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Generating competitive advantage by uncovering lost efficiencies: a Low-Certainty-Need perspective into the Agri-food Supply Chain

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I dedicate this thesis to my mother, Ana, who had an unparalleled influence on my life and fundamentally shaped me into the person I am today. Her passing during the writing of this thesis has left an irreplaceable void, but her memory lives on.

I also dedicate this work to my brother, Hugo, whose unwavering dedication and hard work provided valuable insights and perspective throughout this journey. Your belief in me made this achievement possible, and I am forever grateful for your encouragement. Your passing at the end of 2024 will forever leave a hole in my heart and a belief that your dreams will live on through me.

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Abstract

This thesis explores the integration of resilience and efficiency into the Agri-food Supply Chain (AFSC) and the effects on supply chain (SC) structure, design, and supplier management. Through a comprehensive analysis of the literature on Supply Chain Resilience, resilience in the AFSC, and Alternative Food Networks based in the locality and semi-structured interviews with key players in the AFSC, new theoretical and practical conclusions were found on the management of the AFSC. The findings demonstrate that Food Hubs are an apt organizational and structural innovation that enhance resilience in the lens of SC ambidexterity and the Low-Certainty-Need SC framework. Additionally, the findings provide practical strategies for applying inventory and capacity redundancies in the AFSC with cost-effective considerations and an instance where the collaborative method of collective learning with value co-creation is used and implemented in practice along with practical strategies derived from this case for widespread implementation.

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List of Abbreviations

Agri-food Supply Chain – AFSC

Alternative Food Networks – AFN

Business Model Innovation – BMI

Corporate Social Responsibility – CSR

Digital Food Hub – DFH

Farm Relations Management – FRM

Food Hub – FH

Food Loss and Waste – FLW

Produce Commercial Operations – PCO

Short Food Supply Chain – SFSC

Supply Chain – SC

Supply Chain Management – SCM

Supply Chain Resilience – SCR

Values-based Supply Chain – VBSC

Volatility, Uncertainty, Leanness, Complexity, and Ambiguity – VULCA

1. Introduction

Recent world events, such as the COVID-19 pandemic, have exposed the volatility, uncertainty, leanness, complexity, and ambiguity (VULCA) of modern global Supply Chains (SCs) (Aday and Aday, 2020; Davis, Downs and Gephart, 2020; Golan, Jernegan and Linkov, 2020; Ivanov and Dolgui, 2021b; O'Hara and Toussaint, 2021; Ivanov, 2022; Nikookar and Yanadori, 2022). In combination with unpredictable external events, risks inherent to the SC and the companies operating within their respective SC create a VULCA environment where organisations struggle to maintain market shares and competitive advantage (Ivanov, Sokolov and Kaeschel, 2010; Wieland and Wallenburg, 2012; Wang, 2018; Dubey *et al.*, 2019; Balezentis *et al.*, 2023). Inevitably, as networks connect an increasingly high number of players, not only dependencies between players are formed, but also the SC harbours a significant amount of uncalculated risk, which propagates throughout the network, originating the ripple effect, negatively impacting many organisations in the process, whether they are directly connected or have a seemingly significant number of nodes in between (Ivanov, Sokolov and Dolgui, 2014; Dolgui, Ivanov and Sokolov, 2018; K.E.K *et al.*, 2022; Llaguno, Mula and Campuzano-Bolarin, 2022; United Nations Office for Disaster Risk, 2022). To amplify this effect, many organisations demonstrate an overall lack of risk awareness and risk identification culture, which coupled with power imbalances and lack of trust in other members of the SC, create significant barriers in the deployment of strategies that mitigate risk at a local and global level, such as resilience measures (Spiegler, Naim and Wikner, 2012; Vlajic, Van Der Vorst and Haijema, 2012; Ivanov and Dolgui, 2021b; United Nations Office for Disaster Risk, 2022; Yadav *et al.*, 2022). Therefore, as interconnectedness rises, systemic risk also increases, rendering systemic approaches to risk mitigation and propagation crucial in today's business environment (Gille, 2012; Davis, Downs and Gephart, 2020; Bernard De Raymond *et al.*, 2021; United Nations Office for Disaster Risk, 2022).

In the words of Bourlakis and Weightman: "*There is no aspect of everyday life more critical than the means by which the world is fed.*" in the context of Agri-Food Supply Chains (AFSCs), the VULCA environment seriously questions food security in a global amplitude (Gholami-Zanjani, Klibi, *et al.*, 2021; United Nations Office for Disaster Risk, 2022). Resilience in the AFSC aims to ensure the business continuity of players within this SC and ensure food availability, diversity,

safety, and equity for all humans on Earth (Stone and Rahimifard, 2018; United Nations Office for Disaster Risk, 2022). Furthermore, the lack of resilience measures in organisations operating in the AFSC has resulted in an estimated 40% reduction in income due to the compounded effects of the pandemic and subsequent SC issues (Barman, Das and De, 2022).

In light of these challenges, there is an apparent necessity to deploy Business Model Innovation (BMI), as well as reformulations of existing business models and SC structures, with the goal of restructuring AFSCs to incorporate proactive Supply Chain Management (SCM), implement SC ambidexterity, and minimise the dependency on accurate forecasting and stable environmental conditions (Ivanov and Dolgui, 2019; Nosratabadi, Mosavi and Lakner, 2020; Saetta and Caldarelli, 2020; Ivanov, 2022; Balezentis *et al.*, 2023).

2. Literature Review

2.1 Resilience in Supply Chain Management

Uncertainties in the SC result from the connection between an increasingly turbulent and dynamic environment with the interconnectedness and complexity of global SCs (Hosseini, Ivanov and Dolgui, 2019). The interplay of these factors results in increased risks for companies while making SCs less observable and controllable, introducing additional risk in every aspect of SC operations, from demand forecasting to production and distribution (Ivanov, Sokolov and Dolgui, 2014; Ghadge *et al.*, 2022; Llaguno, Mula and Campuzano-Bolarin, 2022). These risks can be distributed into three categories: internal to the firm (e.g., failures in production systems, inadequate maintenance, inadequate inventory management), external to the firm and internal to the SC (e.g., variations in supply and demand), and external to the SC (e.g., natural disasters, pandemics, and political instability) (Spiegler, Naim and Wikner, 2012).

Uncertainties in the SC come primarily due to variability in customer preferences, supplier variability, disruptions in transport networks, and external shocks. Trends, economics and market competition make customer preferences highly variable, reducing the accuracy of demand forecasting and leading to stockouts or overstocking, which can degrade customer satisfaction and increase costs (Muckstadt *et al.*, 2001). Another factor that companies must take into account is the variability from suppliers, spanning from supplier reliability and delays, which can

halt operations for an unknown period, resulting in possible inefficiencies within operations, such as last-minute changes to the SC, leading to longer lead times and reduced productivity (Muckstadt *et al.*, 2001; Ivanov, Sokolov and Dolgui, 2014). Additionally, several external uncertainties such as weather disruptions, strikes, traffic delays, and regulatory changes (e.g., customs delays) could interrupt transportation networks, which are crucial for the functioning of global SCs, causing increased expenditure due to the reactive and urgent actions to ensure operations continuity, such as opting for expedited transportation to meet time-sensitive delivery requirements (Muckstadt *et al.*, 2001; Blackhurst, Dunn and Craighead, 2011; Ivanov, Sokolov and Dolgui, 2014). Davis, Downs and Gephart (2020) emphasise that external shocks can cascade down the SC, possibly originating price volatility and thus rendering the downstream actors vulnerable. This volatility is particularly pronounced in sectors such as agriculture, where external factors like climate conditions can drastically alter SC dynamics and commodity prices (Li and Song, 2022). Events like these disrupt the entire SC, impacting not just one company but also its suppliers and customers (Muckstadt *et al.*, 2001; Blackhurst, Dunn and Craighead, 2011).

Notably, these uncertainties and their impact on the SC create risks that companies must face to survive in the market. Namely, the increase in the likelihood of SC disruptions and potentially significant financial losses if disruptions are not accounted for, prepared, and managed adequately (Muckstadt *et al.*, 2001; Spiegler, Naim and Wikner, 2012). These events frequently arise from natural or anthropogenic disturbances characterized by low probabilities and significant impact, which differ in type, scale, and nature, and are of erratic and irregular identification (Hosseini, Ivanov and Dolgui, 2019). Therefore, predicting these events and computing probabilities for their occurrence is an arduous task, which makes investments in proactive strategies and contingency plans difficult to justify and deploy (Tang, 2006; Hosseini, Ivanov and Dolgui, 2019; Llaguno, Mula and Campuzano-Bolarin, 2022). Research has indicated that while there are numerous risk identification frameworks available, comprehensive and systematic methodologies for efficiently managing these uncertainties and interconnectedness are frequently lacking (Wieland and Wallenburg, 2012; Wang, 2018; Sunitha, 2024).

Although these risks exist, SCs are expected to have the capacity to respond quickly, efficiently, and effectively to market changes, thus making it even more challenging to operate the SC under

uncertainty (Llaguno, Mula and Campuzano-Bolarin, 2022). Additionally, recent disruptions such as the COVID-19 pandemic and the war in Ukraine have exposed the fragility of global SCs at an unforeseen scale, causing stockouts across many industries (Ivanov and Dolgui, 2021b; Llaguno, Mula and Campuzano-Bolarin, 2022). These risks affect one company and propagate through the SC, affecting different actors in different echelons and generating ripple effect (Scholten and Schilder, 2015).

According to Ivanov, Sokolov and Dolgui (2014), the ripple effect is defined by structural network dynamics, functioning primarily as a downstream phenomenon, wherein the performance of one node influences subsequent stages in the SC. For instance, a drought in Brazil impacting the coffee supply can elevate worldwide prices, illustrating how localised disruptions can have extensive economic ramifications (K.E.K *et al.*, 2022). The simulation performed by Llaguno, Mula and Campuzano-Bolarin (2022) showed that in every single case, if a disruption happens upstream in the SC, the downstream nodes will suffer some negative effect. However, a disruption downstream in the SC could potentially increase the upstream player's profit due to increased orders due to insufficient or loss of inventory (Llaguno, Mula and Campuzano-Bolarin, 2022). This phenomenon has been extensively studied, revealing that disruptions not only affect immediate suppliers, but can also impact customers and partners, resulting in performance degradation across the entire SC (Dolgui, Ivanov and Sokolov, 2018; Birkie and Trucco, 2020). Additionally, the complexity of modern SCs, coupled with their interdependencies, make them particularly vulnerable to such cascading effects (Ivanov and Dolgui, 2021a). Garvey and Carnovale (2020) emphasise that disruptions frequently propagate along the SC due to the intrinsic interdependence among suppliers, manufacturers, and distributors. The interconnection implies that a disturbance in one section can trigger cascading failures across the network, leading to extensive operational difficulties (Garvey and Carnovale, 2020). Therefore, the design and architecture of the SC might either amplify or alleviate the ripple impact, making it necessary for firms to comprehend the configuration and interdependencies of their network (Park *et al.*, 2022).

Another key factor is the character of the disruptions themselves. Mishra *et al.* (2021) observe that disruptions can differ in intensity and occurrence, with infrequent, high-impact incidents

presenting considerable threats to SCs. Disruptions, such as natural disasters, pandemics, or political instability, can result in sudden fluctuations in demand and supply, initiating a ripple effect that impacts several stakeholders. The COVID-19 pandemic illustrated the potential of a worldwide health catastrophe to disrupt supply networks, resulting in shortages and delays across multiple sectors (Ivanov and Das, 2020). The initial shock from such incidents might trigger a domino effect, wherein the failure of one supplier to deliver items impacts downstream partners, resulting in a broader influence on SC performance (Dolgui, Ivanov and Sokolov, 2018). The simulation findings of Ghadge *et al.* (2022) demonstrate that the ripple effect can concurrently disseminate throughout many nodes, with the intensity of the impact dependent upon the risk-resistance capacities of specific SC entities.

Effective SCM solutions are essential to mitigate the ripple effect. Proactive risk management techniques, such as supplier diversification, buffer stock policies, and investment in SC monitoring systems, can alleviate the impact of disruptions (Datta, 2017; Davis, Downs and Gephart, 2020; Li and Zobel, 2020; K.E.K *et al.*, 2022; Nikookar and Yanadori, 2022). Moreover, collaborative engagement across all SC levels can facilitate identifying potential risks and formulating mitigation solutions (Birkie and Trucco, 2020; Park *et al.*, 2022). Dolgui, Ivanov and Rozhkov (2020) assert that information exchange and coordinated responses among SC stakeholders can avert modest disruptions from developing into extensive ripple impacts. The ripple effect alters the SC structure, with immediate impacts and enduring consequences (Ivanov, Dolgui and Sokolov, 2019; Ivanov and Dolgui, 2021b). Consequently, SC design and enhancing risk capacity in the most interconnected nodes are essential for mitigating short-term and long-term propagation (Li and Zobel, 2020; Ivanov and Dolgui, 2021b).

