [37]. Thus, strategic agility examines actions, processes, structures, culture, attributes, skills and relationships designed to ensure the organization, the network or the supply chain remains flexible when it encounters uncertainties [28].

However, does strategic agility provide leverage in supply chains? The thrust of strategic agility's relationships with flexibility throughout an organisation or supply chain implies a perspective of reconfiguring resources in an organization or supply chain for optimum performance [38,39]. Thus, as a competitive strategy component that can be pursued in management scenarios, it is the ability to swiftly change businesses and business processes beyond the normal level of flexibility to effectively manage unpredictable external and internal changes in an organisation or supply chain. Strategic agility, therefore, is seen as a concept with broad scope and has "multidimensional constructs" in supply chains and is generally presented as supply chain agility (SCA) [40].

The literature traces the evolution of the concept of supply chain agility to four main aspects: pathways, criteria, scope and objectives [41]. The early proponents restricted it to customer responsive manner [42], thus limiting the concept to a reactive capability of providing speedy responses to sudden changes in demand, to gain leverage [41]. However, after Li et al. [43] work, the concept has been significantly widened with different adaptations. Do et al. [41] capture this evolution in Figure 1.

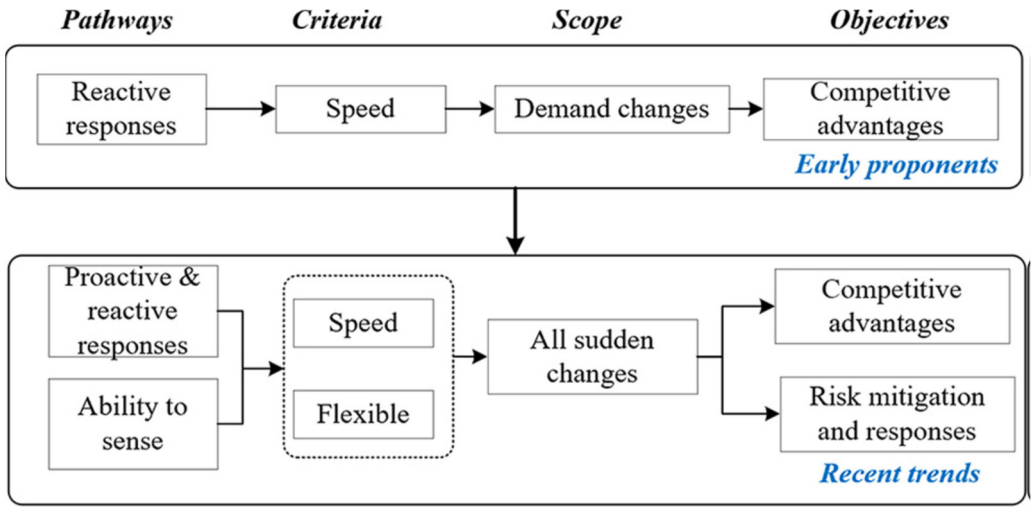

Figure 1. Evolution of Supply Chain Agility Concept (Adapted from Do et al. [41] (p. 739)).

As a pathway, supply chain agility is now conceptualized to include the physical capability of taking reactive and proactive measures, and the cognitive capability of alertness and quick anticipation and detection of opportunities and sensing turbulence [41]. Golgeci et al. [44] expanded these cognitive capabilities to include market learning and innovation. The criteria perspective of supply chain agility expands the speed criterion for response assessment to change to include flexibility [36,39,43,45–47]. The scope perspective ensues supply chain agility expanded to include all sudden changes both internal and external. Li et al. [43] included the immediate and sudden components of change to the scope and other literature includes uncertain, temporary, abrupt and unexpected changes in the short and immediate term [47–50]. Do et al. [41] assert that this attribute of supply chain agility is more pertinent in scenarios such as the COVID-19 pandemic context. From the dimension of the objectives or the overarching goal of the supply chain, Yusuf et al. [47] emphasize that supply chain agility enables firms to attain leverage and competitive advantage. Thus, improving competitive metrics such as operational performance indicators (i.e., product innovation, lead time reduction and service quality), and strategic performance indicators (i.e., competitiveness, financial, relational and marketing performance) [51–53]. In addition, the literature incorporates supply chain agility in business continuity [54], and opportunity–seeking in times of turbulence [13,55] to serve as risk-mitigating factors [38,56,57].

2.1. Horticulture Exports Supply Chain and COVID-19 Pandemic

Research on the global COVID-19 pandemic posits that it is expected to have severe economic consequences, resulting in a 3 % contraction of the world economy [22]. In this view, countries in Sub-Saharan Africa (SSA) are expected to be most severely affected [16]. Vos et al. [9] posited that the COVID-19 pandemic will affect food supply chains in three main ways. These are succinctly captured in Van Hoyweghen et al. [13] (p. 424) as:

i. "disruptions in international trade, stemming from an increase in trade costs due to restrictions in international mobility and quarantine measures, or stemming from trade policy measures, such as export taxes and bans, in response to the crisis."
ii. "decline in on-farm labour, stemming from workers being unwilling or unable to work due to contamination risk and various containment measures, leading to reductions in land productivity and declining agricultural output."
iii. "decline in productivity and farm output, caused by disruptions in distribution channels and in the provision of capital inputs and services. Effects likely differ with the type of product, and the structure and organization of supply chains."

In addition, the literature recognises that the size of production and distribution units, the capital intensity of operations, the level of vertical coordination, the length of the chains, and the level of integration in international markets will be impacted differently resulting in supply chains exhibiting different levels of resilience to the effects of COVID-19 pandemic [49,58,59]. These will affect supply chains differently with distinctions in traditional, transitional and modern supply chains. Van Hoyweghen et al. [13] (p. 424) therefore argued that "as traditional and transitional supply chains are less integrated in international markets on the output side and oriented more toward production for domestic markets, they might be less affected by international trade disruptions."

2.2. Horticulture Exports Supply Chain Monitoring and Evaluation

We then proceed to review the literature on monitoring and evaluation frameworks for horticultural supply chains to enable the study to evaluate the effects of the global COVID-19 pandemic measures in the Ghanaian horticultural supply chain. There is a need to monitor and evaluate the horticulture export supply chain for the impact of the pandemic and present strategic agility imperatives. The literature presents studies and frameworks for optimal replenishment strategy [60] and disruption risk mitigation [2]. However, Webber and Labaste [20] posit the application of traditional monitoring approaches in most Sub-Saharan African horticultural export supply chains encounters difficulties. These include, but are not limited to systems, that are not adjusted to the measurement vocabulary of the

industry; challenges in attributing industry changes to strategic interventions; inability to provide insights from monitoring into enhancing organisational practices to drive the industry; and inability to clearly delegated or insufficient resources allocated monitoring responsibilities. There is, therefore, the need for appropriate methods for monitoring performance in the Sub-Saharan African horticultural export supply chain to provide feedback for decision-making, especially in a global disruption such as the COVID-19 pandemic. Even as the markets for the exporters are driven by foreign demand with high continual business environment changes.

Currently, the literature acknowledges the PAID (Process indicators, Action indicators, Investment indicators, Delivered results) framework as the most comprehensive evaluation approach used for supply chains [20]. This framework not only measures co-investment by stakeholders in addition to delivered results and can be used in supply chain projects when proper benchmarks are determined by chain actors. However, it has not been designed to measure impacts experienced by actors in the supply chain and various systems components of the supply chain. The framework focuses on performance chain-wide by (1) implementation of strategy and (2) increases in productivity [20]. Therefore, leaving a gap of in need for a framework to measure the effects on the systems component of the supply chains.

2.3. A Theoretical Lens for Supply Chain Agility

From Section 2, supply chain agility seen as strategic agility requires the competence to manage, sense changes and mobilize resources to adjust to change caused by strategic discontinuities, business environment and disruptions. Thus, supply chain agility could be considered a dynamic capability, since the literature defines dynamic capability as the ability to "integrate, build and reconfigure internal and external competencies to address rapidly changing environments" (Teece, [61] (p. 516)). Do et al. [41] present research that has employed dynamic capability as a theoretical lens to enhance understanding of strategic supply chain agility [45,48,53,61,62].

The framework to sense the required supply chain agility prerequisites and redesign variables as discussed in Section 2.2 has been sparsely researched and has left a gap in the measurement of supply chain components. Since supply chain agility as strategic agility is a management decision and Mentzer et al. [63] proposed a broader and generalised definition for supply chain management as the systematic, strategic coordination of business functions and organisation tactics across actors within the supply chain, ultimately for improving the long-term performance of the supply chain actors and the supply chain as a whole. In addition, from the system dynamics view and the "logistical concept", a supply chain scenario consists of a managed system, managing system, information and organization [64].

Therefore, to ensure the application of supply chain agility and to implement it, there are identified variables in the supply chain that could be redesigned to achieve the required agile configuration of the supply chain. These are the supply chain redesign variables. A supply chain redesign variable is defined as a management decision variable at the strategic, tactical or operational level that determines the setting of one of the descriptive elements of the managed, managing, information system or organization structure [49]. Vorst [46] (p. 64) classifies these redesign variables in a supply chain as shown in Table 1.

Additionally, Yawson and Aguiar [65,66] developed elements of the components that will require supply chain agility in developing countries' horticultural export supply chains based on the redesign variables in Table 1 and is presented in Table 2.

With the disruptive change due to the COVID-19 pandemic in fresh produce supply chains, therefore, dealing with uncertainty denotes whether or when a certain event occurs. However, dealing with uncertainty requires evaluating the implications if certain events were to occur. In the case of the fresh produce supply chain, strategic agility would be the supply chain actor organizations or chain-wide supply chain response. Generally, for fresh produce supply chains, horticultural producers adopt and develop various strategies in

order to survive and develop [51]. These strategies are based on three key aspects: (1) organisational innovation; (2) production innovation; and (3) product innovation [67].

Table 1. Classification of Supply Chain Redesign Variables. Adapted from Vorst (2000) [46] (p. 64).

Managed System	Managing System	Information System	Organization
Network design Facility design Resource and product characteristics	Hierarchical decision levels Type of decision making Position of the Customer order decoupling point (CODP) Level of coordination ○ Within organization ○ Within the supply chain	Transactional IT systems Analytical IT systems	Division of tasks Division of authority and responsibilities.

Table 2. Typology of Fresh Produce Horticultural Export Supply Chain Elements of the Components Requiring Agility.

Supply Chain Management Concept Component	Elements of The Supply Chain Components Requiring Agility
Managed System (Infrastructure) (MDS)	Cold chain infrastructure_*(MDS 1)*
	Post-harvest infrastructure_*(MDS2)*
	Packaging material (e.g., pallets, cartons)_*(MDS3)*
	Field infrastructure for production_*(MDS4)*
	Field infrastructure for labour_*(MDS5)*
	Internal logistics infrastructure (e.g., transport)_*(MDS6)*
	External logistics infrastructure (e.g., shipping, air)_*(MDS7)*
	Road infrastructure_*(MDS8)*
	Environment (e.g., taxes, regulation)_*(MDS9)*
	Production infrastructure_*(MDS10)*
	Input suppliers (e.g., fertilizers, pesticides)_*(MDS11)*
	Planting material production_*(MDS12)*
	Distribution network design_*(MDS13)*
	Product varieties_*(MDS14)*
	Land for production_*(MDS15)*
	Irrigation facilities_*(MDS16)*
Managing System (Management) (MGS)	Management structure_*(MGS1)*
	Management Systems_*(MGS2)*
	Decision Making_*(MGS3)*
	Level of coordination in the organization_*(MGS4)*
	Level of coordination in the supply chain_*(MGS5)*
Information System (INS)	Information exchange system_*(INS1)*
	Electronic information systems_*(INS2)*
	Electronic information management_*(INS3)*
	Databases on markets and competition_*(INS4)*
	Standardized information system for supply chain integration _*(INS5)*

Table 2. *Cont.*

Supply Chain Management Concept Component	Elements of The Supply Chain Components Requiring Agility
Organization (ORG)	Definition of organizational logistical objectives_*(ORG1)*
	Definition of supply chain logistical objectives_*(ORG2)*
	Definition of organizational logistical performance indicators_*(ORG3)*
	Definition of supply chain logistical performance indicators_*(ORG4)*
	Training of staff (internal and external)_*(ORG5)*

Therefore, we adopt the framework by Yawson and Aguiar [65] and Yawson and Aguiar [66] to identify components and elements in a developing countries' horticultural export supply chain that required agility due to the disruption of the COVID-19 pandemic. This is to provide insight into supply chain evaluation in the horticultural export development context to enable the building of the critical responsive strategy required to compete. In the framework, the external and internal environment are conceptualised to affect the four theoretical (logistical concept) components of the supply chain, the managed system (infrastructure), managing system (management), information system and organisation system. The framework is shown in Figure 2. The relationships of the agility drivers to the various components of the supply chain are presented, ensuring the framework account for internal and external environmental factors (politics, economics, society and technology) [68] and also four agility dimensions: cooperating to enhance competitiveness, enriching the customer, mastering change and uncertainty, and leveraging the impact of people and information [69]. Additionally, the framework also accounts for companies as part of a network, showing the affected and the level of agility of the supply chain [70]. From the framework in Figure 2, the change factors relate to the following components of the supply chain elements:

- **The managed system:** The supply chain actors with specified roles in the supply chain and their required infrastructure [71], which can be viewed from three levels: network design, facility design, and resource characteristics.
- **The managing system:** This component plans, controls and coordinates the business processes in the supply chain to ensure the realization of the logistical objectives within the limitations of the supply chain configuration and strategic supply chain objectives [72].
- **The information system:** This component provides and coordinates the information for the managing system for decision-making and control of actions.
- **The organisation structure:** This component comprises two main elements [73]: the establishment of tasks and their coordination to realize set objectives.
- **Agility drivers:** These are internal or external factors in the business environment influencing the required level of business agility. Zhang and Sharifi [55] (p. 498) define "agility drivers as changes/pressures from the business environment that necessitate a company to search for new ways of running its business in order to maintain its competitiveness".
- **Specification of redesign variables (capabilities):** These are the essential capabilities variable needed by the company in order to respond positively to utilising the business environment changes.
- **Agility gaps:** Agility gaps arise when the firm has difficulty in acquiring the level of agility to respond to business environment changes in a timely and cost-effective manner.
- **Agility enablers:** Agility enablers are the required variables for a business to enhance its strategic agility. The model presents enablers of supply chain actors and supply chain strategic agility.