Alongside the ripple effect, additional variables exacerbate the unpredictability and uncertainty encountered by organisations throughout SCs. Notably, these encompass behavioural uncertainty and power dynamics (Muckstadt *et al.*, 2001; Dubey *et al.*, 2019).

Behavioural uncertainty is defined by the incapacity to anticipate the activities of an SC partner or changes in the external environment (Dubey *et al.*, 2019). Raj and Lakshminarayanan (2010) examine how erratic actions across SC actors can intensify uncertainty, leading to a discrepancy

between the outputs of one entity and the needs of another. This problem occurs mainly due to an unsatisfactory level of communication between partners and information flows (Muckstadt *et al.*, 2001; Dubey *et al.*, 2019).

Power relations emerge from an imbalance in bargaining power among SC partners, affecting decision-making processes, performance outcomes, and the overall dynamics among stakeholders (Muckstadt *et al.*, 2001). Power dynamics within SCs can be described as balanced or imbalanced (Chamanara, Goldstein and Newell, 2023). Balanced power occurs when parties wield comparable degrees of influence, facilitating equitable decision-making (Chamanara, Goldstein and Newell, 2023). Conversely, power imbalances occur when certain partners possess the ability to exert considerable influence on others, frequently resulting in the manipulation of decisions and results (Chamanara, Goldstein and Newell, 2023). This imbalance can yield both advantageous and detrimental effects on SC performance, as it may enable rapid decision-making but can also result in exploitation and inefficiencies if not controlled well, consequently impacting collaboration and innovation (Muckstadt *et al.*, 2001; Leat and Revoredo-Giha, 2008; Chamanara, Goldstein and Newell, 2023).

The COVID-19 pandemic has exposed weaknesses in global SCs, underscoring the necessity for resilience and adaptability in response to unforeseen disruptions (Aday and Aday, 2020; Ivanov and Dolgui, 2021b; Ivanov, 2022; Nikookar and Yanadori, 2022; Ozdemir *et al.*, 2022). Blackhurst, Dunn and Craighead (2011) argue that as SCs become lengthier and more complex, the likelihood of disruptions escalates, rendering resilience a crucial element in risk mitigation. Further, Kim and Chai (2014) emphasise the significance of strategic sourcing and organisational culture in the effective management of SC risks, by cultivating a culture that emphasises risk awareness and proactive management, firms can more effectively mitigate the volatility in their SCs.

Resilience in SCs is increasingly acknowledged as a vital element for firms seeking to manage the complexities and uncertainties of the contemporary global market (Ivanov, 2022). Supply Chain Resilience (SCR) refers to the capacity of a SC to anticipate, react to, and recuperate from disruptions, hence maintaining operational continuity and stability (Blackhurst, Dunn and

Craighead, 2011; Spiegler, Naim and Wikner, 2012; Scholten and Schilder, 2015; Dubey *et al.*, 2019, 2021; Hosseini, Ivanov and Dolgui, 2019). This competence is crucial for preserving competitive advantage and protecting against possible losses from disruptions (Blackhurst, Dunn and Craighead, 2011; Datta, 2017).

In the literature, SCR is a concept with numerous definitions, primarily due to the diverse situations in which resilience is applied:

- Definition by Hosseini, Ivanov and Dolgui (2019): "*SC capability to utilise the absorptive capacity of SC entities to repulse and withstand the impacts of perturbations, to minimise the consequences of disruptions and their propagation by utilising adaptive capacity and to recover performance level to normal operations in a cost-efficient manner using restorative capacity when absorptive and adaptive capacities are not sufficient.*" – This definition frames resilience as a layered capability of the following elements: absorptive capacity, which allows the SC to absorb shocks and the ripple effect using proactive strategies put in place before the disruption, effectively minimising the effects of the disruption; adaptive capacity, which enables the SC to adjust, modify, and realign its operations to post-disruption necessities in a cost-controlled manner; restorative capacity, which brings the system to normal or to the new equilibrium when the absorptive and adaptive capacities fail (Hosseini, Ivanov and Dolgui, 2019).
- Definition by Ponomarov and Holcomb (2009): "*Resilience enables a supply chain to be prepared for events, reduce the impact of a disruption and strengthens the ability to recover quickly from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function.*" – This definition speaks to the effects that implementing resilience in the SC has, mainly creating preparedness for unforeseen events, allowing the SC to continue providing goods or services at appropriate costs according to end consumers requirements, responsiveness by reacting promptly to a specific stimulus, and recovery by returning to normal or balanced conditions, without generating the ripple effect (Ponomarov and Holcomb, 2009).
- Definition by Christopher and Peck (2004): ''*The ability of a system to return to its original state or move to a new, more desirable state after being disturbed*.'' – This definition

speaks of the ability of a resilient system to be agile and flexible in the face of disruption, allowing it to change its structure if needed (Christopher and Peck, 2004).

- Definition by Dolgui, Ivanov and Sokolov (2018): "*Adaptive capacity of a supply chain to prepare for unexpected disruptions, respond to them, and recover while maintaining continuity of operations at the desired levels of performance*" – This definition speaks to the ability of a resilient system to adapt by creating flexibility and agility to adjust to new circumstances through proactive risk management, respond quickly and effectively when a disruption occurs by realigning resources, and recover operations to a pre-disruption state, all while maintaining an acceptable level of performance (Dolgui, Ivanov and Sokolov, 2018).

The previous definitions elaborate on key elements of SCR that serve as building blocks to implement while designing a resilient SC:

- Absorptive Capacity / Preparedness is acknowledged by all definitions as an essential factor in mitigating the initial effects of a disruption prior to its propagation throughout the SC (Christopher and Peck, 2004; Ponomarov and Holcomb, 2009; Dolgui, Ivanov and Sokolov, 2018; Hosseini, Ivanov and Dolgui, 2019). Therefore, the capacity to endure initial disturbances is a vital preliminary measure in sustaining resilience (Hosseini, Ivanov and Dolgui, 2019). Absorptive capacity is typically defined by several critical dimensions: the acquisition of information, the assimilation of knowledge, the transformation of that knowledge into actionable strategies, and the application of these strategies to enhance performance (Dobrzykowski *et al.*, 2015; Isfianadewi and Muhammad Haryo Anindityo, 2022). The capacity to anticipate disturbances through proactive tactics is a crucial element of resilience, facilitating the mitigation of their impact (Scholten and Schilder, 2015; Dolgui, Ivanov and Sokolov, 2018).
- Adaptive Capacity / Flexibility, defined as the ability to adjust, adapt, and respond to changes or disruptions, is crucial in all definitions (Christopher and Peck, 2004; Ponomarov and Holcomb, 2009; Dolgui, Ivanov and Sokolov, 2018; Hosseini, Ivanov and Dolgui, 2019). Dolgui, Ivanov and Sokolov (2018) emphasise adaptive capacity as a SC capability to modify in response to unforeseen disturbances and to react to them

effectively. Hosseini, Ivanov and Dolgui (2019) highlight adaptive capacity to minimise the impacts of disruptions through real-time modifications. Spiegler, Naim and Wikner (2012) emphasise that resilience entails the capacity to transition to a "*new, more desirable state*" following a disturbance, indicating a degree of operational flexibility, thus implicating the establishment of networks capable of reconfiguration in reaction to various disruptions.

- Recovery / Restorative Capacity denotes the system's capability to return to regular operations or attain an improved state after experiencing shock and undergoing adaptation (Christopher and Peck, 2004; Ponomarov and Holcomb, 2009; Dolgui, Ivanov and Sokolov, 2018; Hosseini, Ivanov and Dolgui, 2019). Hosseini, Ivanov and Dolgui (2019) investigate restorative capacity, which is essential when absorptive and adaptive capacities are insufficient, to guarantee efficient and inexpensive performance restoration. Spiegler, Naim and Wikner (2012) underscore the significance of returning to the original or a new optimal state, suggesting a goal that surpasses simple recovery to include possible improvements inside the system.
- Minimization of Disruption Propagation (Ripple Effect) – the capacity to contain disruptions and prevent the ripple effect (Christopher and Peck, 2004; Ponomarov and Holcomb, 2009; Dolgui, Ivanov and Sokolov, 2018; Hosseini, Ivanov and Dolgui, 2019). This element pertains to managing the dissemination of disruptions, ensuring that disruptions do not propagate through the SC, exacerbating negative impacts (Ponomarov and Holcomb, 2009; Hosseini, Ivanov and Dolgui, 2019).
- Continuity of Activities / Redundancy requires maintaining activities during a disruption is crucial for mitigating operational losses and ensuring customer satisfaction (Christopher and Peck, 2004; Ponomarov and Holcomb, 2009; Scholten and Schilder, 2015; Dolgui, Ivanov and Sokolov, 2018; Hosseini, Ivanov and Dolgui, 2019). Dolgui, Ivanov and Sokolov (2018) and Scholten and Schilder (2015) assert that resilience includes survival and the capacity to maintain an acceptable performance level amid disruptions, implying a level of redundancy throughout the SC. Kamalahmadi and Parast (2017) define redundancy as the capacity to react to disturbances, achieved by investments in excess

stocks and improved operating capabilities before the disruption occurs. Talluri *et al.* (2013) investigate the effectiveness of supplier redundancy, such as dual sourcing, as a risk mitigation strategy, emphasising that allocating orders among multiple suppliers can substantially reduce vulnerability to disruptions. This aligns with the study by Kamalahmadi and Parast (2017), which assesses the effectiveness of redundancy solutions, such as backup suppliers and pre-positioned stockpiles, in alleviating supply and external risks.

- Agility allows supply networks to swiftly react to disruptions, reducing delays and preserving operational continuity (Christopher and Peck, 2004; Ponomarov and Holcomb, 2009; Dolgui, Ivanov and Sokolov, 2018; Hosseini, Ivanov and Dolgui, 2019). This strategy is not simply a reactive measure, as it is based on the implementation of proactive approaches that enable firms to adjust in real-time, taking advantage of opportunities created by the proactive SC design and alleviating risks linked to market changes (Li, Holsapple and Goldsby, 2019).

Alongside these factors, there are strategies and tools that enhance each of these factors and contribute to the efficient implementation of resilience. The following strategies and tools are powerful levers to implement resilient strategies, especially if they are already in place or embedded in the SC structure, as they are antecedents of resilience (Dubey *et al.*, 2019; Nikookar and Yanadori, 2022).

Collaboration among SC partners is a crucial antecedent to resilience, allowing companies to create long-term relationships and share resources, information, and risks, thus enhancing their capacity to endure disruptions (Blackhurst, Dunn and Craighead, 2011; Scholten and Schilder, 2015; Nikookar and Yanadori, 2022). Dubey *et al.* (2019) substantiate this concept, asserting that collaboration and information exchange are crucial for developing resilient SCs, enabling businesses to utilise their partners' strengths, thus enhancing their collective resilience. Asamoah, Agyei-Owusu and Ashun (2020) highlight that collaborative connections improve operational performance and customer satisfaction since resilient SCs are more adept at fulfilling client expectations during crises. This collaborative strategy is reinforced by the understanding

that resilience is not a singular endeavour but a continuous process necessitating persistent involvement and coordination across SC participants (Scholten and Schilder, 2015).

Visibility is a prerequisite for effective risk management and operational agility. The capacity to oversee and regulate SC operations in real time enables firms to respond rapidly to evolving circumstances, thus improving individual and collective resilience (Golan, Jernegan and Linkov, 2020). Zhou *et al.* (2024) corroborate this, revealing that visibility, enhanced by information technology skills, substantially influences SCR in times of crisis. Cheng and Lu (2017) assert that increased visibility allows firms to recognise possible hazards and respond proactively.

SC Coordination / Leadership plays a crucial role in maintaining cohesion of diverse SC components, facilitating collaboration and information sharing among various stakeholders, and integrating a holistic implementation of SCR (Ivanov, Sokolov and Kaeschel, 2010). The paradigm presented by Ivanov, Sokolov and Kaeschel (2010) underscores the imperative of adaptability in SC operations, enabling coordinators to modify plans and processes in real time in response to structural alterations and external influences. Advanced information systems and data analytics are essential for equipping coordinators with insights for informed decision-making, as this enables them to augment visibility throughout the SC, resulting in enhanced forecasting, inventory management, and overall operational efficiency (Zhou *et al.*, 2024).

Despite all the aforementioned negative impacts of uncertainties, risk, disruptions, and the ripple effect, companies still often neglect resilience measures in their SCs due to a combination of factors, including short-term focus, cost considerations, and a lack of understanding of the benefits of resilience, leading to a general prevailing mindset that views SCR as an additional cost rather than an investment that enhances competitive advantage (Mishra *et al.*, 2021). Additionally, firms may implement redundancy strategies without considering the broader context of their SC dynamics, leading to inefficiencies and increased costs (Ozdemir *et al.*, 2022).