- **Supply chain performance:** Supply chain performance is the level at which a supply chain fulfils end-user requirements based on performance indicators and the given total cost to the supply chain [46].
- **Agility redesign variable:** This is management decisions at the strategic level that determines one of the logistic concept components of the supply chain (managed, managing, information system and organisation structure).

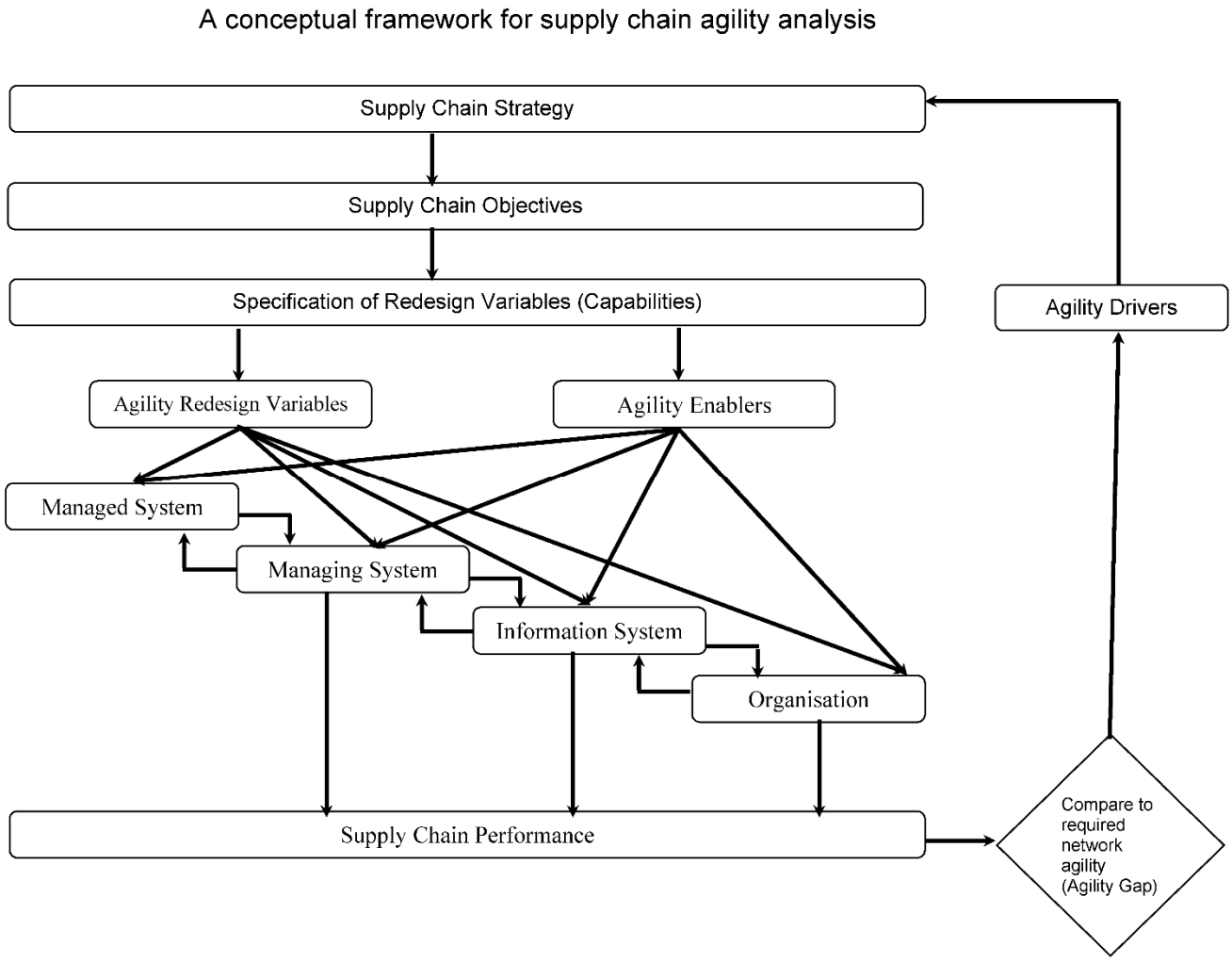

Figure 2. Conceptual Framework for Supply Chain Agility Analysis.

The framework operates in two steps: Firstly, it identifies the elements of the components of the supply chain that requires agility by identifying elements of component that actors of the chain find difficult in meeting or changing to meet in the supply chain. This is done through a questionnaire sent to actors in the supply chain with questions on the elements of the components shown in Table 2. Secondly, the questionnaire is then analysed for the Agility gap using an index interpreted and interventions prescribed.

The Agility Gap Index is adapted from the work of van Oosterhout et al. [70]. They developed a business Agility Gap index for which they argue that if businesses find it difficult to cope with major changes which go beyond their normal flexibility, they are termed to have faced an agility gap. The interview instrument for the framework interrogates strategic agility with a two-stage question approach. The first step asks the participant "To what extent are changes in the current business environment affecting supply chain elements in your business?" (Then, a list of the elements of the components follows). The items are scored on a Likert-5point scale anchored on 1 (Very low) to 5 (Very high). For items representing processes that score 4 or 5 (high and very high extent of

change, respectively) a follow-up question. Therefore, whole business entities, supply change actors and specific supply change processes could be termed to have an agility gap. The changes required are termed business change and the factors causing these are business environment change factors. In the second step, the degree of the impact due to the business environment change factor is measured with a follow-up question in the survey instrument for items representing processes that score 4 or 5 (high and very high extent of change, respectively) on a Likert-5point scale asking the participant to indicate the level of difficulty in having to cope with the change. The responses to the follow-up questions are also scored on a Likert-5point scale of difficulty anchored on 1 (Very low) to 5 (Very high). These are then computed as an Agility gap index score with a percentage. Therefore, Agility gap index scores can be computed for elements of the supply change components, an aggregate of the components in supply chains and whole supply chains [65,66]. The results are interpreted according to a scale developed by Oosterhout et al. [70]. The agility gap index calculated as a ratio in percentage is scaled to a number between 0% (no Agility gap at all) and 100% (largest Agility gap possible). These are classified as 'most urgent' gaps (ratios $\geq$ 60%), 'high urgency' gaps (ratios > 50% and < 60%), 'lower level of urgency' gaps (ratios > 40% and $\leq$ 50%), 'Normal' gaps (ratios < 40%) and 'No Gap at All' (ratios = 0) using a scale by van Oosterhout et al. [70]. The higher the agility gap index ratio percentage, the more urgent the agility gap. According to Oosterhout et al. [70] if businesses find it difficult to cope with major changes, which go beyond their normal level of flexibility, they are faced with an agility gap and need intervention. Therefore, the supply chain agility methodological framework has the potential as a potential panacea to identify components of the horticulture export supply chain for the development of a responsive strategy to resolve fresh produce export chain challenges in a turbulent (COVID-19) business environment.

3. Scenarios for Comparing the Applicability of Strategic Agility under Both Stable and Turbulent COVID-19 Business Environments

This review seeks to contribute to the knowledge of supply chain agility as a strategic alternative for developing country horticulture export supply chains. Thus, from the literature review and framework proposed, our research questions are that supply chain agility as a strategic alternative for fresh produce export supply chains from developing countries provides a better option for export organisations. Secondly, from the nuance of developing country fresh produce export supply chains, the framework proposed will be a potent tool for diagnosing, monitoring and evaluating the strategic options in both stable and turbulent business environments for fresh produce supply chains.

From the literature, Van der Heijden [74] posits that scenarios offer relevant language for strategic conversation as they allow differentiation in views. Earlier on, Porter [75] had defined a scenario as 'an internally consistent view of what the future might turn out to be'. Vorst [46] (p. 47) adds that this view refers to changes in the environment but also to the system itself and then defined a supply chain scenario as "an internally consistent view of a possible instance of the logistical supply chain concept, i.e., the managed, managing, and information systems and organisational structures in the supply chain". In addition, the literature defines a 'best practice' supply chain scenario as 'a feasible supply chain configuration and operational management and control for all supply chain stages that achieves the best outcome for the whole system' [46] and is considered to be about doing things in the most effective manner, usually focusing upon a specific activity or operation (a critical success factor) [76]. Caplice and Sheffi [77], define the effectiveness of a supply chain as 'the degree to which the objectives are realised'. The review, therefore, uses the conceptual framework for supply chain agility analysis scenarios of the stable environment (pre-COVID-19) and turbulent environment (post-COVID-19) of Ghana's pineapple export supply chain to provide an illustrative example of supply chain agility as a concept for developing mitigating strategies due to the disruptions of the COVID-19 pandemic.

3.1. Ghanaian Fresh Pineapple Supply Chain to Europe

In Ghana, supply chains of suppliers to the EU and UK markets are structured differently with different levels of sophistication. Most of the firms aggregate as export organizations and associations as actors in the supply chain to export mainly by sea. The main organisation for fresh pineapple exports is the Sea-Freight Pineapple Exporters of Ghana (SPEG). The Sea-freight Pineapple Exporters Association of Ghana (SPEG), formed in 1994, has about 30 export companies in good standing as members who account for over 80% by volume and close to 95% by value of the total Ghanaian pineapple exports to Europe (Data from SPEG). The organisation is made up of Exporters and Producers/Exporters of Ghanaian pineapples and their focus is to promote growth within the Ghanaian pineapple industry by providing sea-freight and other support services for the benefit of its members. SPEG ships fruits to Port Vado in Italy, Port Vendres in France and Antwerp in Belgium.

The Ghanaian fresh pineapple supply chain to Europe comprises mainly of these 30 firms from SPEG with six large producers-exporters members accounting for over 65% of total exports by volume. These major players are Jei River Farm, Golden Exotics, Koranco Farms, Volta River Estates, Hans Peter Werder (HPW), Prundent Farms and Bomarts Farms all belonging to the Sea-Freight Pineapple Exporters of Ghana. The pineapple sector is characterized by heterogeneous producers which vary in size, technical standards and export volume. Many producers involve small-holders, some involved in out-grower schemes, supplying pineapples to medium to small exporters and domestic market operators [23,73]. In 2018, the association exported 35, 200 MT of fresh pineapples; 18, 280 MT in 2019; 17,402 MT in 2020 and 16,500 MT in 2021. Each company employs a 50 to 550 workforce and an annual turnover of 40,000 USD to 500,000 USD (Data from the survey and verified with SPEG). Additionally, three pineapple processing companies (Blue Skies from the United Kingdom, Tonggu Fruits from The Netherlands and First Catering) export fresh-cut pineapple and other fruits to extraordinarily demanding European retailers such as Marks & Spencer and Sainsbury's. These companies produce and export pineapple fruits of Smooth Cayenne, MD2, organic, Fairtrade and a mix of other varieties. The flow of pineapples from Ghana to the EU and UK was depicted by Fold and Gough [23] from which we derived Figure 3.

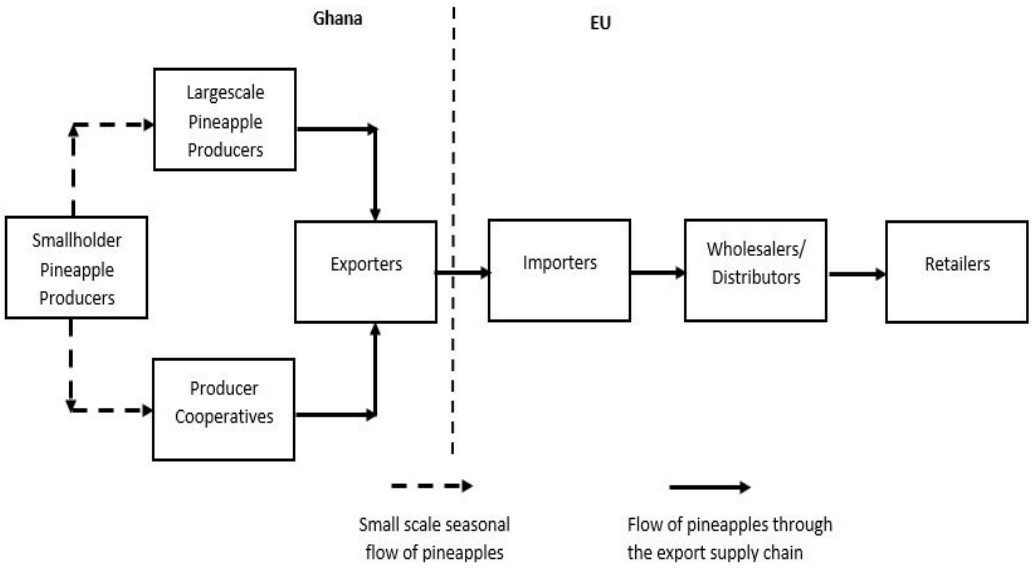

Figure 3. Pineapple Flows from Ghana to EU and UK.

3.2. Supply Chain Agility as a Methodological Framework in a Stable (Pre-COVID-19) and Turbulent (COVID-19) Business Environments

Under a stable (pre-COVID-19) business environment of the Ghana Pineapple Export Supply Chain scenario, Yawson and Aguiar [65] (p. 210) reported that their Agility Gap

framework is a valuable tool to understand international export supply chains for fresh pineapple export chains of Costa Rica, Ivory Coast and Ghana. The framework was found to be valid at the business level such as in the cases of Compagnie Fruitière (UK) Ltd (Dartford, UK). and Wealmoor UK Ltd (Greenford, UK). Therefore, this type of framework used to evaluate strategic supply chain agility could be employed in the supply chain of other subsectors of the economy and industries to guide managers in the identification of agility gaps to enhance competitiveness. As a tool, it also enables supply chain actors to identify and address supply chain strategic issues such as market channel selection, the conditions of market access, and current and future business environment conditions in fresh produce supply chains. This application, we expect when engaged in should improve supply chain agility, performance and competitiveness of the actors in the Ghana fresh pineapple exports."

Alternatively, within the context of supply chain agility as a methodological framework in a turbulent (COVID-19) business environment the framework of the Ghana Pineapple Export Supply Chain scenario, we argue that all the four components (managed system, managing system, information system and organisation) come into sharp focus for intervention at various degrees (see [36,65,66]). It important to emphasise that despite the varied degree of relative intervention required, each component ought to be addressed with dispatch. There are therefore ample grounds to argue that the strategic agility framework offers an adaptable vehicle to serve as a panacea to fresh produce supply chain challenges in a stable (pre-COVID-19) as well as turbulent COVID-19 pandemic business environment. However, the configuration of the components under turbulent environments ought to be amendable for prompt deployment.

This first set of scenarios based on Yawson and Aguiar [66] presents the first step of the framework enabling the identification of the state of the pineapple export supply chain in the stable (pre-COVID-19) business environment and the state of the supply chain in turbulent (COVID-19) business environment. Secondly, the framework enables the identification of the components in the supply chain that needs strategic agility interventions and urgency. Thirdly, the two scenarios when compared show that the COVID-19 pandemic aggravated the need for strategic agility interventions in all four components of the supply chain. Fourth, to enable the recommendation of strategic agility interventions in the supply chain, there is the need for a reference to the scores of the elements in Table 2 reported earlier to identify the areas that need strategic agility interventions in the supply chain. We suggest that strategic agility challenges due to the turbulent environment caused by the COVID-19 disruption most likely affected the managed system, which is the need for the modification of the "Production infrastructure to make it more flexible to respond to high variations in demand in the supply chain. Additionally, other challenges for supply chain agility will mostly occur for "Field infrastructure for production, "External logistics infrastructure (e.g., shipping, air)", and "Input suppliers (e.g., fertilizers, pesticides). These managed system elements challenges in the COVID-19 disruptions create strategic agility challenges for the Ghanaian Pineapple Export supply chain. This is in line with other research which argues for investment and innovation in fresh fruit supply chains to build resilience [7,58,78]. The disruptions certainly required improved communications in the supply chain for governance in the unpredictable environment. Therefore, Ghanaian exporters required increasing sophistication of Market Information Systems and an increasing need to improve the gathering of market information to importers to enable them to communicate with exporters and monitor demand and prevailing market conditions in the EU as suggested by [1,49]. Finally, addressing each of these elements provides a holistic strategic agility intervention to be followed with stakeholder consultation and participation in the implementation of the intervention.

3.3. Propositions

This review paper based on the above narratives recommends the following three research propositions to be empirically explored in future research:

Proposition 1. *The tactical and operational applicability of the agility framework under non-pandemic or stable international business environment as established by Yawson and Aguiar [66] as having potential strategic efficacy and diagnosing bottlenecks to enable the realignment of disrupted fresh produce supply chains under pandemic disrupted global business environment.*

Proposition 2. *The critical areas of focus to drive strategic agility framework application under turbulent or pandemic conditions are: flexibility of production infrastructure; amenability of external logistic infrastructure and effective strategic training programme across producer organisations.*

Proposition 3. *A diversification strategy in the form of developing a complementary premium local market channel alongside international markets holds stabilizing potential for the industry.*

4. Concluding Remarks and Contributions

In conclusion, the rapidly changing business environment due to the COVID-19 global pandemic presented an important organizational challenge to fresh produce export supply chains in exporting developing countries such as Ghana. This supply chain problem highlights the relevance of supply chain agility as a potent methodological framework to measure, monitor and evaluate these challenges in a stable as well as turbulent times. The framework derived in the research could be used to identify components and elements of horticulture supply chains at the strategic, tactical and operational levels to give a fast and easy way to enable the development of supply chain agility interventions to be proposed, implemented and monitored in stable and turbulent business environments.

4.1. Contribution to Practice

In addition, for practice the strategic agility methodology provides both operational and strategic insights on the managed system, managing system, information system and organisation structure components of the supply chain. Further, the review identifies important elements of the supply chain to make management decisions on strategic agility in the supply chain under stable as well as turbulent business environments. Thus, the review's arguments and propositions offers are relevant for practitioners to formulate and recommend alternative paradigms for the development of the supply chain and individual actors in the chain. There is ample coverage of critical information for the strategic decision for globalizing supply chain development in developing countries.

4.2. Implication for Research

In research, firstly, scholars will benefit from the application of the methodology guide for more development and validation of the three propositions. Secondly, this review paper presented another context apart from the Yawson and Aguiar's [65] application in which the framework was used to identify and evaluate interventions for strategic changes by actors and stakeholders in a horticultural export supply chain in a pre-test/post-test context to determine the effect of disruptions and to facilitate the redesign of the supply chain to improve the effectiveness, efficiency and strategies. Additionally, the framework could be employed to assess the impact of market trends, business environment policies, industry application of technology and legislation to enhance the strategic agility of supply chains using our approach. Thirdly, we acknowledge that this approach to assess strategic supply chain agility be considered as an initial step towards a generic framework that could be used to monitor and evaluate interventions in horticulture export supply chains with the ultimate aim of improving supply chain agility in developing countries. Additionally, for future research, we propose first the testing of the propositions in the paper, then the testing of the proposed framework in other developing countries, and thirdly, testing the framework in other developing country industry contexts such as other high-value export perishables.

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References

1. IMF. World Economic Outlook, 2020 (April), the Great Lockdown. Available online: https://www.imf.org/en/Publications/WEO/Issues/2020/04/14/weo-april-2020 (accessed on 24 February 2022).
2. Gao, S.Y.; Simchi-Levi, D.; Teo, C.P.; Yan, Z. Disruption risk mitigation in supply chains: The risk exposure index revisited. *Oper. Res.* **2019**, *67*, 831–852. [CrossRef]
3. World Bank. *World Development Report 2008: Agriculture for Development*; World Bank: Washington, DC, USA, 2008.
4. Giuliani, E.; de Marchi, V.; Rabellotti, R. Do global value chains offer developing countries learning and Innovation opportunities? *Eur. J. Dev. Res.* **2017**, *30*, 389–407.
5. Feyaerts, H.; Van den Broeck, G.; Maertens, M. Global and local food value chains in Africa: A review. *Agric. Econ.* **2020**, *51*, 143–157. [CrossRef]
6. Gereffi, G. Global value chains in a post-Washington consensus world: Shifting governance structures, trade patterns and development prospects. *Rev. Int. Political Econ.* **2014**, *21*, 9–37. [CrossRef]
7. Laborde, D.; Martin, W.; Vos, R. Impacts of COVID-19 on global poverty, food security and diets. *Agric. Econ.* **2021**, *52*, 375–390. [CrossRef]
8. Reardon, T.; Bellemare, M.F.; Zilberman, D. How COVID-19 May Disrupt Food Supply Chains in Developing Countries. Retrieved from IFPRI Blog Post. 2020. Available online: https://www.ifpri.org/blog/how-covid-19-may-disrupt-food-supply-chains-developingcountries (accessed on 20 February 2022).
9. Vos, R.; Martin, W.; Laborde, D. How Much Will Global Poverty Increase Because of COVID-19? 2020. Available online: https://www.ifpri.org/blog/how-much-will-global-poverty-increase-because-covid-19 (accessed on 20 February 2022).
10. Glauber, J.; Laborde, D.; Martin, W.; Vos, R. COVID-19: Trade restrictions are worst possible response to safeguard food security. In *COVID-19 & Global Food Security*; Swinnen, J., McDermott, J., Eds.; International Food Policy Research Institute (IFPRI): Washington, DC, USA, 2020; pp. 66–68. [CrossRef]
11. Hobbs, J.E. Food supply chains during the COVID-19 pandemic. *Can. J. Agric. Econ.* **2020**, *68*, 171–176. [CrossRef]
12. Reardon, T.; Swinnen, J. COVID-19 and Resilience Innovations in Food Supply Chains. Retrieved from IFPRI Blog Post. 2020. Available online: https://www.ifpri.org/blog/covid-19-and-resilience-innovations-food-supply-chains (accessed on 20 February 2022).
13. Van Hoyweghen, K.; Fabry, A.; Feyaerts, H.; Wade, I.; Maertens, M. Resilience of global and local value chains to the COVID-19 pandemic: Survey evidence from vegetable value chains in Senegal. *Agric. Econ.* **2021**, *52*, 423–440. [CrossRef] [PubMed]
14. Christiaensen, L.; Rutledge, Z.; Taylor, J.E. Viewpoint: The future of work in agri-food. *Food Policy* **2021**, *99*, 101963. [CrossRef]
15. Panwar, R. It's time to develop local production and supply networks. Strategy Insight Note. *Calif. Manag. Rev.* **2020**, *28*, 1–3. Available online: https://cmr.berkeley.edu/2020/04/local-production-supply-networks/ (accessed on 24 February 2022).
16. McCullough, E. Labor productivity and employment gaps in Sub-Saharan Africa. *Food Policy* **2017**, *67*, 133–152. [CrossRef]
17. Trienekens, J.; Willems, S. Innovation and Governance in International Food Supply Chains: The Cases of Ghanaian Pineapples and South African Grapes. *Int. Food Agribus. Manag. Rev.* **2007**, *10*, 42–63.
18. Legge, A.; Orchard, J.; Graffham, A.; Greenhalgh, P.; Kleih, U. *The Production of Fresh Produce in Africa for Export to the United Kingdom: Mapping Different Value Chains*; Natural Resources Institute: Chatham, UK, 2006.
19. Amanor, K.S. Global Food Chains, African Smallholders and World Bank Governance. *J. Agrar. Change* **2009**, *9*, 247–262. [CrossRef]
20. Webber, M.C.; Labaste, P. *Building Competitiveness in Africa's Agriculture: A Guide to Value Chain Concepts and Applications*; The International Bank for Reconstruction and Development/The World Bank: Washington, DC, USA, 2010.
21. Asante-Poku, N.A. Global Value-Chain Participation and Development: The Experience of Ghana's Pineapple Export Sector. In *Future Fragmentation Processes*; The Commonwealth: London, UK, 2017; Volume 96.
22. Kleemann, L. Organic Pineapple Farming in Ghana a Good Choice for Smallholders? *J. Dev. Areas* **2016**, *50*, 109–130. [CrossRef]
23. Fold, N.; Gough, K.V. From smallholders to transnationals: The impact of changing consumer preferences in the EU on Ghana's pineapple sector. *Geoforum* **2008**, *39*, 1687–1697. [CrossRef]