Consequently, there is a clear need to combine resilience strategies with efficient decision-making, a matter addressed in the Low-Certainty-Need (LCN) SC framework.

The LCN SC concept has emerged as an essential paradigm change for mitigating disruption risk and improving resilience in SC operations (Ivanov and Dolgui, 2019; Ivanov, 2022). Conventional

SCM frequently depends on the assumption of predictable settings and stable conditions; however, the growing complexity and unpredictability of global markets require a transition to strategies that embrace uncertainty and volatility (Esteso, Alemany and Ortiz, 2018; Wang, 2018; Birkie and Trucco, 2020; Ivanov, 2022; Suali, Srai and Tsolakis, 2024). Ivanov and Dolgui (2019) argue that in unknown circumstances, it is essential to develop SCs that are less dependent on the certainty of knowledge about the external environment and its dynamics, underscoring the significance of adaptability and flexibility in SC operations. Additionally, conventional disruption control measures may be inadequate against unforeseen disruptions, underscoring the importance of transitioning to a resilience-focused SC architecture (Ivanov and Dolgui, 2019). This method entails developing systems capable of absorbing shocks and adjusting to fluctuations in demand and supply dynamics by integrating real-time data analytics and agile methodologies, which can improve an SC's responsiveness to unexpected occurrences, thus diminishing dependence on precise forecasting and planning (Ivanov and Dolgui, 2019). Moreover, the ramifications of the LCN SC framework transcend simple operational modifications, as they require a reassessment of risk management frameworks, in which firms must foster a culture of agility and responsiveness (Ivanov, 2022; Balezentis *et al.*, 2023). This entails investment in technologies that improve visibility and communication throughout the SC, facilitating expedited decision-making in reaction to disturbances (Ivanov and Dolgui, 2019; Ivanov, 2022). Furthermore, organisations can sustain operational continuity despite uncertainty by cultivating resilience, which can be accomplished by implementing tactics such as diversifying suppliers, investing in technology for enhanced visibility, and fostering collaborative connections with partners (Ivanov and Dolgui, 2019). In order to achieve a high level of adaptability and flexibility while depending less on external information, the LCN SC framework arises on three fundamental pillars, which are the outcome of the combination of several resiliency-oriented and efficiency-oriented elements, alongside the deployment of new technologies postulated in the industry 4.0 paradigm:

- Structural Variety – Conventional SC design typically emphasises cost reduction and efficiency, often neglecting the complexities and uncertainties inherent in contemporary SCs. The LCN framework underscores the necessity for establishing adaptable sourcing

structures within SCs, facilitating diverse structural configurations that can respond to evolving conditions and alleviate risks linked to disruptions. In practice, this means applying decentralisation, localisation, and diversification to product-line-oriented SCs (Ivanov and Dolgui, 2019).

- Process Flexibility – The implementation of this concept allows SCs to adjust their processes in response to variations, such as in customer requirements, production schedules, and external disruptions. This adaptability is essential for maintaining service levels and minimising costs associated with delays or excess inventory. In practice, this means including backup and dual sourcing, deploying postponement strategies and capacity pooling, and product substitution while optimising pricing and contracting and deploying additive manufacturing (Ivanov and Dolgui, 2019).
- Parametrical redundancy – This concept refers to strategically incorporating additional resources or capabilities within SC processes to buffer against uncertainties and disruptions. In practice, this means defining a level of risk mitigation inventory, capacity reservations, and lead time reservations by analysing risk associated with materials and suppliers (Ivanov and Dolgui, 2019).

2.2 Resilience in the Agri-food Supply Chain

Agri-food Supply Chains (AFCSs) bring agricultural products from the farm to the fork (Esteso, Alemany and Ortiz, 2018).

The definition of food system is: "*A system that will protect and respect biodiversity and ecosystems, be culturally acceptable, economically fair and affordable, nutritionally adequate, safe and healthy, while optimising the use of natural and human resources.*" (Nehme, 2019).

Historically, food systems were designed for economic efficiency, where cutting costs and economies of scale were the most prominent objectives for creating an agricultural business model and food SCs (Stone and Rahimifard, 2018). Nowadays, the increasing global complexity of food systems, the variety and interplay of risks, and the interconnection of social and ecological transitions generate new vulnerabilities and enable systemic risks (Davis, Downs and Gephart, 2020). Therefore, due to the lack of concern with other important factors, such as the

protection and respect of biodiversity and ecosystems and local cultures and society, these SCs must be re-evaluated to include not only these concerns, but also resilience (Gille, 2012; Stone and Rahimifard, 2018, 2018; Yadav *et al.*, 2022). According to Stone and Rahimifard (2018), the definition of AFSC resilience is the following: "*The collective ability of Agri-food Supply Chain stakeholders to ensure acceptable, sufficient and stable food supplies, at the required times and locations, via accurate anticipation of disruptions and the use of strategies which delay impact, aid rapid recovery and allow cumulative learning post disruption.*", therefore, the main objective of resilience in the AFSC is to provide food security to end consumers (Stone and Rahimifard, 2018). The FAO World Food Summit in 1996 stated that "*Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*." (Bernard De Raymond *et al.*, 2021).

To effectively implement resilience in the agri-food context, it is necessary to fully understand how this sector operates and its main differences from other SCs, as the AFSC has a set of inherent characteristics that distinguish it from other SCs. The main distinguishing characteristic is that products cannot be produced at will; they result from the collaboration between humans and nature (Bernard De Raymond *et al.*, 2021). Plus, the price of the product is a direct function of its freshness, with most agricultural commodities being highly perishable and fragile products that have a high deterioration rate, especially when more time, distance, and handling are involved, decreasing their value (Wang and Li, 2012; Esteso, Alemany and Ortiz, 2018; Gillman, Campbell and Spang, 2019; Gholami-Zanjani, Jabalameli, *et al.*, 2021). Other distinguishing characteristics are aesthetics requirements defined by governmental authorities, the need for most produce to be processed in some way to be consumed, low shelf-life, and the need for refrigerated warehousing and distribution to maintain the produce's freshness (Esteso, Alemany and Ortiz, 2018; Gholami-Zanjani, Klibi, *et al.*, 2021). Finally, an important consideration on the nature of the AFSC is that food demand is not particularly unstable due to the fact that humans depend on it to survive and extreme population fluctuations are rare (Gholami-Zanjani, Jabalameli, *et al.*, 2021). On the other hand, due to the specific intricacies of the AFSC, the

produce price is significantly unstable, especially for upstream actors (Gholami-Zanjani, Jabalameli, *et al.*, 2021).

To more accurately measure the inefficiencies in the contemporary global food system, there is a necessity to explore tangible and observable aspects and results of the operations and activities in this sector. Yadav *et al.* (2022) conducted a systematic literature review with the aim of identifying challenges in the AFSC, reviewing the research contribution to the field of AFSC design and investigating the performance measurement system of the AFSC. According to the authors, the AFSC is subject to the following structural holes:

- Food Loss and Waste (FLW);
- Information asymmetry;
- Lack of trust;
- The existence of an excessive number of intermediaries;
- The non-existence of a SC Coordinator / Leader;
- Power imbalances;
- Unjust price distribution;
- Fragility of SC structure towards disruptions;
- Food traceability;
- Incremented challenges for actors upstream, especially farmers.

One of the most significant quantifiable results of the intricacies of this sector is FLW (Gille, 2012). The research on FLW concludes that an estimated one-third of global food production is either lost or wasted, representing 1.3 billion tons annually (Spang *et al.*, 2019). According to Spang *et al.* (2019), food loss denotes the reduction in the quantity or quality of food that transpires during the production, processing, and distribution phases of the AFSC. This may occur due to several circumstances, including substandard harvesting methods, spoiling during transit, or processing inefficiencies. Produce may be rejected at the farm level due to aesthetic standards or damage incurred during harvesting, failing to fulfil market specifications (Gille, 2012; Gillman, Campbell and Spang, 2019; Spang *et al.*, 2019). In contrast, according to Spang *et al.* (2019), food waste denotes the disposal of food that is appropriate for consumption at the retail and consumer

levels. This notion includes over-purchasing, lack of planning, or misconstruction of expiration dates. In particular, price discounts and promotions at the retail level may lead consumers to purchase over their needs, as well as discarding edible food solely based on expiration dates or best-before labels (Gillman, Campbell and Spang, 2019). Therefore, evaluating both sides of FLW, the conclusion is that there are two main factors in interplay: non-human and human. In order to control non-human factors, technological innovation must be deployed. On the other hand, to optimise human factors, the solution encompasses new institutions and the reorganisation of structures leading to systemic loss (Gille, 2012). Further, this problem is not taken seriously by many players in the SC as the more food waste among customers, the more the food sector can sell, and, as a rule, throughout the SC, downstream waste generally results in increased revenues for upstream entities (Spang *et al.*, 2019).

Yadav *et al.* (2022) argue that the actors in the AFSC can be divided into four categories: producers, processors, distributors, and retailers. However, the stakeholders concerned by this SC reach far beyond, namely consumers, agricultural suppliers, and governmental and non-governmental institutions (United Nations Office for Disaster Risk, 2022). An essential factor is that as consumers buy their food through retailers, these players tend to have increased bargaining power in the SC; hence, along the SC, the bargaining power is asymmetrical, as it becomes higher downstream, where customer information becomes more visible (Yadav *et al.*, 2022). Other significant challenges for farmers include marketing of goods, unjust share of consumer price and weak negotiating power, and the lack or complete inexistence of information on demand (Yadav *et al.*, 2022). Further, the complexity of the conventional AFSC and the number of intermediaries poses a serious obstacle towards collaboration, cooperation, and trust, which decreases SC resilience (Paciarotti and Torregiani, 2021).

Farmers are often overlooked in policy-making solutions involving agriculture (Gille, 2012; Gillman, Campbell and Spang, 2019). On-farm food losses are driven by economic risk mitigation strategies, responding to buyer demands, producers discard surplus or imperfect produce that is unlikely to reach a consumer (Gillman, Campbell and Spang, 2019). Therefore, farm waste often represents an opportunity cost, when it is economically better to leave the produce on the farm than selling it (Gille, 2012). For instance, processors or retailers can reject shipments allegedly

based on quality, even when the rejection might not have been due to quality but decreased demand; hence, buyers often break supply contracts with impunity, even when verification parties are involved (Gille, 2012). In this situation, farmers engage in preventive quality control, as they will have diminished control over the specifications of the produce, such as size or aesthetics; thus, this strategy allows farmers not to lose buyers or their reputation (Gillman, Campbell and Spang, 2019). Plus, the environmental impact of on-farm losses is less than that of food lost further down the SC (Gillman, Campbell and Spang, 2019). Methods such as risk pooling and risk-spreading strategies have been deployed to add stability and security to actors in the AFSC, as farmers often carry the majority of risk and cost (Gille, 2012).

The global AFSC is much more fragile than thought before the pandemic, as even when the negative effects were concentrated in one node or node type, it still propagated to the rest of the network, causing the ripple effect, demonstrating an overall lack of resilience that is inherent to the structure and not simply because of the disruption itself, resulting in increased food insecurity (Aday and Aday, 2020; Alabi and Ngwenyama, 2023). The pandemic affected all levels of the SC, including production due to the shortage of manual labour and border restrictions, logistics due to restrictions on international transportation, and processing as containment measures created a shortage in labour and raw materials (Aday and Aday, 2020; Alabi and Ngwenyama, 2023). Comparatively, the conflict between Russia and Ukraine negatively impacted all actors of the AFSC, especially in Europe and Africa, due to spikes in energy prices (Jagtap *et al.*, 2022).

Davis, Downs and Gephart (2020) argue that countries with substantial globalization, net importers, low GDP, or minimal strategic reserves are most vulnerable to external shock events. At the same time, globalised SCs with specialised foreign markets are at greater risk of SC disruptions (Davis, Downs and Gephart, 2020). These shocks propagate rapidly through networks when the affected product is directly exchanged among partners, resulting in indirect economic repercussions that may surpass direct ones (Davis, Downs and Gephart, 2020). Integrating multiple sourcing options within the SC and managing product substitution and perishability can provide a buffer and dampen variability (Davis, Downs and Gephart, 2020).

Leat and Revoredo-Giha (2008) aim to identify the experiences and challenges of Scottish farmers marketing their meat products and the nature of their marketing relationships. The main challenges for Scottish farmers in the SC are related to a lack of transparency throughout the SC, particularly due to the unavailability of customer awareness and information and the absence of trust in the prices proposed by buyers, with evidence of an unfair price distribution for farmers (Leat and Revoredo-Giha, 2008). According to the authors, although the literature on the "soft" factors of collaboration is often overlooked, these aspects are significantly important, including satisfaction, commitment, and trust (Leat and Revoredo-Giha, 2008). The questionnaire respondents valued long-term partnerships with reliable and trusted buyers with significant importance. The authors also show that leadership is essential for SC direction, coordination, and customer focus. However, few businesses engage in this activity, and the ones that do are generally major players in the SC, such as processors and retailers that have better access to customer information (Leat and Revoredo-Giha, 2008). Despite the attempts of these major players to connect with farmers, it is a complex process as farmers often mistrust these major players due to historical power imbalances in favour of major players (Leat and Revoredo-Giha, 2008).