24. Dupouy, E.; Gurinovic, M. Sustainable food systems for healthy diets in Europe and Central Asia: Introduction to the special issue. *Food Policy* **2020**, *96*, 101952. [CrossRef]
25. Falkowski, J. Resilience of farmer-processor relationships to adverse shocks: The case of dairy sector in Poland. *Br. Food J.* **2015**, *117*, 2465–2483. [CrossRef]
26. Jacobi, J.; Mukhovi, S.; Llanque, A.; Augstburger, H.; Käser, F.; Pozo, C.; Peter, M.N.; Delgado, J.M.F.; Kiteme, B.P.; Rist, S.; et al. Operationalizing food system resilience: An indicator-based assessment in agroindustrial, smallholder farming, and agroecological contexts in Bolivia and Kenya. *Land Use Policy* **2018**, *79*, 433–446. [CrossRef]
27. Bourlakis, M.A.; Weightman, P.W.H. *Food Supply Chain Management*; Blackwell Publishing Ltd.: Oxford, UK, 2004.
28. Weber, Y.; Tarba, S.Y. Strategic agility: A state of the art introduction to the special section on strategic agility. *Calif. Manag. Rev.* **2014**, *56*, 5–12. [CrossRef]
29. De Groote, X. The Flexibility of production processes: A general framework. *Manag. Sci.* **1994**, *40*, 7. [CrossRef]
30. Shukla, S.K.; Sushil; Sharma, M.K. Managerial paradox toward flexibility: Emergent views using thematic analysis of literature. *Glob. J. Flex. Syst. Manag.* **2019**, *20*, 349–370. [CrossRef]
31. Ivory, S.B.; Brooks, S.B. Managing corporate sustainability with a paradoxical lens: Lessons from strategic agility. *J. Bus. Ethics* **2018**, *148*, 347–361. [CrossRef]
32. Iacocca Institute. *21st Century Manufacturing Enterprise Strategy: An Industry-Led View*; Iacocca Institute: Bethlehem, PA, USA, 1991.
33. Burgess, T. Making the leap to agility: Defining and achieving agile manufacturing through business process redesign and business network redesign. *Int. J. Oper. Prod. Manag.* **1994**, *14*, 23–34. [CrossRef]
34. McCann, J. Organizational effectiveness: Changing concepts for changing environments. *People Strategy* **2004**, *27*, 42.
35. Malaviya, P.; Wadhwa, S. Innovation management in organizational context: An empirical study. *Glob. J. Flex. Syst. Manag.* **2005**, *6*, 1–14.
36. Evans, S.; Bahrami, H. Super-flexibility in practice: Insights from a crisis. *Glob. J. Flex. Syst. Manag.* **2020**, *21*, 207–214. [CrossRef]
37. Doz, Y.; Kosonen, M. The dynamics of strategic agility: Nokia's rollercoaster experience. *Calif. Manag. Rev.* **2008**, *50*, 95–118. [CrossRef]
38. Van Hoek, R.I.; Harrison, A.; Christopher, M. Measuring agile capabilities in the supply chain. *Int. J. Oper. Prod. Manag.* **2001**, *21*, 126–147. [CrossRef]
39. Tse, Y.K.; Zhang, M.; Akhtar, P.; MacBryde, J. Embracing supply chain agility: An investigation in the electronics industry. *Supply Chain Manag.* **2016**, *21*, 140–156. [CrossRef]
40. Ngai, E.W.T.T.; Chau, D.C.K.K.; Chan, T.L.A.A. Information technology, operational, and management competencies for supply chain agility: Findings from case studies. *J. Strateg. Inf. Syst.* **2011**, *20*, 232–249. [CrossRef]
41. Do, Q.N.; Mishra, N.; Wulandhari, N.B.I.; Ramudhin, A.; Sivarajah, U.; Milligan, G. Supply chain agility responding to unprecedented changes: Empirical evidence from the UK food supply chain during COVID-19 crisis. *Supply Chain Manag.* **2021**, *26*, 737–752. [CrossRef]
42. Swafford, P.M.; Ghosh, S.; Murthy, N.; Gligor, D.M. Achieving supply chain agility through IT integration and flexibility. *Int. J. Prod. Econ.* **2008**, *116*, 288–297. [CrossRef]
43. Li, X.; Chung, C.; Goldsby, T.J.; Holsapple, C.W. A unified model of supply chain agility: The work-design perspective. *The Int. J. Logist. Manag.* **2008**, *19*, 408–435. [CrossRef]
44. Golgeci, I.; Bouguerra, A.; Rofcanin, Y. The human impact on the emergence of firm supply chain agility: A multilevel framework. *Pers. Rev.* **2019**, *49*, 733–754. [CrossRef]
45. Gligor, D.M.; Holcomb, M.C.; Feizabadi, J. An exploration of the strategic antecedents of firm supply chain agility: The role of a firm's orientations. *Int. J. Prod. Econ.* **2016**, *179*, 24–34. [CrossRef]
46. Vorst, J.G.A.J. Effective Supply Chains: Generating, Modeling and Evaluating Supply Chain Scenarios. Ph.D. Thesis, Wageningen University, The Hague, The Netherlands, 2000.
47. Yusuf, Y.Y.; Gunasekaran, A.; Adeleye, E.O.; Sivayoganathan, K. Agile supply chain capabilities: Determinants of competitive objectives. *Eur. J. Oper. Res.* **2004**, *159*, 379–392. [CrossRef]
48. Eckstein, D.; Goellner, M.; Blome, C.; Henke, M. The performance impact of supply chain agility and supply chain adaptability: The moderating effect of product complexity. *Int. J. Prod. Res.* **2015**, *53*, 3028–3046. [CrossRef]
49. Vorst, J.G.A.J.; Beulens, A.J.M. A Research Model for the Redesign of Food Supply Chains. *Int. J. Logist. Res. Appl.* **1999**, *2*, 161–174. [CrossRef]
50. Yusuf, Y.Y.; Sarhadi, M.; Gunasekaran, A. Agile manufacturing: The drivers, concepts and attributes. *Int. J. Prod. Econ.* **1999**, *62*, 33–43. [CrossRef]
51. Thoen, R. The EU market for fresh horticultural products: Trends and opportunities for Sub-Sahara Africa producers. In *Potential Contribution of Horticulture to Growth Strategies in Sub-Sahara Africa: Developing Horticulture Supply Chains for Growth and Poverty Reduction in Sub-Saharan Africa*; World Bank Institute Seminar: Washington, DC, USA, 2004.
52. Wadhwa, S.; Rao, K.S. Flexibility and agility for enterprise synchronisation: Knowledge and innovation management towards flexagility. *Stud. Inform. Control* **2003**, *12*, 111–128.
53. Whitten, G.D.; Green, K.W.; Zelbst, P.J. Triple-a supply chain performance. *Int. J. Oper. Prod. Manag.* **2012**, *32*, 28–48. [CrossRef]
54. Fayezi, S.; Zomorrodi, M. The role of relationship integration in supply chain agility and flexibility development: An Australian perspective. *J. Manuf. Technol. Manag.* **2015**, *26*, 1126–1157. [CrossRef]

55. Zhang, Z.; Sharifi, H. A methodology for achieving agility in manufacturing organizations. *Int. J. Oper. Prod. Manag.* **2000**, *20*, 496–512. [CrossRef]
56. Braunscheidel, M.J.; Suresh, N.C. The organizational antecedents of a firm's supply chain agility for risk mitigation and response. *J. Oper. Manag.* **2009**, *27*, 119–140. [CrossRef]
57. Wieland, A.; Wallenburg, C.M. Dealing with supply chain risks: Linking risk management practices and strategies to performance. *Int. J. Phys. Distrib. Logist. Manag.* **2012**, *42*, 887–905. [CrossRef]
58. Ryder, R.; Fearne, A. Procurement best practice in the food industry: Supplier clustering as a source of strategic competitive advantage. *Supply Chain Manag. Int. J.* **2003**, *8*, 12–16. [CrossRef]
59. Sheffi, Y.; Rice, J.B., Jr. A supply chain view of the resilient enterprise. *MIT Sloan Manag. Rev.* **2005**, *47*, 41. Available online: https://sloanreview.mit.edu/article/a-supply-chain-viewof-the-resilient-enterprise/ (accessed on 1 November 2010).
60. Corsini, R.R.; Costa, A.; Fichera, S.; Framinan, J.M. A new data-driven framework to select the optimal replenishment strategy in complex supply chains. *IFAC-PapersOnLine* **2022**, *55*, 1–25. [CrossRef]
61. Teece, D.J.; Pisano, G.; Shuen, A. Dynamic capabilities and strategic management. *Strateg. Manag. J.* **1997**, *18*, 509–533. [CrossRef]
62. Blome, D.; Schoenherr, T.; Rexhausen, C. Antecedents and enablers of supply chain agility and its effect on performance: A dynamic capabilities perspective. *Int. J. Prod. Res.* **2013**, *51*, 1295–1318. [CrossRef]
63. Mentzer, J.T.; DeWitt, W.; Keebler, J.S.; Min, S.; Nix, N.W.; Smith, C.D.; Zacharia, Z.G. Defining supply chain management. *J. Bus. Logist.* **2001**, *22*, 1–25. [CrossRef]
64. Ribbers, A.M.A.; Verstegen, M.F.G.M. *Toegepaste Logistiek*; Kluwer Bedrijfswetenschappen: Deventer, The Netherlands, 1992.
65. Yawson, D.E.; Aguiar, L.K. Agility in the Ghanaian International Pineapple Supply Chain. In Proceedings of the International Symposium on Fresh Produce Supply Chain Management, Chiang Mai, Thailand, 6–10 December 2006; Available online: http://www.fao.org/ag/ags/subjects/en/agmarket/chiangmai/aguiar.pdf (accessed on 1 November 2007).
66. Yawson, D.E.; Aguiar, L.K. Agility in the Ghanaian international pineapple supply chain. Presented at the 17th Annual Forum and Symposium IAMA Conference, Parma, Italy, 14–17 June 2007; RAPRA Publication 2007/21. UN Food and Agriculture Organisation: Rome, Italy, 2007; pp. 200–213.
67. Capitanio, F.; Coppola, A.; Pascucci, S. Indicators for drivers of innovation in the food sector. *Br. Food J.* **2009**, *111*, 820–838. [CrossRef]
68. Palmer, A.; Hartley, B. *The Business Environment*; McGraw-Hill Education: New York, NY, USA, 2002.
69. Goldman, S.; Nagel, R.; Preiss, K. *Agile Competitors and Virtual Organizations*; Van Nostrand Reinhold: New York, NY, USA, 1995.
70. Van Oosterhout, M.; Waarts, E.; van Hillegersberg, J. Change factors requiring agility and implications for IT. *Eur. J. Inf. Syst.* **2006**, *15*, 132–145. [CrossRef]
71. Beulens, A.J.M. Continuous replenishment in food chains and associated planning problems. In Proceedings of the Workshop on Advances in Methodology and Software for Decision Support Systems, Luxemburg, 8–10 September 1996; IIASA: Laxenburg, Austria, 1996.
72. Bertrand, J.W.M.; Wortmann, J.C.; Wijngaard, J. *Production Control—A Structural and Design-Oriented Approach*; Elsevier: Amsterdam, The Netherlands, 1990.
73. Mintzberg, H. *The Structuring of Organisations*; Prentice-Hall: Hoboken, NJ, USA, 1979.
74. Van der Heijden, K. *Scenarios: The Art of Strategic Conversation*; John Wiley & Sons: Hoboken, NJ, USA, 2005.
75. Porter, M.E. *Competitive Advantage, Creating and Sustaining Superior Performance*; Free Press: New York, NY, USA, 1985.
76. Gattorna, J.L.; Walters, D.W. *Managing the Supply Chain: A Strategic Perspective*; MacMillan Press: London, UK, 1996.
77. Caplice, C.; Sheffi, Y. A review and evaluation of logistics metrics. *Int. J. Logist. Manag.* **1994**, *5*, 11–28. [CrossRef]
78. Manning, L.; Soon, J.M. Building strategic resilience in the food supply chain. *Br. Food J.* **2016**, *118*, 1447–1493. [CrossRef]

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Systematic Review

Who Prefers Regional Products? A Systematic Literature Review of Consumer Characteristics and Attitudes in Short Food Supply Chains

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Abstract: The present work is a selection of empirical studies focusing on the characteristics and attitudes of Short Food Supply Chain (SFSC) consumers. Using a systematic literature review approach (PRISMA), we identified five different aspects of the SFSC within the publications: producer participation, swot, state intervention, attitude and "other". Based on the findings of studies from the academic literature, the results are quite mixed. Though the number of SFSC-related empirical studies has risen in recent years, there is a lack of SFSC-related data, even in the European Union (EU), where a sustainable agriculture and food system must play a crucial role in the implementation of the Green Deal. Overall, it is hard to name those features that, without any doubt, affect the willingness of consumers to purchase from an SFSC. The studies mostly remarked on age and education; however, even these findings cannot be generalized. Therefore, some consumers of non-global food supply chains could be characterized very well, but these observations could differ in diverse cases because of local factors.

Keywords: Short Food Supply Chains; regional products; characteristics of consumers; systematic review

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1. Introduction

In the last few decades, the unsustainable operation of the global food system could be the reason for the rising level of food waste and food safety hazards, and it could also increase environmental pollution. We also must emphasize the vulnerable situation of supply chain members since the distribution of added value is not fair. To mitigate these problems and provide more environmentally friendly and sustainable production, numerous alternative ways have been developed in agriculture. Fisk [1] published the ancestor of sustainable consumption in 1973. It was the concept of responsible consumption. The author defined it as the efficient and rational use of resources with respect to the global human population. This definition concentrated only on the supply side, but the article noted that the production serves the consumers' needs and wants. Nearly twenty years later, one of the first appearances of sustainable consumption was published in 1987 by the Brundtland report [2]. There are various definitions of this idea. One of the most comprehensive was published by Ofstad [3]. He identified sustainable consumption as a lifestyle that focuses on basic needs. At the same time, it minimizes pollution, toxic materials, natural resources and emissions of waste and does not jeopardize the needs of the future generation [4,5]. Some academic researchers emphasize the contrary position and meaning of sustainability and consumption [6,7]. According to Vermeir and Verbeke [8], sustainable consumption involves a decision-making process that accounts not only for the consumer's social responsibility but also for the individual's needs and wants. Nowadays, consumers appreciate trust a great deal, especially in the food sector [9,10]. Many stakeholders can be found in the traditional food supply chain, which could also obstruct the products' effective traceability. One way that traceability and trust could be increased,

and the environmental damage decreased, is the application of a Short Food Supply Chain (SFSC). An SFSC embodies an alternative to the standardized industrial food supply, where the distance between consumer and producer is shorter (often face-to-face interaction), and the information flow between the participants is smoother. We can also find environmental, social and economic reasons why this alternative could be favorable, but the SFSC has two main functions: to stress the key position of producers in sustainable agriculture and to emphasize the consumers' role in sustainable consumption [11,12]. Since the supply depends on the consumers' needs in the "food democracy", the new consumption habits could change food supply systems [13].

2. Materials and Methods

To achieve a wide range of articles in line with SFSCs, a comprehensive literature review was conducted using five significant online databases: Scopus, Web of Science, JSTOR, ProQuest and Science Direct. The keyword used was "short food supply chain". This expression had to be included in the title, abstract or keywords. The involved article had to contain empirical data. The search was restricted to studies in English. We also included reports published by the European Commission, FAO, United Nations and Strength2Food (an EU-funded project). None of the online databases, such as FADN Public Database, Eurostat or OECD, had related information. Our review could not be extended with the articles' references since the involved publications principally identified a particular phenomenon. From the online databases, 496 items fulfilled the above-defined requirements. The procedure for the systematic review was managed by the online platform Rayyan [14], applying the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach. PRISMA is a concept used to sum up why the studied review was written, what methodology was used and what the authors found [15]. The original concept was published in 2009 [16]. However, the idea was extended in 2020 [17]. Based on these, the applied multi-round screening can be seen in Figure 1.

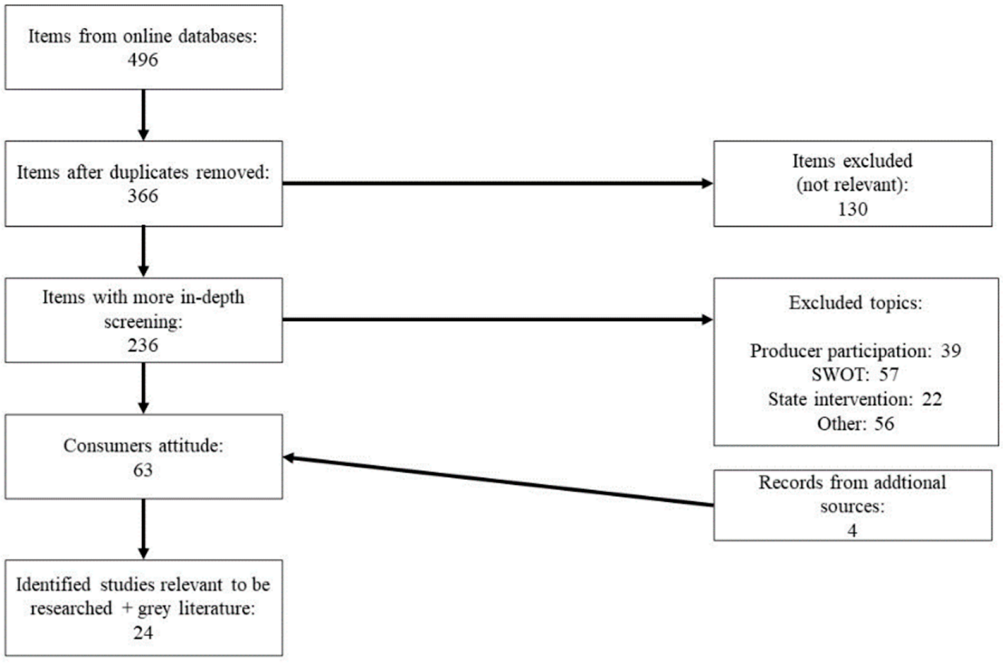

Figure 1. Pathway of the systematic literature review based on the PRISMA concept. Source: Own elaboration.

To exclude duplicates and irrelevant studies, the aforementioned online platform was used. After excluding the duplicates, 366 studies provided the base of our systematic literature review. The initial screening was based on the abstract and performed independently by both authors. The conflicting outcomes were discussed. This first round resulted

in 130 items being excluded. Then, the remaining 236 articles were deeply analyzed to identify the different directions within the examined topic since SFSC became a buzzword and many poorly related areas have been linked to the main idea. The share of different directions within the main topics were the following: consumer attitude: 63, SWOT: 57, other: 55, producer participation: 39, state intervention: 22.

These articles were mostly published in high-ranked journals, which confirms the scientific demand on this topic. Before analyzing the chosen primary studies, demographic and sociographic information were sought in the selected articles to obtain those rarely published papers that researched the consumers' attitudes and characteristics. The final set of relevant studies contained 23 academic publications and 1 study from the grey literature to cover all the related publications until 11 April 2022.

As mentioned earlier, in the last few years, the topic of sustainability has been stressed more and more. While global warming and its consequences were mostly researched earlier, the same can be seen with the topic of sustainability nowadays, since many more articles have formulated suggestions for the industry and agriculture in the last few years than before. However, it could also be distorted through the growing number of publications (Figure 2).

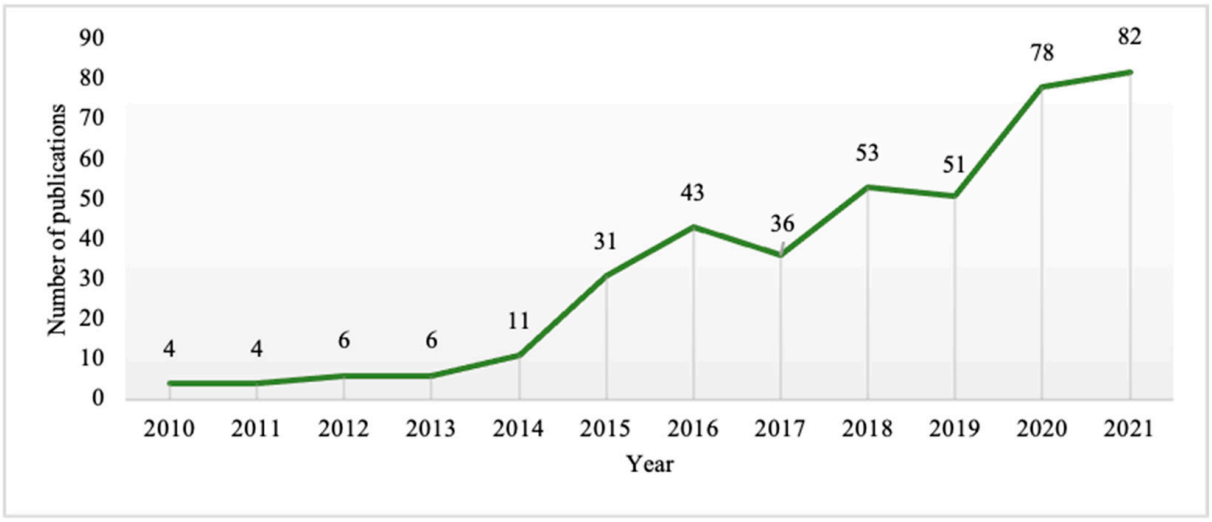

Figure 2. The identified SFSC studies by year of publication (the base of the study without duplications). Source: Own elaboration; the collection covers studies available on 11 April 2022.

3. Results and Discussion

3.1. Related Reviews

To justify the importance of consumers' attitudes regarding the development of SFCSs, the relevant reviews were analyzed in depth. The searching method was similar to the one explained above, but this time, the authors looked for reviews only. The number of publications did not provide an opportunity for proper classification, so only SFSC-related works were involved. Since the databases of JSTORE and Proquest could not be limited to "review articles", only the databases of Scopus, Web of Science and Science Direct were used for this purpose. Table 1 shows the different issues of the already published papers.

The listed works highlight that the main directions within this topic are related to sustainability, locality, community and development. These reviews foreshadow the stressed role of consumers' personalities and attitudes, which this research studies.

Table 1. Studies reviewing the academic literature on SFSC-related topics.

Article	Issues Reviewed	Key Findings
[18]	The development of Short Food Supply Chains	The Alternative Agri-Food Networks are the result of the "change" from industrialized and standardized systems to the "domestic" world. In terms of food, it means local and trust.
[19]	The benefits of Short Food Supply Chains for the producer, consumer and community	The application of SFSC could be considered as a response to the crisis of modernization. Relocalization supports sustainability. Consumers can not only look for a given product but also have the chance to participate in social life through SFSCs. The producers can improve the added value and quality of the products while they play an important role in the community.
[20]	How competitive and sustainable processing could be realized at a small-scale level in the future	Several principles work at all scales, and their technologies are already available. Transfer time and reaction kinetics constraints should be rethought, especially at different time and length scales to utilize the competitiveness of small-scale technologies.
[21]	To define and characterize the different SFSCs and their sustainability	The authors agree on the social benefits of SFSCs. However, their health and governance dimensions are underexplored. The economic and environmental outcomes of SFSCs are quite heterogeneous.
[22]	The Supply Chain Responsibility (SCR) effect on rural development	By comparing wealth-oriented SCR and community-oriented SCR, this work highlights the lack of literature regarding the connection between community development and the integration of supply chain performance.
[23]	How to effectively improve the Short Food Supply Chain from a logistics perspective	Based on the reviewed articles, the authors think the re-engineering of the supply chain, the application of logistics innovations and new network creation could most improve the sustainability and development of SFSCs. The optimal positioning of critical network nodes is also quite important, but finding the balance between local agriculture values and large supply chain values could mean the real breakthrough.
[24]	Analysis of beliefs about local food systems—from the perspectives of consumers, farmers, communities and environment	The effect of local food systems on the investigated social, economic and environmental factors depends on the supply chain type. Further differences could be found within product types and countries.
[25]	Challenges in Short Food Supply Chains	The focus is on the production and distribution processes in SFSCs, but the ordering, packaging and storage processes are often missing.

Source: own elaboration.

3.2. Academic Papers

D'Amico et al. [26] examined the direct sales of locally produced wine in Italy. The data were collected from a random sample of 953 consumers and used in a binary logit model to identify the socio-demographic characteristics of local consumers. The following variables were involved in the model: age, sex, income, number of household members, education and profession, the type of purchased wine, and the features of the shopping process (such as frequency). The statistical test strengthened the significant role of all the above-defined perspectives. This paper also characterized the typical consumer, who, based on the collected data, is self-employed, adult, male with a lower income and lives in a larger-than-average household.

The work of Llazo [27] is based on six focus groups, where 42 participants were observed in Albania. However, this research methodology is not the most appropriate, but it could be helpful to establish the main direction of a representative survey. The topics were tested earlier (pilot test) to be clear for all; these focused on the general interest in local products, determination of deciding factors that could lead to the purchase of local products and the role of a short chain. Regarding their residence, the experimental groups differed the most from each other in the case of their interests. Some of them preferred local products because they are fresh and offer higher quality, while others estimated their lower price. In general, the respondents stressed the higher share of profit for local farmers, but food safety was also mentioned as an essential advantage of short chains.

Schifani et al. [28] randomly surveyed 196 consumers to examine local honey purchasing habits in Palermo (Italy). The authors created an econometric model to identify those criteria that affect local food purchasing, where socio-demographic variables, honey attributes and consumer preferences were implemented. According to the statistical tests, civic (trust), institutional (certification) and domestic (quality) conventions influence the

purchase; however, from socio-demographic aspects, only income statistically affects it. Age, sex and education level are not deciding factors.

Chinnici, Di Pino and Allegra [29] interviewed 300 consumers in Italy to analyze their attitude toward almond consumption. Principal component analysis was conducted to define the key components that summarize the characteristics of the correspondents. Based on it, the authors defined three homogeneous clusters. The first group indicated one-fifth of the sample, characterized by a higher level of education, and these participants were self-employed. Consumers from this group ate almonds often because they are considered nutritious and healthy. The researchers called this class "healthy person". The biggest group represented nearly 60% of all participants. These consumers were singles who lived alone and had a middle academic qualification. They consumed almonds once a month. This group was named "pragmatics" by the study. The last group embodied a bit more than 20% of the correspondents. These citizens were retired (over 65 years) with an income under EUR 10,000. They ate almonds once a year because of their high price. They created the so-called "distrustful" customers.

Mancini, Marchini and Simeone [30] studied which sustainable attributes have an impact on consumers' behavior. To do so, 240 face-to-face interviews were conducted in Benevento (Italy). The researchers defined the consumer as "virtuous"—as the object of the study—if he met a minimum five of the six requirements from the following aspects: purchases local products, eats only seasonal fruit, prefers products with recyclable packaging, pays attention to the fat content in foods, gives importance to traceability, purchases products only in the place of origin. The results, which were based on constructed binary logistic regression models, showed the following of virtuous behavior does not depend on the presence of children, and it was lower in the case of men and older people than in women and adults. It was particularly so in rural areas since they are eco-conscious and take into consideration the seasonal food cycles more. According to the same study, a higher education level was connected with heightened awareness. The educated correspondents were five times more virtuous than the less qualified consumers. In addition, the probability of being a member of the virtuous group was two times higher if the consumer took care to consider product information, five times higher if the consumer seriously considered the ingredients, and six times more if he bought organic products. Thus, the real virtuous customers did not care about brand and special offers; they looked for quality.

Szabo [31] surveyed 1015 adults in Hungary to examine which consumers prefer SFSC products. The Likert-scale-based study stated that it is important for consumers to support small Hungarian farms, direct sales and production through purchasing local products, but they often doubt their self-produced nature. According to the principal component analysis, five clusters were determined and compared by variance analysis. The author called the first group "Favouring imports and large farms". More than every fifth correspondent belonged to this cluster. These consumers, who were primarily under 25 years old, liked the global food supply systems more than local small farms and enterprises, but they were aware of proper food consumption. The age group of 25–35 years was also significantly represented, but members of the older groups were not. Surprisingly, more than 40% of these consumers were full-time homemakers, and 30% were students. According to their income level, every second consumer had a very high one, which could be explained by the high number of citizens within this group who lived in the capital (over 25%). Nearly the same proportion created the "Favouring small farms" group as the former one. The surveyed promoted only the smallest farms. These consumers usually had a secondary school education background. Within the cluster, a higher share of men than women was measured. The third group was called "Informed and empowered" consumers. These consumers preferred large farms and imports. The share of the oldest participants was nearly two times higher within the group than the youngest, so the dominant role of employed and retired economic status is not surprising. The share of college or university degree owners was the highest here compared to other groups; however, this was one of the "poorest" consumer clusters. According to the survey, nearly every fourth adult belonged

to this party, and the share of women was higher within the group. The most significant cluster was called "Universally positive". More than one-fourth of the correspondents created this group. Similar to the former defined party, the dominant role of the older correspondents within the cluster was seen, but here, there also appears in parallel a high proportion of correspondents with vocational school education level. The members of this cluster earned less compared to other groups. The authors could not identify one dominant place of residence since one-third of these consumers lived in the countryside but one-fifth in the capital. These retired consumers thought it important to develop local food, but supporting global food security was also crucial for them. The last and smallest group (8%) was called "Unconcerned". These men, who were principally under 25 years old with primary school education, dominated the higher share of this party, but the oldest group (50+ years) also represented itself here. These consumers did not agree with any of the earlier defined principal component statements. According to the same study, the outlets (hyper-supermarket, discounters) were the most often visited by the group of "Favouring imports and large farms", "Universally positive" and "Informed and empowered" consumers. However, the members of the last two clusters also regularly visited smaller grocery stores and public markets.

Giampietri et al. [10] involved 260 consumers (online) to study consumer trust towards purchasing at short chains based on the Theory of Planned Behavior (TPB). According to the statistical tests, perceived behavioral control has the biggest impact on intention, but trust also plays a significant role. Easier access to SFSC shops and higher trust lead to greater intention, but a better consumer attitude and better understanding (social referents) can also cause more consumer intention. The authors stated that the consumer behavior antecedents are the intention and the perceived behavioral control, so trust does not directly affect it. The study also determined that buying fair-trade food and living in the countryside are two points that positively affect behavior.