Handayati, Simatupang and Perdana (2015) point out that coordination is understudied in the AFSC, particularly regarding the soft aspects of coordination, consumer requirements, the value of co-creation, and a holistic view of coordination in the SC. In the past decade, consumers have stopped being passive recipients in the AFSC and are shifting to a more active role, using their knowledge and power to not only influence the decisions of the other players in the SC but also be directly involved and contribute to decision-making processes (Handayati, Simatupang and Perdana, 2015). The authors found that SC contracts are the most common method used to coordinate between two actors; however, this method has an inherent limitation because it is typically used solely between two parties. This poses an interesting light on the topic, as it highlights another limitation of the current AFSC, which is the need for coordination between multiple actors in the SC (Handayati, Simatupang and Perdana, 2015). As actions have a cascading effect, it would be expected that SC contracts between more than two parties would exist, yet only one was found in the literature (Handayati, Simatupang and Perdana, 2015). Additionally,

currently, the AFSC is significantly end-consumer oriented, meaning that there exists a general tendency to press farmers and other types of firms upstream to lower prices, while retailers have a privileged position (e.g., direct contact with the consumer, price freedom, quality specifications, risk avoidance) that contribute to power imbalances in the AFSC (Handayati, Simatupang and Perdana, 2015). Plus, when there are contracts between two actors, the soft aspects of coordination greatly influence the aspects agreed upon, and these appear to be more favourable to the buyers than to the seller in this context; hence, these situations result in a double factor of pressure towards the upstream actors (Handayati, Simatupang and Perdana, 2015).

Posed with these challenges, the authors of the aforementioned articles postulated solutions. Many of the aforementioned articles concluded that Industry 4.0 is shifting the paradigm towards technology and information and is a viable solution to tackle the challenges relating to food waste, food safety and security, information asymmetry, and issues in incorporating sustainability (Yadav *et al.*, 2022, 2022). These tactics include the deployment of e-commerce platforms, end-to-end SC visibility, cloud-based technology, real-time responses, and system decentralisation and are proposed to enhance resilience in the AFSC (Davis, Downs and Gephart, 2020; Alabi and Ngwenyama, 2023). Alongside these strategies, Jagtap *et al.* (2022) found that in disruption scenarios, SC collaboration would be an effective solution to mitigate the risks as well as recover the SC to a new state. Furthermore, according to Leat and Revoredo-Giha (2008), building mutually beneficial information systems is an effective strategy to rebuild trust in the SC. Apart from this, the results of the analysis performed by Handayati, Simatupang and Perdana (2015) show that specific types of coordination methods are better for specific situations, in particular, when there is a high-quality requirement and significant interdependencies, the most commonly used coordination mechanisms are specialised contracts, data integration in information sharing, and collective learning with value co-creation, this last method is a suggestion, and no research was found by the authors in this specific context.

According to Qian *et al.* (2020), food traceability is defined as "*The ability to access any or all information relating to that which is under consideration, throughout its entire life cycle, by means of recorded identifications.*". Therefore, a combination of all the previous actions,

particularly the implementation of information sharing, data processing, collaboration and coordination methods, allows for each link of the AFSC to record and share the information on product transactions, thus making the AFSC fully traceable (Qian *et al.*, 2020).

Suali, Srai and Tsolakis (2024) explore the market experience of established and emergent digital food platforms. The results show that digital platforms allow disintermediation, which shortens the SC by removing intermediaries, bringing consumers and producers closer. Plus, the process of disintermediation powered by digital platforms induces horizontal value-creation, connection, and elevated collaborative value for existing stakeholders (Suali, Srai and Tsolakis, 2024). Digital platforms enable a bidirectional flow of data and information in the SC, resulting in a decrease in needed inventory, which is of high value within the AFSC as most products have limited shelf-life (Suali, Srai and Tsolakis, 2024). On the strategic levels, digital food SC reconfigure the network to increase diversification, decentralisation and localisation, and flexibility, allowing cross-sector partnerships and bridging circularity holes in the SC (Suali, Srai and Tsolakis, 2024).

According to Aday and Aday (2020), food waste decreased during the pandemic, primarily due to the increase in locally bought food and online shopping; thus, an effective method of avoiding COVID-19 associated risks is the decentralisation of food manufacturing. Additionally, Aday and Aday (2020) found that network-oriented SCM systems allow information to flow all across the SC, creating faster and more flexible collaboration between buyer and seller. E-commerce helps to shorten the distance between producers and consumers, allowing the producers to reach broader markets (Aday and Aday, 2020). Davis, Downs and Gephart (2020) find that asynchrony and diversity in food production and sourcing, combined with the processing and storage of excess produce during abundant years, can mitigate instability in food supply under growing climatic and environmental instability.

As demonstrated by the challenges highlighted by Yadav *et al.* (2022) and Alabi and Ngwenyama (2023), there is a variety of structural holes in the AFSC that bring inherent fragilities to food systems. Currently, the AFSC is composed of many nodes that are independent and are becoming increasingly interconnected, resulting in little effort of collaboration or even trust in the SC (Balezentis *et al.*, 2023). Thus, in the context of AFSCs, cost-effective resilience is particularly vital

due to the complex interplay of social, environmental, economic, and political factors that influence food systems (Stone and Rahimifard, 2018).

Stone and Rahimifard (2018) conducted a holistic literature review, and the findings were integrated into a food security-oriented framework for applying resilience in AFSC in the developed world. The concept of "Evolutionary" or "Adaptive" Resilience has emerged, highlighting the importance of not only recovering from disruptions but also learning and evolving from them to improve future responses (Stone and Rahimifard, 2018). Adaptive Resilience incorporates a broader understanding of risk, recognising that disruptions can arise from diverse and distant sources with nonlinear impacts (Stone and Rahimifard, 2018). Thus, as outside interference is constant, the equilibrium state is impossible to achieve; instead, there is a continuous adaptive cycle, which is influenced by the three components of absorptive capacity, adaptive capacity, and transformability as the ability to dynamically reorganise the operational system for the new context (Stone and Rahimifard, 2018). Furthermore, Adaptive Resilience emphasises collaboration among SC partners, which can enhance visibility and responsiveness, ultimately leading to more robust recovery strategies (Stone and Rahimifard, 2018). By fostering a culture of adaptability, organisations can better anticipate potential disruptions and implement proactive measures, thereby reducing vulnerability and enhancing overall system performance (Stone and Rahimifard, 2018).

Gholami-Zanjani, Klibi, *et al.* (2021) propose a mathematical model to build a resilient food SC amidst demand uncertainty and epidemic disruptions. This study is based on a global, lengthy cold SC of meat products; thus, the main characteristics defining the SC are focused on the preparation of the product for distribution between production centres and distribution centres, handling, and storing in vast geographical areas. The design of resilient SCs begins with strategic decisions regarding the location and capacity of production and distribution facilities (Gholami-Zanjani, Klibi, *et al.*, 2021). Among the resiliency-seeking models, fortification as a proactive strategy, including strengthening and protecting facilities and backup suppliers as secondary suppliers or facilities that can be activated in disruption scenarios when primary sources fail, were strategies that provided the most flexible and resilient solutions, minimising disruptive impacts (Gholami-Zanjani, Klibi, *et al.*, 2021). Advanced risk modelling as a technique to understand and

mitigate risks in the SC, allowing organisations to simulate different scenarios and assess the potential impacts of disruptions (Gholami-Zanjani, Klibi, *et al.*, 2021).

Gholami-Zanjani, Jabalameli, *et al.* (2021) developed a mathematical model to integrate key features of location-allocation and inventory-replenishment decisions for food SCs operating under disruption. This theoretical implementation shows that for every single instance, the model prefers to invest in resilience with the adaptive seeking strategies of readiness, flexibility, and responsiveness all combined than to ignore risk, with the combination of these three methods outperforming all other strategies, including the separate implementation of resiliency strategies and the risk-neutral strategy. An interesting behaviour is that within the spectrum of disruption frequency and intensity, an increased number of disruptions correlates with a superior performance of technology-focused strategies over outsourcing strategies (Gholami-Zanjani, Jabalameli, *et al.*, 2021). This indicates that, in practical scenarios, investing in technology not only provides a competitive advantage but also facilitates the retention of information regarding the SC external environment, thereby enhancing decision-making and establishing a barrier against potential disruptions within the SC ecosystem (Gholami-Zanjani, Jabalameli, *et al.*, 2021). This paper shows that the perishability of food products has a significant impact on how the SC should be designed; thus, specifically for the case of highly perishable food products, having long-term inventory will not bring advantages to the system, resilience will not be achieved by inventory redundancies, but with sourcing adaptation. Thus, a trade-off between inventory and deterioration rate is seen, with profound impacts on the SC design and prices practised along the SC (Gholami-Zanjani, Jabalameli, *et al.*, 2021).

Business model innovation (BMI) is an effective method for improving SCR by adapting in response to the changing environment in which SCs operate (Kähkönen, 2012; Nosratabadi, Mosavi and Lakner, 2020). BMI involves the reconfiguration of value propositions, revenue models, and operational processes, which can significantly bolster an SC's ability to withstand disruptions and recover swiftly. A new business model explored in both these articles is the value net concept, which fosters interaction between organisations with complementary core businesses, enhancing collaboration and value co-creation with a more flexible and agile nature whilst incorporating technology. Unlike traditional value chains, where value creation is linear

and sequential, value nets emphasise a networked approach where multiple actors co-create value through shared resources, competencies, and capabilities (Kähkönen, 2012; Nosratabadi, Mosavi and Lakner, 2020). The dynamic nature of value nets also contributes to resilience by facilitating rapid information sharing and decision-making among players, thus leveraging the interconnectedness of players in the SC for quicker identification of potential risks and the implementation of mitigation strategies (Kähkönen, 2012; Nosratabadi, Mosavi and Lakner, 2020). Collaboration, together with technology and information sharing, allows for future-oriented thinking in the value net and unlocks its full potential, thus strengthening relationships among organisations and promoting a shared commitment to resilience (Kähkönen, 2012).

In conclusion, due to the specific characteristics of the AFSC, the application of resilience in this SC incorporates not only generic resilience measures for SCM, as well as specified strategies and methods that optimise the constraints of the AFSC.

2.3 The Relocation Paradigm and Alternative Food Networks

Alternative food networks (AFNs) are systems of food production and distribution that prioritise local sourcing, sustainability, and social equity, contrasting sharply with conventional AFSCs dominated by large-scale industrial agriculture (Renting, Marsden and Banks, 2003; Felicetti, 2014). These networks encompass various initiatives, such as farmers' markets, food cooperatives, community-supported agriculture (CSA), and Food Hubs (FH), all designed to foster direct relationships between producers and consumers and shift food production from an agricultural industrialisation paradigm to a rural development paradigm (Wiskerke, 2003; Berti and Mulligan, 2016). AFNs are seen as a solution to reconnect consumers with the sources of their food, emphasising transparency, community engagement, and environmental stewardship while creating cooperative businesses that allow to decrease the distance between producers and consumers, as well as increasing profits for farmers and lowering prices for consumers by removing intermediaries (Cohen and Derryk, 2011; Berti and Mulligan, 2016). One of the defining characteristics of AFNs is their focus on Short Food Supply Chains (SFSCs) where "*The foods involved are identified by, and traceable to a farmer and the number of intermediaries between farmer and consumer should be minimal or ideally nil.*", effectively reducing the distance food travels from farm to table (Cleveland *et al.*, 2014). Thus, SFSCs are characterised by geographical

proximity, temporal proximity, or by a small number of intermediaries, resulting in the ability to maintain information flows between the farmer and consumer, namely product information and state of demand (Collet and Mormont, 2003; Venn *et al.*, 2006; Paciarotti and Torregiani, 2021). This localisation minimises a range of issues within the AFSC, such as transportation costs, carbon emissions, mitigating FLW, and fair distribution of profit within the SC (Renting, Marsden and Banks, 2003; Mundler and Rumpus, 2012; Paciarotti and Torregiani, 2021; Perdana *et al.*, 2022). By promoting local production and consumption, AFNs are viewed by consumers as a healthier and higher quality option to conventional food chains, particularly during times of crises when there are scares in food quality and transparency (Stassart and Whatmore, 2003; Wiskerke, 2003; Hingley *et al.*, 2011; Galli *et al.*, 2015). Plus, as consumers become increasingly concerned with their food and distrust major conventional food system players, demand for local and regional produce increases, and they often seek AFNs to become involved in the production, distribution, and decision-making regarding their food (Renting, Marsden and Banks, 2003; Venn *et al.*, 2006; Felicetti, 2014). Simultaneously, farmers also seek AFN as an attempt to recapture value in the SC and contradict the increasing pressure from a consumer-oriented SC, where they are able to arrange better selling conditions (Renting, Marsden and Banks, 2003; Hingley *et al.*, 2011). As highly contextualised business models, AFNs allow entrepreneurs and businesses to create value by linking their business models to the unique resources associated with a particular locale, building resilience, sustainability, and prosperity in social, community, or ecological contexts (Di Gregorio, 2017).