Oñederra-Aramendi, Begiristain-Zubillaga and Malagón-Zaldua [32] studied Spain with Cluster Analysis to examine what encourages producers and consumers to attend food markets. From the 396 correspondents, 159 created the first and most prominent cluster. Almost 99% of them only had instrumentalist reasons to purchase food at the market. They did not look for quality based on the organic source or label, and these consumers evaluated the social and cultural context of the products more. The authors called them "instrumentalist consumers". The typical member of this cluster was between 35 and 50 years old. They looked for quality, healthy food and seasonal fresh food; in addition, convenience was also essential for them. Half of them did the shopping once a week and spent less than 10 min and EUR 16.6 in the market. The members of the "community consumers" group were highly motivated by social reasons (82.8%) and a bit more by collective reasons (85%). The members were characteristically under 35 years old, used to buying fresh and processed products and also looked for local and/or ecological food through which to support smaller producers. Compared to the former class, they spent more time and money at the market. These consumers had more personal relationships with the sellers and liked the atmosphere and the pleasant experience of purchasing there. The last identified cluster was called "cultural consumers". They did not have any instrumentalist or social motivations, and they purchased food at the market because of cultural inspiration. These purchasers were typically over 50 years old and retired. Even if they went to the market the most often (two or three times a week) and spent a great deal of time there, they spent less money. It would be a rational hypothesis that they had social reasons to buy there; however, the statistics proved it was only one habit. Based on this observation, the authors stated that cultural and social motivations are strongly connected.

Chinnici, Di Grusa and D'amico [33] examined the attitudes of fresh-cut vegetable consumers based on 250 Italian (Sicily) respondents. Based on the closed questions (binary or multiple selections), the research stated that six out of ten consumers were interested in the consumption of fresh-cut products. The majority of these consumers were between 18 and 35 years old. More than half of them regularly (once a week) consumed at home

products bought in the supermarket. The authors found that the involved consumers did not know a lot about the quality control of fresh-cut vegetables.

Stanco et al. [34] studied the socio-demographical characteristics of farmers' market consumers based on sixty face-to-face interviews. The answers of the involved Italian consumers were evaluated on a seven-point Likert scale. The interviewed consumers purchased weekly at farmers' markets. They enjoyed keeping in touch with the producers; however, they did not like to buy directly from them. The surveyed consumers purchased certified organic products earlier because they considered environmental protection, support of local producers through remuneration, and the importance of rights (all these aspects reached more than six points out of seven). The authors stated that, based on the above-measured phenomenon, the interviewed consumers thought about sustainability as a multidimensional idea. According to the Food-Related Lifestyle (FRL) scale used, the market cannot be characterized by convenience and novelty. Cooking and specialty shops belong to the disinterested range, too. These could be explained by the lack of ready-to-eat and international foods since the traditional market is built on local, fresh and unprocessed products. Based on the same scale, the price/quality relationship, organic product, price criterion, freshness, health and importance of product information belong to the farmers' market's main features.

Bakos and Khademi-Vidraa [35] analyzed a "buying group" in Hungary. This research aimed to discover the sociometrics and lifestyles of these consumers. The author worked with a representative database of 297 respondents. The surveyed consumers answered with the help of the Likert scale (one to six), and their responses were evaluated with principal component analysis and cluster analysis. In general, we can state that, for six out of ten consumers, it was crucial to buy locally produced food. More than 70% of the surveyed consumers had higher education degrees and incomes higher than HUF 250,000. The members of the buying groups preferred to purchase fresh and healthy products from a trusted source. The researchers stated that social responsibility was stressed in their purchasing decisions since local producers and economy were essential for them. To act in an environmentally friendly manner was also important; however, even those consumers with higher incomes seemed price-sensitive. According to the lifestyle characteristics, health, family and a calm, balanced life were the main reasons behind this functional consumer behavior. This means there was no symbolic motivation to purchase these goods; they looked for their well-being. The author divided the analyzed buying group to identify the different clusters within the whole group. Three clusters were determined based on the Principal Component Analysis. The first factor included health consciousness, environmentally friendly packaging, bio-origin, the recommendation of friends and family and quality. The second contained the following points: everything should be available in one place, price and the fame of the food brand. The last factor consisted of Hungarian origin, locally produced food and the fame of the shop. Based on these main components, the following clusters were identified. "Conscious-locational patriotic" cluster: 33 surveyed consumers belonged to this group. The third factor was dominant in this case, which meant these consumers appreciated Hungarian, healthy and good-quality products. Nearly the same proportion (34 consumers) created the "Convenient and Price Sensitive Brand Loyal" cluster. The first factor dominated this group. The members of this class considered the shop's brand a lot, but for them, it was not essential that all the products be available in one place. They were loyal to their brands and products and were price-sensitive. Price, for them, was even more important than quality and health preference. They did not know a lot about local food, so they did not have any special preference in line with it. The biggest cluster was the so-called "Hybrid" created by 81 consumers. In this case, one dominant principal component could not be found. As the name shows, this group was a mix of the two former ones. These surveyed consumers wanted to buy Hungarian, healthy and environmentally friendly products, but all in one place. They stuck to certain brands and products; however, the price/value ratio was also considered by them.

De Bernardi et al. [36] studied the role of social capital and transparency in the performance of purchases from alternative food networks. The research involved 2115 consumers from the Italian food assemblies (FAs). These FAs are a mix of online and offline farmer shops. The consumers order from the platform of the farmer, and they receive the goods at the weekly farmers' market. According to the respondents' socio-demographic characteristics, the typical consumer is a middle-aged woman with a higher education, and according to her salary, she belongs to the middle class. Based on the regression analysis used, the authors stated that both social capital and transparency had a positive and significant effect on the quantity and the frequency of shopping. The same study explored the positive impact of age, duration and income on the quantity, and a similar impact could be measured in the case of age and income on the frequency of purchasing. Based on these findings, the article stated that older and wealthier consumers buy more often.

April-Lalonde et al. [37] examined why consumers use direct purchasing channels and how these people could be characterized. A representative sample of 2914 households from Ecuador (Ibarra, Quito and Riobamba) was used. The direct market consumers (DMCs) created 12% and the agroecological consumers (ACs) 11% of the sample. The paper first analyzed the features of the surveyed consumers. Consumers with a lower probability were young adults and were more likely to live in Riobamba with two or more adults together. In line with education, employment, diet-related chronic diseases and eating habits, differences were measured between these two types of consumers. The DMC consumers had two times higher probability of being affected by diet-related chronic disease. Nearly the same likelihood was measured (1.9 times) for those who had no educational degree and did not eat fruits or vegetables daily compared to the other surveyed consumers. ACs had a lower chance to be unemployed; however, the probability of having a higher education was 3.5 times higher, controlling the used quantity of salt was 3.9 times higher, having excellent knowledge about food label information was 2.5 times higher, often eating traditional dishes was 2.3 times higher, eating fruits or vegetables everyday was 1.9 times higher, and never or almost never eating industrially processed foods was 1.9 times higher compared the rest of the population. The researchers also studied the motivation of the different groups. The AC and non-AC consumers group connected quality, freshness and nutritional balance with these marketing channels, which help them to be healthy. The members of the AC group stressed the importance of taste and pesticide-less products. For them, the offered transparency and security meant a lot, since they were interested in where products come from and how they are made and are ready to pay more for this information. Naturally, saving money on food was crucial for both groups. The study also stated that the ACs had higher environmental motivations for direct purchasing than others.

Kiss et al. [38] studied the characteristics of consumers who prefer local food. This research involved 1034 respondents from the North Hungarian region. Based on the online survey, the authors stated that one-third of the sample spent less than EUR 16 at local producers monthly. The same share paid between EUR 16 and 31, and the rest of the consumers spent more. The main products sold by small producers are honey, eggs, fruits and vegetables. The statistical tests did not measure any correlation between the gender and the monthly expenditure, and the same could be said about the marital status and expenses. Living in a single household was positively correlated with expenditure on local goods, and the same could be stated about a higher level of education, age and financial status. The type of residence and the monthly expenditure on local products were also correlated positively. The researchers also studied the willingness to pay a premium price for local products, and the findings stated that there was a positive correlation between the current expenses and the above-defined extra fee. However, the willingness to pay was lower in the bigger cities than in the villages and small towns. In reality, consumers in the countryside spent more on local products than consumers in cities with a population above 20,000 people. Based on the monthly expenditure on local goods, the authors classified the respondents and examined their decision-making factors. The cluster with the highest

income was less price-sensitive. These consumers preferred Hungarian products with high quality and uniqueness. Actual demand for organic products was not measured. The groups with higher expenditures stressed the role of family traditions, personal contact and environmental awareness. The same respondents were asked about their favorite place to purchase food. According to the five-point Likert scale used, supermarkets and discount stores were the most often visited. The conventional markets were less popular, and hypermarkets owned the third place in this comparison. Based on the earlier defined findings, the authors stated the dominant position of smaller-scale commercial channels in the villages. It was statistically proven that consumers in villages purchased vegetables and fruits, meat and meat products, and honey from the producers in a bigger proportion than the others surveyed.

A paper by Fogarassy et al. [39] focused on consumers' characteristics and attitudes towards purchasing food in Hungary. The authors first applied factor analyses to 842 respondents' answers. The following main components were identified: food components, tracking, consciousness and market purchase vs. store purchase. According to the factor analyses, four clusters were identified and examined. All 194 consumers in Cluster 1 were called "Information dependent" since they cared a lot about the health impact of ingredients. Hungarian origin was most important for them, but the label and trustworthy products were also sought. These consumers who regularly visited the market were usually highly qualified and had higher incomes. The 195 members of cluster 2 were called "careless" since they took less consideration of the health impact of the food. They trusted food stores and did not mind the label and origin of food. Cluster 3 was created by 249 respondents. They were called "Direct purchasers" since they often purchased directly and preferred organic products. They were middle-aged employees who tried to avoid harmful ingredients, but the label, for them, was not most crucial even though, compared to the other groups, the origin and label influenced their decision. The preferred Hungarian food was purchased in the market directly from the producer since they evaluated this source to be safer and also liked to keep in contact with the farmers. The authors stated these criteria had the most enormous effect on their attitudes. Cluster 4 was called "Food store fans". The 190 consumers within the group trusted food stores more than markets. These highly qualified citizens did not consider the brand but focused on the ingredients.

Szegedyné Fricz et al. [40] studied which factors make the food local according to the consumers' point of view. The research was based on a representative survey, where the data of the involved 1000 Hungarian consumers were analyzed by cluster analysis. To obtain a general overview of respondents' interests, a five-point Likert scale was used. Food purchasing was dominated by quality (4.64), but safety (4.46), a readable label (4.24) and detailed product information (4.11) were also crucial for the customers. The brand, whether the product fit into a healthy diet and the lack of additives in the product were also considered (above 3.9); however, consumers were conscious since the recommendation, package and price did not affect their decision too much. According to the surveyed consumers, those goods could be called local that were produced and sold in the same geographical area. Compared to other products, these taste more natural and delicious. The participants prized when producers directly sell their goods and when the town or region of origin of their goods is also identifiable. The ingredients' traditional production and processing method were also mentioned as advantages of local products. During the classification, five clusters were determined. Four of these had a positive attitude towards local products, which meant 90% of the consumers. The authors defined the first group as "Fan", who appreciated local and buy it. These independent females over 40 years old bought local for their consumption since it meant quality for them. They frequently bought all the examined product categories (vegetables, cheese, jam and syrup) directly from the farmer. In addition, they tried to get to know more about food safety and quality, even if they had already learned about it from the family. The second cluster was called "Marketgoer". These females appreciated local but only bought fresh vegetables; that was the main difference compared to the previous cluster. They did not purchase jam and syrup

at all; rather, they prepared them by themselves. In line with cheese, they regularly bought it in larger shops and only rarely from the producer. These consumers were also over 40 years old, but this group had the highest share of retired people. The next group was named "Indecisive". These consumers did not have a definitive opinion on local goods. They tended to see the higher quality of them compared to others. The ladies who had the highest percentage of the five clusters regularly bought vegetables at the market, but the other two products were only seldom bought. The average member of "Indecisive" was above 30 years old, but the age group of 40 to 59 years represented the highest share here. The consumers who appreciated local but did not buy were called "Theoretical fan". These men were around 30 years old (late 20s and early 30s) and bought vegetables and cheese exclusively only at larger stores. The authors supposed they had a high probability of becoming fans since they will earn more over the years. Those respondents who disagreed with the better quality of local food and did not purchase it were called "Rejective". Based on the survey, mostly male students created this group, who will be future consumers. Not surprisingly, the low price was the most important factor within this cluster, but the label and the product's fit in a healthy diet were also considered.

Kallas et al. [41] examined consumers' opinions about SFSCs and their willingness to pay for local honey in Argentina. Based on 210 face-to-face interviews and the Likert scale used, the authors stated that having an opportunity to buy fresher products was evaluated the most, but supporting the local economy (with fair prices) and the traceability of the products were also crucial according to the respondents. The exploratory factor analysis used described that all studied items (freshness, quality, traceability, fair price, environmentally friendly, support the local economy) were related to one latent factor that explains 54.5% of the total variance. The surveyed women agreed more with the role of the created SFSC model than men, and similar differences could be measured between pensioners and students too. The older generation (above 65 years) also evaluated it more positively than younger consumers (18–31 years), and unipersonal households could agree with it more than households with more than three members. The same study also highlighted that the higher agreement with the created SFSC, the higher willingness to pay for the local product.

Oliveira et al. [42] studied how Brazilian organic street market characteristics influence consumers. Based on 389 interviews, the authors stated that consumers in these places were mostly between 21 and 50 years old, and they used their cars to transport the purchased fruits and vegetables. Half of the respondents bought these goods only at the market because they received better quality compared to the supermarket for the same price. The customers believed that the accessibility and the location of the market were associated with the quality, price and selection of products.

Khuziakhmetov [43] examined how socio-economic characteristics affect consumers' behavior in Russia (Western Siberia). Based on 1610 interviews, the authors stated that the respondents trusted direct sellers the most (above 60%), big stores next (51%), and entrepreneurs the least (29%). The researchers observed a significant difference between groups with diverse incomes. A higher income was connected to higher trust in food. The study states that income, gender, age and settlement type significantly affected the decision when consumers choose an outlet. However, only income and gender affected the attitude toward markets. Social status and education seemed to be less decisive factors. With regard to gender and trust, a significant relation was not measured; even the difference among rural residents compared to the citizens was more outstanding. While elders preferred the convenience of stores, younger consumers preferred to do their shopping in retail chains. Online grocery shopping belonged to the privilege of the "rich" social class. Within this cluster, 21% was its share, while among urban residents and citizens between 25–44 years, it reached only 5–6%. The study identified products that were purchased with a higher probability (and more frequently) in stores near the consumers' home/work. Not surprisingly, bakery, dairy and grocery products belonged to this group, and almost anything else was usually bought in large stores at once. At the same time, food markets,

fairs and food bases also have their consumers. Their share also has to be mentioned since meat and meat products, poultry and vegetables are often sold through these channels, especially in rural areas, but the citizens also visit these places. The surveyed Russian consumers focused the most on price, freshness, expiration date and taste, but they cared less about the place of production, presence of GMO and preservatives. (The topic of GMO was especially interesting for the middle-aged woman in the cities.) The classical marketing tools, such as the package and brand, were irrelevant for the surveyed consumers (however, the social classes with a higher income paid more attention to it). The research stated that the freshness and expiration date were nearly similarly important for all social groups. When the role of price was investigated, the key position of it was measured in the case of pensioners (over 65 years) who lived in small towns and younger consumers (under 24) and, in addition, in the social group "poor" people.

The research of Kovács, Lendvai and Beke [44] studied which food attributes and motivational factors influence the purchasing of local food products. The analysis was based on the answers of 1756 Hungarian respondents between 18 and 45 years old. In this database, the authors placed factor analysis, then identified three groups with the K-means cluster analysis. They called "trend-follower" the 405 people who created the first cluster. Two-thirds of this group were composed by women who had high school degrees and lived in small towns and villages. Regarding age, a similar share (37%, 38%) could be identified between the 18–24 and 25–34 age groups. These respondents thought local products were nutritious and healthy and had better taste. They preferred local, traditional and national food products; however, they are not committed to choosing local products. Easy access to food purchasing played an important role in their case. This group's members' main motivations were health and credibility. The second cluster was named "distrustful". Less than 20% belonged to this group, where the members were between 18 and 24 years old with a high school degree. The share of sexes was quite similar within the cluster (women, 46.10% and men, 52.10%). As the name suggests, these consumers did not trust local products, and according to them, these were even less nutritious and healthy. In their case, the importance of national or local products was lower, but convenience shopping was as relevant as in the case of cluster one. The last cluster, "value-creator", involved the sample's majority (57%). This group was created by women between 35 and 39 years with a university degree who lived in the capital and the city. These respondents trusted local products and considered them nutritious and healthy. They were committed to purchasing them, not just because they preferred them, but because their price was favorable. The easy access to shopping was necessary for the members of this cluster, too.

The appearance of COVID-19 affected purchasing, too. It reshaped consumers' opportunities and habits. The new situation caused by the lockdown also opened up the opportunity for alternative solutions, and the various consumers' groups responded in different ways [45].

Butu et al. [46] analyzed the effect of the pandemic on the fresh vegetable buying behavior of consumers in Romania. The research is based on the answers of 257 consumers. Based on the biplot analysis, most consumers (both women and men) from the 35–49-year-old age group with a big household (4–6 people) and mixed education background did not buy fresh vegetables directly from producers before 16 March (lockdown). The same can be said about those males between 35 and 49 years who lived together with four or five people in a household and were Ph.D. fellows. In contrast, women from the 20–34 and 50–64 age categories with a master's degree and two or three household members purchased these goods. The researchers studied the ordering habits of the surveyed consumers. Nearly 90% of the surveyed consumers had never ordered before the lockdown; around 60% had been ordering since the lockdown; and 81% planned to continue ordering after the lockdown. If we divide this further according to age groups, we can see that the group of 20–34-year-old consumers increased the number of orders the most since the lockdown; a bit weaker but similar increase was measured in the case of the 35–49 age group, too. Weekly purchasing had the highest share in each age group. The researchers also studied

the source of information channels regarding the fresh vegetables offered. The surveyed consumers preferred to use Facebook, but specialized sites and online platforms were also often visited. The domination of Facebook could be seen very well, especially in the case of the 20–34 and 35–49 age groups. The orders were placed mostly through order forms and online platforms. The defeated position of the vendor's basket was also clearly seen in this study since more than 95% of the surveyed consumers preferred to order according to "chose alone the products and quantities". The consumers preferred to pay in cash before the lockdown; however, during the highly regulated period, the share of debit card payments increased. It seems that more Romanians planned to keep this new habit after the pandemic. According to the biplot analysis used, different groups could be identified. Those consumers who ordered fresh vegetables from the farmer before the lockdown did so once or twice a week and planned to do the same after the crisis. They paid with cash and were between 35 and 49 years old. Those correspondents between 50 and 64 years who ordered monthly before preferred to pay by bank transfer, but since the lockdown, they did not order. The third class was created from those consumers over 65 years old who did not order earlier and did not plan it later. The younger generation (20–34 years old) ordered once a week since the lockdown, paid with a card and planned to do so after the crisis, too.

Brumă et al. [47] studied how the pandemic influenced consumers' behavior in line with dairy products delivered directly from producers. The data are based on the answers of 447 Romanian consumers who were interested in home delivery. The surveyed consumers preferred to choose the ordered product and quantity themselves rather than buy monthly subscription boxes. In general, they ordered once a week or once every second week. The payment was regularly made with cash. Less than every fourth of the respondents ordered before the lockdown; their share increased a bit during the pandemic, and a great proportion of purchasers planned to keep/have this new habit. Online shopping was dominated by dairy products, and the needed information was collected mostly from Facebook or the website of the shop. Surprisingly, calls were the most popular way to order, followed by online platforms and online forms. The authors also analyzed how family status affected online shopping. The statistic proved that married consumers bought (once–twice a week) directly from the producer more often than unmarried ones. The study involved more variables in parallel to investigate in a biplot how the examined characteristics were connected. Based on the above-defined methodology, the singles and the families of two ordered directly from the producer when their need arose. In the case of families of three, four or five members, regular (once or twice a week) orders were characteristic. Based on these findings, the authors concluded that the presence of children increased the frequency of ordering. Comparing single and married consumers according to their preferred channels to order dairy products directly from producers highlighted that these consumers' behavior is similar.

Nchanji and Lutomia [48] examined the impact of the pandemic on sustainable production and consumption. This paper was concerned primarily with the consumption of fruits and vegetables in Eastern and Southern African countries. This work differs markedly from the previous ones since the sources of the data are developing countries. Up to this point, in the studies presented earlier, the consumption depended on the demand (the distribution of the consumers' resources) because the supply was stable. However, this paper instead presented how vulnerabilities in the agriculture and food systems multiply the impact of a global crisis on developing countries. The authors studied from different points of view the collected data and stated that those families who did home gardening increased their resilience to foodstuff shortfalls. The most crucial part of the work was the formulated suggestions to shorten the food supply chains in rural and urban areas and to enhance resilience to coming crises.

3.3. Grey Literature

The number of papers that were published in this section is really slight (includes documents not controlled by commercial publishing organizations). Generally, all these

works rather give an overview of the phenomenon of SFSCs. The examination of consumers' attitudes is not even addressed by them. The only work of Vittersø et al. [49] (financed by the EU) was the only grey literature that deserved to be mentioned. Short Food Supply Chains as drivers of sustainable development divide the effect of SFSCs into three pillars. These are the economic, social and environmental aspects. The authors more or less try to convince the readers about the advantages of alternative food networks. The only insightful and thought-provoking Figure in this strategy guide is the one about the different sizes of the diverse supply chains' carbon footprint. Within the nine compared chains, internet sales and sales to intermediaries cause the smallest aggregated (producer and consumer) pollution, so a suggestion for the future preferences of environmentally friendly consumers is formulated. Consequently, from this weakly related work, environmental awareness appears as a socio-demographic characteristic that could affect consumption.

The most often analyzed variables from the above reviewed work are summarized in Table 2. The selected papers reveal that the different studies mostly focus on different factors, which causes difficulties in a comprehensive analysis.

Table 2. The most often studied socio-demographic variables and their effect in the reviewed papers.

	Age	Sex	Income	Household Size	Education	Profession	Residence	Children	Social and Cultural Context	Marital Status
[26]	✓	✓	✓	✓	✓	✓	?	?	?	?
[27]	?	?	?	?	?	?	✓	?	?	?
[28]	×	×	✓	?	×	?	?	?	?	?
[29]	?	?	✓	✓	✓	✓	?	?	?	?
[30]	✓	✓	?	?	✓	?	?	✓	?	?
[31]	✓	✓	✓	?	✓	✓	✓	?	?	?
[10]	?	?	?	?	?	?	✓	?	?	?
[32]	✓	?	?	?	?	✓	?	?	✓	?
[33]	✓	?	?	?	?	?	?	?	?	?
[34]	?	?	?	?	?	?	?	?	✓	?
[35]	?	?	✓	?	✓	?	?	?	?	?
[36]	✓	✓	✓	?	✓	?	?	?	?	?
[37]	✓	?	?	?	?	?	✓	?	?	?
[38]	✓	?	✓	✓	✓	?	?	✓	?	×
[39]	✓	?	✓	?	✓	?	✓	?	✓	?
[40]	✓	✓	?	?	✓	?	?	?	?	?
[41]	✓	✓	?	✓	?	✓	?	?	?	?
[42]	✓	?	?	?	?	?	?	?	?	?
[43]	✓	✓	✓	?	?	?	✓	?	?	?
[44]	✓	✓	?	?	✓	?	✓	?	?	?
[46]	✓	?	?	✓	✓	?	?	?	?	✓
[47]	?	?	?	✓	?	?	?	✓	?	✓
[48]	?	?	?	?	?	?	✓	?	?	?

Source: own elaboration. Note: ✓ positive impact, × negative impact, ? not studied.

If we investigate the connections between the publications' abstracts, we can observe three clusters that are created by the VOSviewer. The green keywords are settled around "information" and are linked strongly together (as the thickness of the lines shows). This group is mostly connected through "behaviour" to "importance", which plays a central role in this model. With it, those "features" and "needs" could be defined that could be satisfied by the "producer". This latter keyword is dominant within the red group. It affects the products' features (blue) and consumers' behavior (green), too. This linkage confirms that direct communication (information, knowledge) can influence the perceived product

quality. Although only a few works are related to the pandemic, even its effect can be seen in Figure 3. In essence, the local products' features are important for the consumers, but the "story" of them has to be told by the producers.

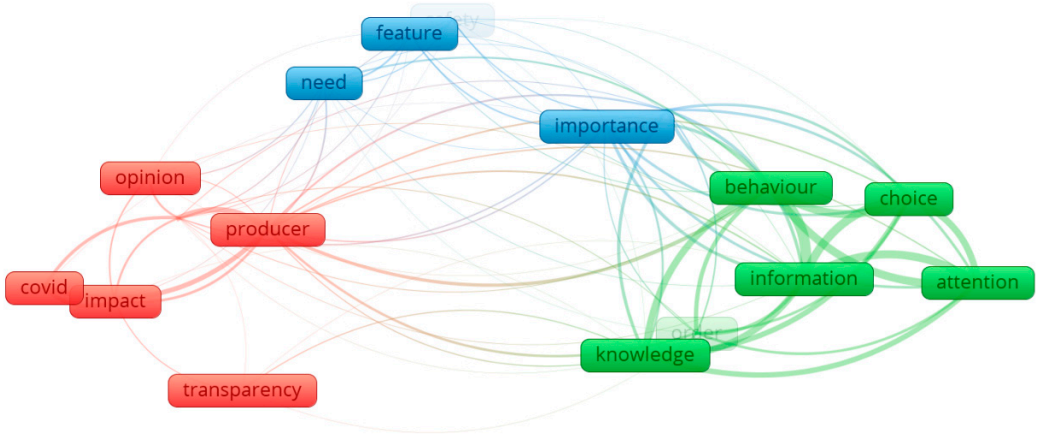

Figure 3. The relationship between behavior, product feature and producer through the studied abstracts. Source: own elaboration. Note: "safety" in the blue and "order" in the green clusters are pale because, even though they are relevant, they did not have sufficient connections.