On the other hand, it is essential to recognise the limitations of AFNs, which can hinder their effectiveness and sustainability. Lamine (2015) mentions three limits to the relocation paradigm, which are the failure to consider the change in diet and eating habits induced by relocation, the failure to consider interdependencies in the agri-food system and only focus on consumers and producers, and the reductive dichotomy of alternative or conventional. Hingley *et al.* (2011) explored two working AFNs and found that there is difficulty for national-scale cooperatives to maintain a standardised image to the customer in each store. As individual stores established the local SC, they experienced that their conventional retail competitors often took advantage of the new local structure to embellish their sustainability standard for consumers, creating a "free

riding" problem (Hingley *et al.*, 2011). Additionally, in both case studies, there were concerns about volume consistency and critical mass (Hingley *et al.*, 2011). Berti and Mulligan (2016) found that providing the right quantity and consistency of products, maintaining quality for individuals, families, and big buyers, and offering a diverse array of products was a challenge in the local AFNs. Additionally, the lack of accessibility and convenience and lack of economic, organizational, and physical structures of appropriate scale for moving locally grown food to local eaters are significant obstacles to the relocation paradigm (Berti and Mulligan, 2016). Paciarotti and Torregiani (2021) argue that logistics is a major barrier for local SCs and SFSCs, which needs re-engineering and innovation to adapt to their unique contexts. Commonly, small farmers are responsible for logistics activities in local markets, which often creates problems regarding the variety and quantity of products, difficulties in coordinating and organising logistics, leading to frequent journeys with low loads and increasing the use of private cars, lack of economies of scale due to the small size of farms, confusion amongst consumers as where to buy produce, limited financial and managerial resources for marketing and communication, limited capacity to expand for small farmers, and possible burnout due to small workforces and reliance on key multi-tasking individuals (Paciarotti and Torregiani, 2021).

Regional FHs have emerged as a promising solution to address the limitations of AFNs (Cleveland *et al.*, 2014; Berti, Mulligan and Yap, 2017). FHs are a BMI with the goal of scaling small and local food businesses by pooling resources to reduce costs and aggregate production, distribution, and marketing services to achieve a significant, consistent, and varied volume of produce (O'Hara and Toussaint, 2021). Thus, FHs serve as intermediaries in the local food SC, enhancing the distribution and accessibility of locally produced food while promoting social and environmental sustainability (Cleveland *et al.*, 2014; Berti, Mulligan and Yap, 2017). The underlying principle in the foundation of the FH is the shared value perspective by Porter and Kramer, their mission-driven approach and emphasis on collaboration among stakeholders position them as key players in the development of resilient and equitable food systems (Berti and Mulligan, 2016). Additionally, FHs position themselves within the concept of Value-based Supply Chains (VBSCs), where there is a conservation of unique stories that identify where the food comes from, the development of coopetition, as the combination of coordination with competition, to achieve

collaborative advantages and adapt quickly to changes in the market, the increase of performance and trust levels, and the creation of a unique shared vision and decision-making (Berti and Mulligan, 2016). In this context, there is a strong commitment to the welfare of all participants, where prices are based on calculations of production, transaction costs, and fair wages, effectively establishing fair profit margins (Berti and Mulligan, 2016). Business agreements are drawn with appropriately extended durations, with farmers functioning as strategic partners instead of interchangeable input suppliers (Berti and Mulligan, 2016). Cleveland *et al.* (2014) conducted a case study that showed that these characteristics were high motivators for farmers to sell their produce through FHs. Further, Felicetti (2014) demonstrates that FHs have the potential to economically support small and medium-sized enterprises through aggregation processes that facilitate economies of scale by distributing products from various enterprises in larger volumes than individuals could achieve. Plus, FHs also coordinate with the demand side of the SC by directly connecting farmers, distributors, processors, wholesalers, and consumers, offering a single sales point, which in turn lowers transaction costs and reduces SC complexity (Felicetti, 2014).

There are two main variants of FHs: FH – Intermediary Organization acts as the SC Coordinator and broker, providing a logistical and organisational platform for the aggregation, marketing, and distribution of source-identified food products from local and regional producers to both wholesale buyers and end consumers, as well as developing a shared web of practices and value adding services (Berti and Mulligan, 2016); FH – Strategic Network functions as a catalyst and a promoter of a value net, including all participants along the food chain from production to consumption, collaborating at various levels of collective effort to generate shared value that is fairly distributed within the network, resulting in strategically beneficial economic, social, and environmental spillover effects in the local community (Berti and Mulligan, 2016; Berti, Mulligan and Yap, 2017).

Therefore, the FH acts on four main principles:

- Aggregative Scaling / Coopetition.
- Strategic Coordination.

- Distribution of Power.
- SC Leadership / Coordination.

Aggregative Scaling refers to the process of enhancing the capacity and reach of local food systems by aggregating products from multiple small-scale and mid-scale producers and facilitating their distribution to a broader market, resulting in the scaling up of AFNs and the scaling down of conventional food systems (Cleveland *et al.*, 2014; Felicetti, 2014; Berti and Mulligan, 2016). The combination of the output of multiple producers in the same region allows for farmers to achieve higher volumes with more consistency without the intense individual capital investment in technological advancements and innovation for competitiveness or the increase in size of individual farms, resulting in the increased access to larger markets, which would be out of reach individually (Cohen and Derryk, 2011; Hingley *et al.*, 2011; Cleveland *et al.*, 2014; Felicetti, 2014; Berti and Mulligan, 2016). This horizontal structure involves farm-farm cooperation in sharing information and experience to gain competitive advantage to improve the farm's production chain (Gurnani, Erkoc and Luo, 2007). Further, the action of aggregative scaling allows the reduction of transportation costs and minimises carbon emissions per unit transported, creating logistical efficiencies (Paciarotti and Torregiani, 2021). Thus, an important goal within the FH is to develop coordination and collaboration between enterprises with similar core businesses that usually compete with one another so aggregation can be achieved, hence creating a state of voluntary coopetition (Cohen and Derryk, 2011; Berti, Mulligan and Yap, 2017; Imami, Valentinov and Skreli, 2021). Unsupervised coopetition can put farms out of business, especially when bigger farms gain sufficient bargaining power (Berti, Mulligan and Yap, 2017). By engaging in voluntary cooperation in the locality, farmers are able to come together and achieve a multiplier effect rather than out-competing other local businesses while also gaining more bargaining power collectively (Berti, Mulligan and Yap, 2017). This sharply contrasts with involuntary coopetition, which is created artificially through contracts between more prominent buyers with strong bargaining power and small farms, creating a power imbalance that ultimately puts smaller farms out of business (Berti, Mulligan and Yap, 2017).

Strategic coordination refers to the process of integrating fragmented and isolated segments of the agri-food markets, including producers, processors, retailers, and consumers (Berti and Mulligan, 2016). Through a process of vertical coordination within the network of AFSC participants, rather than following a linear approach to SC design by building vertical integration within one organisation, this process connects players in different echelons of the SC, originating a value net (Gurnani, Erkoc and Luo, 2007). This process is a catalyst for the fair trade of agricultural products, as it connects sellers and buyers within the AFSC, each functioning as price setters rather than price takers (Stevenson *et al.*, 2011). The vertical structure involves seller-buyer cooperation in sharing resources on market access, facilitating a constant flow of high-quality products and information within the value net, both regarding consumer demand information and the origins of the products (Cohen and Derryk, 2011; Hingley *et al.*, 2011; Cleveland *et al.*, 2014; Felicetti, 2014; Berti and Mulligan, 2016). Additionally, the FH has the ability to find buyers right away, allowing them to move products rapidly and at ease, so the freshness of the produce is not compromised by time, meaning greater agility, flexibility, and prices for sellers (Cleveland *et al.*, 2014).

Distributed power refers to the capability of the FH to redistribute value across the SC and deploy procedural justice in the management of processes and relationships, substituting powerful processors and retailers as gatekeepers by applying democratisation in its activities as a broker (Berti and Mulligan, 2016). The emergence of VBSCs highlights the importance of aligning social, environmental, and economic values in power distribution, effectively reconstructing trust amongst SC actors by building information flows and transparency along the value chain (Berti and Mulligan, 2016). Further, the concept of value in VBSCs extends beyond economic considerations to include locality, sustainability, and quality, which can help shift power dynamics by prioritising the interests of local communities and promoting ethical practices in food production, distribution, and marketing (Berti and Mulligan, 2016). Additionally, maintaining a power balance is crucial to voluntary cooperation (Berti, Mulligan and Yap, 2017).

SC Coordination / Leadership refers to the action of coordinating and connecting, as well as building trust, mutual benefit and commitment among different typologies of participants, which are autonomous entities with a range of specific individual interests that may not consistently

align (Berti and Mulligan, 2016; Berti, Mulligan and Yap, 2017). This leadership is essential not only to maintain both the horizontal coopetition and the vertical coordination, as well as promoting sustainable and fair practices within the SC, collective learning, innovation, and co-creation amongst the value net actors by acting as a conduit for information and resources (Berti and Mulligan, 2016).

Recently, with the introduction of the new I4.0 paradigm, manufacturing and production processes have transformed through the integration of digital technologies, automation, and data exchange (Saetta and Caldarelli, 2020). The importance of Industry 4.0 in the context of AFSCs can be understood through several key dimensions: enhanced efficiency, improved traceability, increased sustainability, and the facilitation of BMI (Saetta and Caldarelli, 2020).

I4.0 has significantly evolved the FH business model to incorporate recent technological innovations, resulting in the Digital Food Hub (DFH) concept (Berti and Mulligan, 2016; Berti, Mulligan and Yap, 2017; Saetta and Caldarelli, 2020). DFHs are defined by (Horst *et al.*, 2011) as "I*nternet-based online directory and marketplace that fosters efficient connections between local and regional food producers and consumers, including institutions, restaurants, and stores.*". DFHs significantly enhance disintermediation processes through platformisation and create strategic alliances that make international scaling possible (Hingley *et al.*, 2011; Paciarotti and Torregiani, 2021).

3. Methodology

The methodology of this research is fundamentally structured to analyse the integration of resilience and efficiency of SCM within the AFSC. The study adopts a qualitative, case-based methodology to explore the dynamics between partners in the AFSC. First, a systematic literature review was conducted on the topics of SCR, resilience strategies in the AFSC, and the contribution of AFN to resilience in the AFSC. The articles were chosen based on the search of keywords relevant to these topics in the following academic databases: *Google Scholar*, *Scopus*, *Science Direct*, and *IEEE Xplore*. Second, an interview protocol (Appendix A) was elaborated to assess how different organisations acting within the AFSC implemented resilience, SC ambidexterity, collaboration, innovation, and SC Coordination. The participants were chosen

based on their different governance models, representing conventional AFSC players, AFN players, and a combination of the two. Third, primary data was collected from the three interviews, analysed, and interpreted in light of the literature review to obtain findings and conclusions to answer the research objective.

4. Intra-Case Analysis

4.1 Interview Consumer Cooperative

The Cooperative interviewed is a franchised shop of a multinational organisation (henceforth mentioned as Headquarters) that owns most of their shops. The Headquarters detain 25% of the revenue of this individual Cooperative as the Cooperative uses its logo and support. This arrangement brings efficiencies that the Cooperative could not achieve on its own, especially regarding its organisational structure, management of international products and suppliers, research on ethical and sustainable standards and sourcing, and collaboration with other shops. The Cooperative benefits from the network with other shops created by the Headquarters, mainly redistributing products according to fluctuating demand in each shop and sourcing from international suppliers for all year-round and specialty products or produce not found in the locality.

As a Cooperative, the decision-making process is based on democratic principles, where members have a number of votes according to their number of shares. An assembly general is held every two months that includes representatives of the Cooperative's stakeholders with the primary goal of guiding direction and making strategic decisions. Regarding day-to-day operations and management, these are made mainly by the Cooperative's manager, who combines the Headquarters' directives and the decisions made in the assembly general.

The involvement and feedback of the Cooperative's shareholders are crucial for sourcing activities, as they provide essential information for assortment, quantity, and prices. This information is then combined with the Headquarters' research and recommendations and shared with all the Cooperative producers, creating information flows from downstream to upstream.

Although there is an effort from the Headquarters to maintain brand identity throughout the shops, it also encourages its shops and the franchises to design and operate their own local SC. This Cooperative actively seeks partnerships with agricultural cooperatives and local small producers to include locally grown produce in its offering. The main goal is to interact with these producers directly, without an intermediary. These interactions are highly sought out by the producers that want to sell to the Cooperative as it promotes fair trade, where producers set the price according to their operational costs. Thus, the Cooperative does not demand specific quantities at reduced prices. In this case, suppliers are contracted and fully managed by Headquarters, as it aggregates the demand for all the individual shops, it has better leverage and bargaining power. At the same time, each shop manages local and small producers, maintaining the power balance in the SC. Combined with the Headquarters' network of shops, this arrangement allows for a varied sourcing structure: an international supply network alongside a locally focused network of smaller producers and other shops, demonstrating structural variety and process flexibility.

One of the Cooperative's objectives is to rival conventional retail; for that, it makes strategic decisions regarding its assortment to include all year-round products such as bananas and tomatoes, as without these essential products, consumers will likely do their shopping elsewhere. Therefore, the Cooperative couples international sourcing with a strong local offering, suggesting, through labels and promotional initiatives, that consumers could change their eating habits to include a bigger percentage of seasonal food.

Operating within the VBSC concept, this Cooperative seeks to maintain business interactions with their producers and negotiate better conditions for both sides rather than altogether abandoning them when obstacles are found, especially regarding price and quantities, keeping an open and transparent line of communication to reach a consensus. This happens as there is a clear objective of mutual benefit when working with the Cooperative, resulting in a higher level of trust and commitment in the SC. Additionally, when necessary, product substitutions are discussed with suppliers, focusing on maintaining relationships rather than strict purchasing requirements, which, on the other hand, could introduce behavioural uncertainty into the SC.

Regarding communication methods, the Cooperative works mainly with messaging applications, online drive systems, and newsletters. Therefore, this Cooperative does not use specific communication software to streamline all communications, which proves difficult while handling and keeping track of multiple producers. Additionally, collaboration methods in local settings are often solely based on communication methods, as the Cooperative rarely celebrates written contracts with local partners, which increases behavioural uncertainty.

Due to the COVID-19 pandemic, most of the Cooperative's client base shrank drastically and unexpectedly for an extended time, resulting in an all-time low revenue reduction. Thus, the Cooperative had to adapt its structure to ensure business continuity, especially because before the pandemic, it prioritised a growth-oriented strategy, which was forced to change to an efficiency-oriented strategy. This complete turn in strategy showed that the Cooperative did not have an adequate absorptive capacity to cope with disruptions, yet it managed to adapt successfully to changing circumstances. The revenue reduction and the change in strategy induced the cooperative to reduce the number of local producers it worked with and to completely re-think the assortment of product offerings. While the Cooperative maintained regular and transparent communication with producers, it had to re-negotiate prices and readjust quantities. At the same time, local producers had the capacity to deliver volume consistency, while the mainstream suppliers contracted by Headquarters could not meet the Cooperative's demand completely, showing a lack of parametrical redundancy. Apart from this, the Cooperative managed to survive and recover mainly due to the involvement of stakeholders who believed in the concept and still made continued and frequent purchases.

During this time, the Cooperative became aware of the necessity of enhancing its absorptive capacity. This translated into a significant reduction in suppliers and the integration of local producers within specific suppliers that corresponded to a large part of its product offering, resulting in a decreased structural variety and visibility initially created. Despite this, the Cooperative does not create incentives amongst producers for knowledge transfer, sharing of resources, or coopetition, as post-pandemic, they are most interested in working with suppliers sourced by Headquarters to streamline their operations, significantly reducing the process flexibility initially created. At the same time, the Cooperative's manager actively seeks a balance

between the number of suppliers and resilience in the Cooperative's SC, as there is no intention of being served by a single supplier for most of their essential offerings as there is a possibility that this supplier could fail and result in product shortages, which has happened in the past.

Furthermore, in the interest of resilience and efficiency, the Cooperative seeks to study other shops within the Headquarters' network that have a better performance to replicate key aspects of their strategy and operations, demonstrating a concern for process flexibility. Thus, although the Cooperative works on a small scale, the fact that it is incorporated into the Headquarters' network allows it and other shops to gain economies of scale mainly through collaboration and coordination of resources, giving them the ability to compete with conventional retail.

4.2 Interview Conventional Food Retail Company

The Conventional Retailer interviewed is an international company operating in over 40 countries with a revenue of €80 billion (EUR) and a gross profit margin of 19% in 2023.

This company has a hierarchical decision-making structure with many layers and departments involved that all work together according to the level of criticality and the level of expenditure of each decision. Usually, higher-level employees are the ones with the authority to sign contracts with suppliers.

To satisfy customers' needs, the Retailer mainly uses market research and forecasts, resulting in a comprehensive set of product specifications, which are used during the procurement process to source products as close as possible to the customer's specifications.

The Retailer's supplier enrollment process is thorough and complex, involving more than price considerations. Typically, the Retailer initiates contact, requests a quote, and performs a detailed analysis of the potential supplier's financial structure, market presence, and customer feedback to ensure reliability for the contract duration. If the supplier's profile is favourable, the Retailer meets with its management to understand how the supplier works and their organisational and operational structure. Suppliers have minimal influence in negotiations due to the Retailer's dominant bargaining power, which ultimately determines terms and final decisions, creating a significant power imbalance in the SC.

In recent years, the Retailer has shifted towards a more collaborative supplier management strategy, focusing on mutually beneficial contracts. They aim to improve efficiencies, service levels, and preparedness for disruptions by fostering communication and information sharing among tier-one suppliers. Massification of products is an important method the Retailer uses to achieve its goals, thus bringing together different suppliers and aligning them to collectively enhance their operations, creating efficiencies that benefit both the Retailer and the suppliers. On the other hand, the collaboration created is induced by the Retailer, thus potentially creating involuntary coopetition, which can have adversary effects, especially when the dimensions of the companies collaborating differ significantly. From experience, the Retailer believes that companies with considerate dimension highly benefit from these strategies, as overall efficiency is higher, reducing prices paid by the Retailer. However, this strategy is limited for tier-one suppliers, as coordinating activities with upstream members of the SC is highly complex and cost-prohibitive for both parties.

During the COVID-19 pandemic, the Retailer faced challenges sourcing products to customer specifications, leading them to explore overseas suppliers and unfamiliar markets. This urgency complicated routine background checks and led to a relaxation of standard rigour, exposing the Retailer to greater risks and demonstrating a lack of process flexibility. On the other hand, as conventional retailers were among the only stores open during the pandemic, the Retailer saw an increase in revenue, which contributed to the continuity of the business. At the same time, suppliers started to demand price increases as the costs of materials and labour also increased; thus, the market situation became completely different. These challenges show that the Retailer has a lack of structural variety or proper absorptive capacity to deal with this kind of disruption, as they did not identify nor prepare that these scenarios were possible or their impact on the organisation. Nevertheless, the Retailer was able to navigate and recover from these challenges by leveraging its power and dimension to keep prices of products and contracts from spiking. To mitigate future volatility, the Retailer focused on altering supplier contracts to control price increases and ensure business continuity, though this approach prioritises the Retailer's stability over the viability of their partners or the rest of the SC, thus creating behavioural uncertainty and a power imbalance that will negatively impact businesses upstream.

Due to these disruptions, the Retailer is starting to implement agility within the organisation and relationships with tier-one suppliers, especially by fostering open and frequent communication and information flows. However, the Retailer is still in a reaction-oriented approach and lacking both absorptive and adaptive capacities, as it emphasises that if another disruption occurs, they will adapt by reacting to the new circumstances, using the experience created during these past disruptions, as it is considered unrealistic for the Retailer to prepare in advance to these types of events as the number of different possible events and their estimated probabilities make it difficult to justify investments in resilience, resulting in an overall lack of structural variety, process flexibility and parametrical redundancy.

Although the Retailer has vast resources and influence over the SC, such as proprietary software for SC visibility, it considers that it is out of scope for its business to monitor the activities of the entire SC, such as profit distribution, information sharing, power balances, and traceability. The Retailer focuses on deploying fair practices while doing business with tier-one and tier-two suppliers, for instance, paying prices that reflect current wages according to the market. However, as the rest of the SC becomes more distant or composed of smaller or more local companies that are difficult to trace and do not have the resources to report their activities, transactions, or use the Retailer's software, the Retailer does not seek to coordinate with them or assess if their practices contribute to the viability of the SC, despite these actions mitigating the ripple effect created by disruptions.

4.3 Interview Food Processor

The Processor interviewed is part of a certified B-Corp global conglomerate operating in over 120 countries with an annual revenue of €25 billion (EUR), 52% of which comes from food processing activities, and a gross profit margin of 47% in 2023.

The Processor follows a hierarchical decision-making structure, with multiple layers and departments involved. In each factory, the produce department is divided into two sections: farm relations management (FRM) and produce commercial operations (PCO). The FRM team is locally anchored, meaning that it seeks local producers to supply the factory, creating a local SC and minimising intermediaries. Thus, this team is in direct contact with farmers and is solely

dedicated to accompanying the farmers during the entire duration of their contracts. It is also highly involved in farm processes to uphold quality, sustainability, and ethics standards, which are audited in each farm biannually. Apart from this, the FRM team also develops projects alongside farmers that lead to the co-creation of new, more efficient and sustainable farming practices. From the moment the produce leaves the farm, it is the responsibility of the PCO team, which manages quantities for the factory and its inventory, working closely with the factory's operations to oversee the efficient use of raw materials. Additionally, the PCO team is directly linked to the European procurement team, making it possible to reach a higher level of planning and inventory management by balancing supply and demand across European factories, as well as investments in research and development for the most efficient use of raw materials and minimisation of FLW. This structure allows the Processor to leverage the benefits of localisation and the coordination of European operations, thus incorporating the opposing elements of decentralisation and centralisation within one strategy. By fostering a local SC to source the factory, the Processor is able to reduce transportation costs and environmental impact while also creating long-term collaborative relationships with the farmers, reducing dependency on the global market's volatility. This effect, coupled with the connection to the European factory network, allows the Processor to redistribute produce according to the fluctuations in each factory, taking advantage of the fact that each factory sources its produce locally, thus reducing price volatility even more. Alongside these initiatives, the Processor seeks to build a geographically diverse and price-conscious supplier portfolio that is also used to procure produce for factories at the European level. This structure results in enhanced structural variety, composed of a two-levelled network, with an internal level formed by the aggregation of the European factories' inventory and another level corresponding to the sourcing combination of producers and suppliers, effectively creating a network-oriented SC instead of relying on a linear concept for SCM. This configuration brings resiliency and flexibility to the SC, as the Processor does not depend on a single supplier or supplier structure to obtain its raw materials.

Contracts between farmers or the suppliers and the Processor are based on transparency and mutually beneficial principles, where both parties contribute and actively participate in negotiations. In this case, contracts are drawn in cooperation between both parties in joint

decision-making. Therefore, the farmer or the supplier is not a price taker, but prices are negotiated to establish fair margins for both parties, not according to market prices, but are set upon a combination of the costs of the means of production of the seller, national standards, and quality premiums. At the same time, collaboration goes beyond contracts to include joint knowledge creation, joint decision-making, co-creation, and long-term partnerships. The collaboration created goes both ways as it creates open lines of communication between the Processor and its partners, allowing for both parties to support each other in problem-solving and maintaining the required high ethical and sustainability practices, resulting in an environment of mutual aid, where the benefits of efficiency through long-term experience and familiarity are multiplied. Additionally, these collaboration methods unveil new forms of efficiency that could not be otherwise achieved, allowing coordination between multiple entities.

At the same time, the Processor effectively performs aggregative scaling by bringing farmers together in producers' organisations or cooperatives, which allow them to collectively learn, co-create value and share resources for increased yields and efficiencies, as well as benefiting their collective interests and creating better conditions. The aggregation created results in a critical mass where the Processor can source a consistent volume for the factory's needs with local produce, creating a value net of voluntary coopetition. Further, these local farmers' organisations simplify the management of farmer relations, as shared goals and issues allow for streamlined pricing, negotiation, and mutually beneficial agreements. The Processor promotes this model in every country they operate in, fostering a strong, unified representation for farmers, thus achieving scale, providing the appropriately sized infrastructure for their local SCs, and optimising local logistics.

Initially, these collaboration programs are costly. However, they ultimately reduce prices and operational costs, providing long-term financial benefits. Furthermore, the Processor actively invests in research and development of new methodologies and technologies, for instance, for managing the perishability of the produce, that make possible longer shelf-life, product substitution, postponement, and waste reduction, enhancing process flexibility and parametrical redundancy.

The combination of the Processor's SC design and inventory and product management allows for increased flexibility, collaboration, and stability, creating an inherently resilient SC. Therefore, even though the Processor did not predict the COVID-19 pandemic, they could effectively leverage their absorptive and adaptive capacities to navigate these unpredicted events, reducing exposure to market vulnerability and unpredictability. The Processor believes that relying solely on reactive measures is more costly than implementing proactive strategies, such as maintaining a diversified supplier portfolio. Thus, the Processor successfully implemented SC ambidexterity, allowing it to benefit from proactive strategies that mitigate risks in extraordinary circumstances and incorporate them in normal operations, overcoming the trade-over of resilience versus efficiency. For example, during the aforementioned disruptions, the Processor dealt with the increase of produce and labour prices by exchanging within their internal network, simultaneously, exchanges with the European level department became more frequent to ensure that the raw materials were being optimised at the European level, thus allowing them to share the price increase between factories. Additionally, these characteristics create absorptive capacity, creating a barrier between the environment in which the SC exists and the Processor's operations. Thus, the Processor is less dependent on information, predictions, or probabilities of future events.