4. Conclusions

Sustainable and environmentally friendly development is a hot topic nowadays. In agriculture, repetitive environmental disasters and food safety problems encourage more and more consumers to strive to ensure their purchase comes from a reliable source. The alternatives to the Global/Long Food Supply Chains have existed for years, but the current pandemic situation highlighted more of these advantages. At the same time, this research reflects the fact that there are only very limited relevant empirical economic data available about consumers' characteristics and attitudes that determine their intention to purchase through SFSCs. This aspect of the topic is not widely studied. From many points of view, studies were published, but international databases have not collected information about these channels. The reviewed papers differed widely in their directions. Over the years, the number of publications has increased, and different aspects of the studies have also increased. Many works analyzed producer participation in the SFSC, and various studies were made about the potential advantages/disadvantages, weaknesses and threats of SFSCs, too. The role of state intervention was also a popular direction, especially in developing countries, and many slightly related ideas were brought out, too. The number of the involved studies is relatively low, and even these were mostly done in Italy and Hungary; however, the western European countries would be more interested. German and Austrian consumers' green purchasing behavior is well-known, but relevant research from these countries was not published. One of the fundamental issues in the reviewed consumers' attitude studies is the lack of trust. The used additives, low quality, missing traceability and sometimes high prices drive customers to change. The published studies analyze the same product features regularly, but the authors rarely apply a more complicated methodology than mean or percentage calculation. The studied socio-demographic characteristics offer a relatively good base of comparison; however, the results of these could often rather be handled as case studies. Because of the special form of local SFSCs, randomly (without representativity) chosen consumers cannot provide any chance to statistically and correctly reproduce the same study results in another location. Despite this criticism, the involved publications and their primary data provided an insight into the features most often stressed by consumers that affect their decision making. Obviously, age is one of the most crucial demographical factors in many publications independently of the country, and education also plays an essential role according to numerous studies. On the other hand, sociological reasons could also be identified behind the formerly mentioned

characteristics. A higher social class, which could be connected to a higher income or even a higher educational background, necessitates better, more expensive products, but old habits (from childhood), new trends (order directly online from the producer) or even the desire for social contact also can drive people to purchase from SFSCs. Gender also can affect the purchasing channel used, because some of the studies found that women would rather choose this opportunity (especially in a given age group). Naturally, the gender roles within the country of the study can also strengthen or weaken its effect. The residence is also often studied as a demographic factor, but like earlier, many social explanations could be related to this point, too. Recently, family status, number of households and even the presence of a baby have been examined, which reflects the need to refer the studies' socio-demographical features to all the formerly defined variables. Representative studies are barely published, and the proper exploration and examination of sociological contexts are also often missing. However, next to the above-defined main socio-demographical factors, an adequate presentation of the general economic/well-being situation is highly recommended to facilitate a real comparison between studies.

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References

1. Fisk, G. Criteria for a Theory of Responsible Consumption. *J. Mark.* **1973**, *37*, 24–31. [CrossRef]
2. Brundtland, G.H. Our Common Future—Call for Action. *Environ. Conserv.* **1987**, *14*, 291–294. [CrossRef]
3. Ofstad, S.; Westly, L.; Bratelli, T.; Miljøverndepartementet Norway. *Symposium: Sustainable Consumption: 19–20 January 1994: Oslo, Norway*; Ministry of Environment: Oslo, Norway, 1994.
4. Rohm, H.; Oostindjer, M.; Aschemann-Witzel, J.; Symmank, C.; Almli, V.L.; De Hooge, I.E.; Normann, A.; Karantininis, K. Consumers in a Sustainable Food Supply Chain (COSUS): Understanding Consumer Behavior to Encourage Food Waste Reduction. *Foods* **2017**, *6*, 104. [CrossRef]
5. Mesterházy, Á.; Oláh, J.; Popp, J. Losses in the grain supply chain: Causes and solutions. *Sustainability* **2020**, *12*, 2342. [CrossRef]
6. Cherrier, H. Anti-consumption discourses and consumer-resistant identities. *J. Bus. Res.* **2009**, *62*, 181–190. [CrossRef]
7. Gregg, R.B. *The Value of Voluntary Simplicity*; Floating Press: Auckland, New Zealand, 2009.
8. Vermeir, I.; Verbeke, W. Sustainable Food Consumption: Exploring the Consumer "Attitude—Behavioral Intention" Gap. *J. Agric. Environ. Ethics* **2006**, *19*, 169–194. [CrossRef]
9. Simeone, M.; Scarpato, D.; Marinelli, N. Factors Affecting Food Label Complexity: Does the New EU Regulation Satisfy Consumer Issues? An Exploratory Study. *J. Food Prod. Mark.* **2016**, *22*, 571–583. [CrossRef]
10. Giampietri, E.; Verneau, F.; Del Giudice, T.; Carfora, V.; Finco, A. A Theory of Planned behaviour perspective for investigating the role of trust in consumer purchasing decision related to short food supply chains. *Food Qual. Prefer.* **2018**, *64*, 160–166. [CrossRef]
11. Psarikidou, K.; Szerszynski, B. The Moral Economy of Civic Food Networks in Manchester. *Int. J. Sociol. Agric. Food* **2012**, *19*, 309–327.
12. Zhu, Z.; Chu, F.; Dolgui, A.; Chu, C.; Zhou, W.; Piramuthu, S. Recent advances and opportunities in sustainable food supply chain: A model-oriented review. *Int. J. Prod. Res.* **2018**, *56*, 5700–5722. [CrossRef]
13. Rusciano, V.; Scarpato, D. Orientation of Agri-Food Companies to CSR and Consumer Perception: A Survey on Two Italian Companies. *Recent Patents Food Nutr. Agric.* **2018**, *9*, 134–141. [CrossRef]
14. Rayyan. 2022. Available online: http://rayyan.ai (accessed on 12 May 2022).
15. Page, M.J.; McKenzie, J.E.; Bossuyt, P.M.; Boutron, I.; Hoffmann, T.C.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; Akl, E.A.; Brennan, S.E.; et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *Int. J. Surg.* **2021**, *88*, 105906. [CrossRef]

16. Liberati, A.; Altman, D.G.; Tetzlaff, J.; Mulrow, C.; Gøtzsche, P.C.; Ioannidis, J.P.A.; Clarke, M.; Devereaux, P.J.; Kleijnen, J.; Moher, D. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *J. Clin. Epidemiol.* **2009**, *62*, e1–e34. [CrossRef]
17. Page, M.J.; McKenzie, J.E.; Bossuyt, P.M.; Boutron, I.; Hoffmann, T.C.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; Moher, D. Updating guidance for reporting systematic reviews: Development of the PRISMA 2020 statement. *J. Clin. Epidemiol.* **2021**, *134*, 103–112. [CrossRef]
18. Bazzani, C.; Canavari, M. Alternative agri-food networks and short food supply chains: A review of the literature. *Econ. Agro Aliment.* **2013**, *15*, 11–34. [CrossRef]
19. Fabbrizzi, S.; Menghini, S.; Marinelli, N. The short food supply chain: A concrete example of sustainability—A literature review. *Riv. Studi Sulla Sostenibilita* **2014**, *2*, 189–206. [CrossRef]
20. De Vries, H.; Mikolajczak, M.; Salmon, J.M.; Abecassis, J.; Chaunier, L.; Guessasma, S.; Trystram, G. Small-scale food process engineering—Challenges and perspectives. *Innov. Food Sci. Emerg. Technol.* **2018**, *46*, 122–130. [CrossRef]
21. Chiffoleau, Y.; Dourian, T. Sustainable Food Supply Chains: Is Shortening the Answer? A Literature Review for a Research and Innovation Agenda. *Sustainability* **2020**, *12*, 9831. [CrossRef]
22. Liu, L.; Cavaye, J.; Ariyawardana, A. Supply chain responsibility in agriculture and its integration with rural community development: A review of issues and perspectives. *J. Rural Stud.* **2022**, *93*, 134–143. [CrossRef]
23. Paciarotti, C.; Torregiani, F. The logistics of the short food supply chain: A literature review. *Sustain. Prod. Consum.* **2021**, *26*, 428–442. [CrossRef]
24. Enthoven, L.; Van den Broeck, G. Local food systems: Reviewing two decades of research. *Agric. Syst.* **2021**, *193*, 103226. [CrossRef]
25. Bayir, B.; Charles, A.; Sekhari, A.; Ouzrout, Y. Issues and Challenges in Short Food Supply Chains: A Systematic Literature Review. *Sustainability* **2022**, *14*, 3029. [CrossRef]
26. D'Amico, M.; Di Vita, G.; Chinnici, G.; Pappalardo, G.; Pecorino, B. Short food supply chain and locally produced wines: Factors affecting consumer behavior. *Ital. J. Food Sci.* **2014**, *26*, 329–334.
27. Llazo, E. Customer attitudes towards short food supply chain in Albania. *Univ. Bucur. An. Ser. Stiinte Econ. Adm.* **2014**, *8*, 3–20.
28. Schifani, G.; Romeo, P.; Guccione, G.D.; Schimmenti, E.; Columba, P.; Migliore, G. Conventions of Quality in Consumer Preference toward Local Honey in Southern Italy. *Qual. Access Success Calitatea* **2016**, *17*, 92–97.
29. Chinnici, G.; di Pino, L.; Allegra, V. Consumption of almonds in Sicily: Attitudes and purchasing behaviour. *Qual. Access Success Calitatea* **2016**, *17*, 33–41.
30. Mancini, P.; Marchini, A.; Simeone, M. Which are the sustainable attributes affecting the real consumption behaviour? Consumer understanding and choices. *Br. Food J.* **2017**, *119*, 1839–1853. [CrossRef]
31. Szabó, D. Determining the target groups of Hungarian short food supply chains based on consumer attitude and socio-demographic factors. *Stud. Agric. Econ.* **2017**, *119*, 115–122. [CrossRef]
32. Oñederra-Aramendi, A.; Begiristain-Zubillaga, M.; Malagón-Zaldua, E. Who is feeding embeddedness in farmers' markets? A cluster study of farmers' markets in Gipuzkoa. *J. Rural Stud.* **2018**, *61*, 22–33. [CrossRef]
33. Chinnici, G.; Di Grusa, A.; D'amico, M. The consumption of fresh-cut vegetables: Features and purchasing behaviour. *Qual. Access Success* **2019**, *20*, 178–185.
34. Stanco, M.; Lerro, M.; Marotta, G.; Nazzaro, C. Consumers' and farmers' characteristics in short food supply chains: An exploratory analysis. *Stud. Agric. Econ.* **2019**, *121*, 67–74. [CrossRef]
35. Bakos, I.M.; Khademi-Vidraa, A. Empirical experiences of the hungarian alternative food buying communities. *Deturope* **2019**, *11*, 55–73. [CrossRef]
36. De Bernardi, P.; Bertello, A.; Venuti, F.; Foscolo, E. How to avoid the tragedy of alternative food networks (AFNs)? The impact of social capital and transparency on AFN performance. *Br. Food J.* **2020**, *122*, 2171–2186. [CrossRef]
37. April-Lalonde, G.; Latorre, S.; Paredes, M.; Hurtado, M.; Muñoz, F.; Deaconu, A.; Cole, D.; Batal, M. Characteristics and Motivations of Consumers of Direct Purchasing Channels and the Perceived Barriers to Alternative Food Purchase: A Cross-Sectional Study in the Ecuadorian Andes. *Sustainability* **2020**, *12*, 6923. [CrossRef]
38. Kiss, K.; Ruszaki, C.; Szűcs, A.; Koncz, G. Examining the Role of Local Products in Rural Development in the Light of Consumer Preferences—Results of a Consumer Survey from Hungary. *Sustainability* **2020**, *12*, 5473. [CrossRef]
39. Fogarassy, C.; Nagy-Pércsi, K.; Ajibade, S.; Gyuricza, C.; Ymeri, P. Relations between Circular Economic "Principles" and Organic Food Purchasing Behavior in Hungary. *Agronomy* **2020**, *10*, 616. [CrossRef]
40. Fricz, S.; Ittzés, A.; Ózsvári, L.; Szakos, D.; Kasza, G. Consumer perception of local food products in Hungary. *Br. Food J.* **2020**, *122*, 2965–2979. [CrossRef]
41. Kallas, Z.; Alba, M.F.; Casellas, K.; Berges, M.; Degreef, G.; Gil, J.M. The development of short food supply chain for locally produced honey: Understanding consumers' opinions and willingness to pay in Argentina TT—Development of SFSC for locally produced honey. *Br. Food J.* **2021**, *123*, 1664–1680. [CrossRef]
42. Oliveira, I.; Oliveira, L.; Lisboa, M.; Madalon, E.; Freitas, L.; Filho, A.P. The Geographical Distance between Producers and Consumers of the Organic Street Markets: The Case of Belo Horizonte, Brazil. *Logistics* **2021**, *5*, 30. [CrossRef]
43. Skripnuk, D.F.; Davydenko, V.A.; Romashkina, G.F.; Khuziakhmetov, R.R. Consumer Trust in Quality and Safety of Food Products in Western Siberia. *Agronomy* **2021**, *11*, 257. [CrossRef]

44. Kovács, I.; Lendvai, M.B.; Beke, J. The Importance of Food Attributes and Motivational Factors for Purchasing Local Food Products: Segmentation of Young Local Food Consumers in Hungary. *Sustainability* **2022**, *14*, 3224. [CrossRef]
45. Rabbi, M.F.; Oláh, J.; Popp, J.; Máté, D.; Kovács, S. Food Security and the COVID-19 Crisis from a Consumer Buying Behaviour Perspective—The Case of Bangladesh. *Foods* **2021**, *10*, 3073. [CrossRef] [PubMed]
46. Butu, A.; Brumă, I.S.; Tanasă, L.; Rodino, S.; Vasiliu, C.D.; Doboș, S.; Butu, M. The Impact of COVID-19 Crisis upon the Consumer Buying Behavior of Fresh Vegetables Directly from Local Producers. Case Study: The Quarantined Area of Suceava County, Romania. *Int. J. Environ. Res. Public Health* **2020**, *17*, 5485. [CrossRef] [PubMed]
47. Brumă, I.; Vasiliu, C.; Rodino, S.; Butu, M.; Tanasă, L.; Doboș, S.; Butu, A.; Coca, O.; Stefan, G. The Behavior of Dairy Consumers in Short Food Supply Chains during COVID-19 Pandemic in Suceava Area, Romania. *Sustainability* **2021**, *13*, 3072. [CrossRef]
48. Nchanji, E.B.; Lutomia, C.K. COVID-19 challenges to sustainable food production and consumption: Future lessons for food systems in eastern and southern Africa from a gender lens. *Sustain. Prod. Consum.* **2021**, *27*, 2208–2220. [CrossRef]
49. Vittersø, G.; Torjusen, H.; Laitala, K.; Tocco, B.; Biasini, B.; Csillag, P.; de Labarre, M.D.; Lecoeur, J.-L.; Maj, A.; Majewski, E.; et al. Short Food Supply Chains and Their Contributions to Sustainability: Participants' Views and Perceptions from 12 European Cases. *Sustainability* **2019**, *11*, 4800. [CrossRef]

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