The Processor aims to lead in their mission and uses its influence to encourage its partners to follow the same directives on sustainability and fair practices, prioritising working with companies that independently adopt these practices or creating a natural tendency for partners to adopt these values over time for mutual benefit. While upstream relationships are easier to manage, downstream interactions are more complex as they involve larger, more influential companies, which are more challenging to negotiate with. At the same time, the Processor always seeks to be mindful of its impact on other companies, as it is not in its interest to create disruptive events in other companies, thus refraining from exploiting other companies, especially farmers. Activities, such as monitoring price distribution in the SC and connecting actors upstream and downstream, are not part of their core business, as their supplier network is centred around them, meaning that all transactions go through the Processor. However, the Processor creates information flows with partners, whether upstream or downstream, making an effort to make

adequate interactions with partners and considering power balances in the SC. Despite its significant market presence, the Processor recognises that transforming the entire SC toward a more collaborative model would require not just its own initiatives but also the involvement of multiple companies of significant influence.

5. Cross Case Analysis

Comparing these organisations, the Cooperative embodies a VBSC approach, fostering trust and community-centric relationships but encountering limitations in flexibility and communication. The Retailer excels in cost efficiency and centralised control but suffers from rigidity, limited collaboration, and a reactive approach to SCM. In contrast, the Processor effectively combines resilience, efficiency, and sustainability, integrating local empowerment and centralised coordination to create a resilient, proactive SC that benefits from long-term supplier partnerships and structural adaptability.

Regarding SC structure and sourcing, both the Processor and the Cooperative employ a network-oriented SC, abandoning the linear SC concept and taking advantage of the network's flexibility and agility, creating a hybrid SC, which combines centralisation of large-scale resources and decentralisation by leveraging local resources. However, the Processor goes a step further in creating a value net and in minimising intermediaries for both its local and global SC, while the Cooperative had this concern pre-pandemic in managing its local SC but changed strategies post-pandemic by seeking to integrate local partners into the Headquarters' contracted suppliers. In this aspect, the Retailer operates with a traditional hierarchical and centralised SC, resulting in a rigid structure with limited flexibility, particularly in supplier relations.

All three companies demonstrate different strategies for managing supplier relationships and power dynamics. The Cooperative and the Processor take advantage of local resources to build a SC, yet they do it differently. In the Cooperative, the process is relatively informal, where contracts are rarely celebrated with local partners, with quantities and prices defined by tacit agreements, which ultimately can lead to behavioural uncertainty, especially during the COVID-19 pandemic as the Cooperative's demand plummeted. In contrast, the Processor always formalises a contract with farmers and has a team dedicated to supporting them. Another aspect

is that the Processor proceeds to create aggregative scaling with their farmers, not only to achieve a critical mass and consistent volume of produce but also to benefit the farmers and encourage them to collaborate and coordinate with each other. In the case of the Cooperative, there is a healthy power dynamic in place, as the Headquarters deals with international suppliers and the Cooperative itself deals with local producers. In the case of the Processor, it can be seen that there is an effort to create collaborative, long-term relationships in the SC that foster trust and commitment, this strategy effectively balances the drastic dimension differences between partners, while also reducing behavioural uncertainty. In the case of the Retailer, due to its centralised nature, the SC exhibits a significant power imbalance and behavioural uncertainty due to the dominant power exhorted by the Retailer.

Regarding absorptive capacity, adaptive capacity, and resilience in response to disruptions, the Processor demonstrated a significantly higher awareness and implementation of these characteristics in the SC. Although both the Retailer and the Processor saw an increase in demand and revenue during the COVID-19 pandemic, in the case of the Retailer, this increase was essential for the continuity of business. On the other hand, for the Processor, the continuity of the business was assured by their organisational and supplier structures, which provided adequate absorptive and adaptive capacities, thus corresponding to a significantly higher level of resilience in the SC. In contrast, the Retailer ensured survival by using its leverage and bargaining power to limit prices, ultimately displaying a lack of preparedness and adaptability embedded in their SC structure and design. The Cooperative also demonstrated a lack of overall resilience as the drastic decrease in revenue endangered business continuity and resulted in dramatic changes to the structure and organisation, yet survival was ensured by their inherent democratic governance. None of the companies interviewed predicted the COVID-19 pandemic. However, the Processor showed a heightened level of preparedness and adaptability, allowing it to successfully navigate these turbulent times while upholding rigour standards. Regarding mitigation and management of the ripple effect, the Cooperative and the Retailer considerably opened their business to the ripple effect. In the case of the Cooperative, the disruption cascaded through the SC, originating in the Headquarters' contracted suppliers, and in the case of the Retailer, sourcing rigour was overlooked to meet customer requirements.

Although the three interviewees implement collaboration and communication differently, they all conclude that being part of a collaborative network creates economies of scale and efficiencies that would not otherwise exist. In the case of the Cooperative, collaboration and communication methods are lacking, including contracts, as most agreements with local partners are tacit and made through informal channels. Despite this, the Cooperative aims to inform local producers of demand information. The Retailer goes a step further in collaboration and communication methods, using contracts and proprietary software to coordinate tier-one suppliers. In contrast, the Processor deploys multiple collaboration methods, strengthening collective resilience and creating a future-oriented approach to SCM. Simultaneously, both the Retailer and the Processor create coopetition, yet through different methods and strategies. The Retailer creates an artificial environment of collaboration by demanding two different companies to work together to achieve collaboration and efficiency, contradictory to the initial intention, this often creates issues between the companies working together as the partnership is involuntary, ultimately resulting in involuntary coopetition. In contrast, the Processor not only connects multiple farmers, but also encourages them to create organisational structures to share resources and advance collective learning, creating a natural environment for collaboration and co-creation, resulting in voluntary coopetition.

The Cooperative and the Processor show concern for sustainability and ethical practices beyond compliance, as the Cooperative is inserted in a VBSC and the Processor is a certified B-Corp. However, the Processor goes a step further in implementing formal verification processes such as including them in contracts, implementing joint projects and regular audits. Regarding the Retailer, these practices show compliance with Corporate Social Responsibility (CSR) directives and are limited to the payment of wages and materials according to the market, with tier-one and tier-two suppliers.

In contrast with the Processor, the Cooperative and the Retailer have limited investments in innovation and technological competencies. In the Cooperative's case, due to a lack of resources, however, they do show concern for this as post-pandemic, they are trying to replicate other more efficient stores. In the case of the Retailer, there is some awareness of this topic as they

developed proprietary software to enhance the visibility of transactions within their tier-one and tier-two suppliers. Oppositely, the Processor shows a heighted implementation for research and development, for instance, improving farming practices and product and inventory management.

Of the three companies interviewed, the Processor is the only one that approximates the LCN SC framework, building a hybrid design of its SC, coupled with investments in technology and new methodologies and voluntary collaboration, allowing a strong structural variety, intentional process flexibility, and optimised parametrical redundancy. Furthermore, the Processor is also the only company amongst the three that performs FH actions, including aggregative scaling and a just distribution of power. Regarding strategic coordination, although the Cooperative's Headquarters and the Retailer demonstrate that they have the resources to perform this activity, none of the companies performs this. In the case of the Processor, this goes entirely against their core business, as they do all value-adding activities to transform the produce into the final product. None of the companies perform SC Coordination / Leadership activities primarily due to a lack of resources, a lack of core business focus, and the complexity of the SC, respectively for the Cooperative, the Retailer, and the Processor.

6. Discussion of Findings

6.1 Integration of Resilience and Efficiency

The findings demonstrate that in well-designed SCs, resilience and efficiency are not mutually exclusive but can coexist in developing SC ambidexterity, especially while implementing redundancy strategies in SCM (Aslam *et al.*, 2020). This challenges traditional trade-off models and aligns with emerging theories that emphasise hybrid approaches, such as the LCN SC framework (Ivanov and Dolgui, 2019; Ivanov, 2022). Aslam et al. (2020) argue that organisations must develop capabilities that allow them to respond effectively to disruptions while maintaining operational efficiency. Implementing structural variety, process flexibility, and parametric redundancy makes a dramatic difference in the way companies deal with vulnerabilities and disruptions, allowing to reach a state of efficient resilience, where resilience measures are fully utilised in normal operations and add a dynamic component to the SC, aiding companies transition their operations during disruptions to adapt to the new state (Stone and Rahimifard, 2018; Ivanov and Dolgui, 2019; Ivanov, 2022; Balezentis *et al.*, 2023). Each of these three aspects

is a form of generating redundancy in a specialised and optimised way, making it possible to create absorptive and adaptive capacities for a broad range of risks without specifying in detail different probabilities or scenarios or deploying highly specific strategies for each of them that would only work for a few risk instances (Tang, 2006). The case studies show that these strategies are not only proactive but are embedded into the SC structure, not just added post-disruption, allowing the coverage of all aspects of SC design, product management, and inventory management, ensuring preparedness in a cost-efficient manner and ensuring business continuity. Specifically, the Food Processor's approach succeeded in the SC dynamic environment by applying ambidexterity, this dual capability allowed the organisation to respond effectively to disruptions while maintaining operational efficiency, leveraging collaboration through shared resources and capabilities, reducing the need for excessive redundancy within individual organisations (Aslam *et al.*, 2020).

6.2 Aggregation and Innovation to achieve Parametrical Redundancy in the AFSC

The LCN SC framework for generic SCM proposes having additional inventory and capacity to deal with risk and lead time, however, in the context of AFSC, most products are highly perishable; therefore, building inventory may not necessarily be a satisfactory solution to create parametric redundancy (Ivanov and Dolgui, 2019; Gholami-Zanjani, Jabalameli, *et al.*, 2021; Gholami-Zanjani, Klibi, *et al.*, 2021; Yadav *et al.*, 2022). The findings show that parametric redundancy can be achieved through other methods, such as aggregation of producers and product innovation, that reach the benefits of capacity redundancies and product storage, substitution, and postponement. On the one hand, aggregation of producers allows for capacity pooling and direct interaction with producers, creating a consistent flow of volume according to production while also achieving efficient redundancies in capacity and eliminating time and distance introduced by intermediaries (Hingley *et al.*, 2011; Berti and Mulligan, 2016; Berti, Mulligan and Yap, 2017; Imami, Valentinov and Skreli, 2021). On the other hand, in line with Davis, Downs and Gephart (2020), processed produce has a longer shelf-life; thus, innovating processing methodologies and technology allows to elongate the shelf time of the produce, hence supplementary inventory is dependent on research and development and processing. Therefore, the findings show that in the context of the AFSC, instead of achieving parametrical redundancy through inventory and

internal capacity redundancies, parametrical redundancy is achieved through the collective combination of produce from various local producers and novel processing techniques.

6.3 Hybrid SC and Value Net models enhance Structural Variety

The findings show that the process of implementing a hybrid SC complements two opposing strategies with each other, which are localisation (decentralisation) and globalisation (centralisation), creating two entirely different and low interconnected supplier structures (Cohen and Derryk, 2011; Ivanov and Dolgui, 2019). This effect, in combination with the value net strategy, which leverages the interconnectedness between actors within the same SC structure to foster collaboration and innovation, creates a considerate range of sourcing combinations which are mainly based in local partnerships and are also scalable for national and international markets, introducing decentralisation, localisation, and diversification into the SC, which are fundamental strategies for structural variety (Cohen and Derryk, 2011; Hingley *et al.*, 2011; Kähkönen, 2012; Ivanov and Dolgui, 2019).

6.4 SC Coordinator in the AFSC

The empirical evidence agrees with the literature findings, resulting in four fundamental principles in integrating an SC Coordinator (Ivanov, Sokolov and Kaeschel, 2010; Lamine, 2015; Berti and Mulligan, 2016; Li, Holsapple and Goldsby, 2019; Cui, Guo and Zhang, 2020):

- One company's efforts—no matter how large—are insufficient to drive industry-wide change.
- Although organisations aim to lead within their respective missions, if their core business is not to coordinate the SC and implement SC-wide collaboration and resilience initiatives, then managing these additional activities beyond its direct relationships would add limited value.
- Organizations with a strong mission emphasis on sustainability and ethics have a higher tendency to perform SC Coordination actions, as these activities become value-adding.
- To reduce complexity, the company seeking to be the coordinator of the SC needs to have direct access to all transactions occurring within the SC. Thus, it would need to have a centralised transaction system.

Furthermore, although the Food Processor does not implement holistic SC Coordination, it can be seen that it does manage, guide, and influence the local sub-structure of its SC by fostering collaboration, collective action and organisations, resource sharing, and the development and implementation of sustainable and ethical practices. The findings show that these actions have a profound positive impact on the locality, including support and stability for small and mid-scale farmers and improved resilience for producers, processors, and other companies within the same SC (Stevenson *et al.*, 2011).

6.5 Collective Learning with Value Co-creation in the AFSC

The findings are aligned with the literature and show that the implementation of the collaborative method of collective learning with value co-creation is possible and exists in practice in the AFSC by the creation of an environment of collaboration, including joint projects, joint decision-making, co-creation, voluntary coopetition, and long-term commitment (Muckstadt *et al.*, 2001; Leat and Revoredo-Giha, 2008; Scholten and Schilder, 2015). The findings reveal that to implement this method in the AFSC, organisations must work closely alongside each other to develop knowledge collectively and implement innovation that enhances sustainable practices and increases product efficiency and quality. Furthermore, the process of aggregative scaling creates more than capacity building and economies of scale, it also establishes connections, for example, between farmers so they can create organisations in their favour, creating flows of knowledge sharing amongst the farmers and also with other typologies of actors in the SC, such as processors and retailers, enabling them to go a step further in innovation and resources sharing without depending on a specific entity or the SC Coordinator (Muckstadt *et al.*, 2001; Ivanov, Sokolov and Kaeschel, 2010; Scholten and Schilder, 2015; Dania, Xing and Amer, 2018; Gholami-Zanjani, Jabalameli, *et al.*, 2021; Yadav *et al.*, 2022). The development of long-term partnerships not only serves as a basis for these collaborating structures, but also increases trust and commitment, facilitating flows of communication and information sharing, strengthening collective learning (Vittuari *et al.*, 2021). These strategies result in a widespread initiative of collective learning and value co-creation, contributing to heightened efficiency, which is significantly influenced by knowledge management practices, and promotes a culture of continuous improvement and adaptability within the SC (Handayati,

Simatupang and Perdana, 2015; Ali, Golgeci and Arslan, 2023). The various collaborative methods deployed allow for effective long-term coordination between large networks of entities, while optimising contract and supplier management and strengthening collective resilience (Handayati, Simatupang and Perdana, 2015).

6.6 Value Nets to overcome localisation limitations

Based on the literature and interviews, value nets overcome localisation limitations through their ability to integrate co-creation in diverse, decentralised networks while maintaining efficiency, scalability, and resilience (Kähkönen, 2012; Lamine, 2015; Nosratabadi, Mosavi and Lakner, 2020). Unlike conventional models that focus on linear processes, value nets facilitate a dynamic and flexible network where different actors, including producers, distributors, retailers, and consumers, work together to co-create value by leveraging their unique resources, competencies, and capabilities, effectively creating scale by aggregation and strategic coordination in the SC, allowing them to overcome tensions of volume, quality, and seasonality (Gille, 2012; Stone and Rahimifard, 2018). Moreover, value nets facilitate the integration of technology and e-commerce, which are crucial for enhancing communication and efficiency across the SC, improving transparency, and fostering consumer engagement, thereby aligning the interests of both alternative and conventional SC actors (Gille, 2012; Suali, Srai and Tsolakis, 2024). Furthermore, value nets facilitate the coordination infrastructure and manage logistics between different actors in the locality, making it possible for locally grown produce to also be processed and distributed in the locality, thus overcoming tensions in lack of logistics and physical and economic structures (Kähkönen, 2012; Cleveland *et al.*, 2014; Nosratabadi, Mosavi and Lakner, 2020; Paciarotti and Torregiani, 2021).

6.7 Implementing LCN in the AFSC through Food Hubs

In order to implement the LCN framework in the AFSC, theoretical principles must be recognised and adjusted to the inherent realities of this sector. The findings are aligned with the literature on the central issues that affect the AFSC, such as perishability and inventory management, lack of trust and power imbalances, overall lack of collaboration or collaborative initiatives within the SC, and limited resources and coordination for innovation and logistics (Yadav *et al.*, 2022). Thus,

to successfully implement the LCN framework in the AFSC, aggregative scaling, strategic coordination, fair power distribution, and SC coordination are important levers that fundamentally change the SC design and generate efficient resilience (Balezentis *et al.*, 2023).

The case studies demonstrate that a fair distribution of power in the SC lays the foundation so collaboration, knowledge sharing, and long-term relationships can flourish (Dubey *et al.*, 2019; Nikookar and Yanadori, 2022). These aspects are antecedents of resilience, and each one of them creates internal and inter-organizational efficiencies that are implemented in both normal operations and disrupted operations, thus contributing to overcoming the trade-off between efficiency and resilience (Kähkönen, 2012; Stone and Rahimifard, 2018; Dubey *et al.*, 2019; Aslam *et al.*, 2020; Ivanov, 2022). Collaboration among stakeholders in the AFSC effectively combines horizontal collaboration and vertical collaboration, which have been shown to reduce vulnerability to risks and enhance overall SC performance (Leat and Revoredo-Giha, 2008; Handayati, Simatupang and Perdana, 2015; Ali, Golgeci and Arslan, 2023). Effective information exchange among SC participants enables network relations, which allows stakeholders to access resources and knowledge that enhance their operational capabilities (Ali, Golgeci and Arslan, 2023). Long-term relationships establish trust and commitment over time, leading to stronger partnerships, including mutual understanding and shared goals, originating a more cohesive network better equipped to handle uncertainties and adapt to evolving market conditions (Dania, Xing and Amer, 2018).

The empirical evidence shows that the action of aggregative scaling allows to aggregate producers in the locality to pool their collective produce, achieving consistent volumes and variety in the locality, minimising the need for inventory extensions, as well as achieving production capacity flexibility, where each producer serves as a strategic partner (Berti and Mulligan, 2016; Berti, Mulligan and Yap, 2017). This horizontal coordination leverages multiple sourcing in the locality and enables optimisation of transportation logistics, effectively creating structural variety by decentralising the SC and diversifying the range of suppliers, as well as process flexibility through the coordination of multiple entities that achieve scale through

capacity pooling and flexibility (Horst *et al.*, 2011; Cleveland *et al.*, 2014; Felicetti, 2014; Berti and Mulligan, 2016; Berti, Mulligan and Yap, 2017).

Although the findings are not conclusive for strategic coordination and SC coordination, it can be seen that the development of value nets and the presence of an organisation with strong values in the SC completely change its design and interactions between organisations. The value net design introduces into the SC vertical coordination, co-creation, and collective learning between actors with different core businesses, originating the possibility of interdisciplinary knowledge development, such as higher product efficiency and conservation methods, contributing to both process flexibility and parametric redundancy through postponement, product substitution, and inventory extensions (Kähkönen, 2012; Ivanov and Dolgui, 2019; Nosratabadi, Mosavi and Lakner, 2020; Ivanov, 2022; Balezentis *et al.*, 2023). At the same time, the value net enhances collaboration between multiple entities, contributing to scale in the locality and reach of broader markets, leveraging these aspects for decentralisation, localisation, and diversification of suppliers (Handayati, Simatupang and Perdana, 2015). This strategy creates flexibility in collaboration and transactions between SC entities, which ultimately achieves the same result as strategic coordination.

The findings highlight that deploying the aforementioned strategies and activities significantly impacts SC design parameters, such as the network structure, inventory management, transportation logistics, and responsiveness and agility (Gholami-Zanjani, Jabalameli, *et al.*, 2021; Gholami-Zanjani, Klibi, *et al.*, 2021). The network structure becomes multilayered, with different sub-structures that have low interconnectedness with each other, mitigating SC complexity. Inventory management becomes a function of the number of producers needed to supply the factory, and inventory redundancies are optimised with product innovation as a result of collaborative activities and collective learning. Transportation logistics in the locality are optimised through horizontal and vertical coordination powered by aggregative scaling and value nets. Responsiveness and agility are enhanced due to the network-oriented design with a centralised transaction point and the multiple collaborative methods deployed (Felicetti, 2014; Berti and Mulligan, 2016).

7. Conclusion

This thesis has explored the importance of the implementation of resilient strategies in modern SCM, with a specific focus on AFSCs. In a VULCA environment, there is an inevitable, natural tendency for disruptions to occur, whether they span from natural disasters, pandemics, or geopolitical conflicts. Therefore, in order to maintain competitive advantage, SCs must evolve beyond traditional cost reduction focused models to embrace flexibility and resilience (Scholten and Schilder, 2015; Vittuari *et al.*, 2021; Ozdemir *et al.*, 2022; Alabi and Ngwenyama, 2023; Balezentis *et al.*, 2023). Emerging concepts and frameworks, such as the LCN SC, adaptive resilience, and SC ambidexterity, allow SC practitioners to shift from a linear perspective of SCM into a multilayered view of not only resilience but also efficiency (Stone and Rahimifard, 2018; Ivanov and Dolgui, 2019; Aslam *et al.*, 2020; Ivanov, 2022).

AFSCs are no exception, plus their unique characteristics, such as perishability, dependency on natural conditions, and power and information asymmetries, require that SCM findings be adapted to this evolving and dynamic context (Stone and Rahimifard, 2018; Ali, Golgeci and Arslan, 2023; Balezentis *et al.*, 2023; Chamanara, Goldstein and Newell, 2023). The research findings highlight the importance of restructuring the AFSC to modern considerations, which involve a paradigm change in SC design and management of relationships between organisations (Yadav *et al.*, 2022). Strategies such as hybrid SC, value nets, and collective learning with value co-creation dramatically change the network structure, inventory management policies, transportation logistics, and flexibility (Kähkönen, 2012; Felicetti, 2014; Berti and Mulligan, 2016; Yadav *et al.*, 2022). Apart from this, the FH organisational model demonstrated to be an adequate restructuring of the current AFSC according to the LCN SC framework, as it allows to implement cost-efficient resilience in the SC with structural, process, and parametric redundancies (Horst *et al.*, 2011; Cleveland *et al.*, 2014; Felicetti, 2014; Berti and Mulligan, 2016; Balezentis *et al.*, 2023).

While this study has provided valuable insights, it is important to acknowledge its limitations. The analysis primarily focused on theoretical frameworks and select case studies, which may not fully capture the diversity of challenges faced across different regions. Future research could address these gaps by exploring the scalability of proposed strategies, their long-term economic implications, and their adaptability to varied contexts. Additionally, it is proposed that further

research be done in organisations that fully implement strategic coordination and SC coordination, as well as disintermediation in DFHs and its impact on SCR.

In conclusion, by addressing the vulnerabilities of AFSCs and proposing actionable strategies, this thesis provides a pathway toward building more resilient, efficient, and sustainable supply networks. These efforts are vital not only for ensuring food security but also for supporting the broader goal of a resilient global economy in the face of future uncertainties.

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Appendix A – Interview Protocol

Promoting Viable Supply Chains in the Agri-Food Sector

Background on Project:

The project I am working on is a master's thesis at the Louvain School of Management, supervised by Professor Constantin Blome. This work focuses on how hybrid Supply Chains (SC) can bring viability to businesses that specialise in sourcing and selling food products. Itis believed that collaboration within the SC can largely enhance its results, sustainability,and survivability during normal operations and disruptive events, such as a pandemic. This project aims at analysing this assumption and bring new conclusions to this topic.

Why I want to talk to you specifically:

I want to interview you specifically as I believe you and the organisation you work in can bring valuable insights in my study.

How will the results be used?

The results will be used only for academic purposes.

How will data be handled (storage/confidentiality):

With your permission, this interview will be recorded and stored in a safe location, offline (not in the cloud). You have the right to remain anonymous in this process, and participationis voluntary.

Do you consent to these terms?

Interview

Name:

Date:

Anonymity:

1. First, I would like to talk about the general structure of the organisation and itsdecision-making process.
    a. Could you describe the structure of this organisation in general terms?
    b. Do you believe that this structure enhances collaboration with the partners you

work with?

i. *If so*: What types of collaboration methods are more common in your organisation (e.g., contract, information sharing, joint-decision, co-creation)?
ii. *If not*: What characteristic of the organisation is the most important to you?

c. → Cooperatives: Does this cooperative actively seek collaborations with other cooperatives (e.g. consumers, farmers')?
→ Conventional: Does this organisation actively seek collaborations with other players (e.g. to promote the environment and society)?
d. In general terms, could you explain how the decision-making process works?
   i. How are the requirements of the many stakeholders (e.g. members/consumers, suppliers, farmers) integrated?
   ii. Does the organisation have specific, standardised guidelines for decision-making, or is this process often dependent on personal judgement?
e. To satisfy the consumers' needs, which strategies does the organisation useto source products?
   i. → Cooperatives: Are members willing to adapt their diet according to seasonality?
   → Conventional: Was it ever necessary to do product substitution?
   If so: How did you proceed?
   ii. What are the criteria for selecting/rejecting specific suppliers?
   iii. How do you define the supply conditions (e.g. price, risk of overproduction or underproduction)?
f. Do you believe this organisation shares the same values as its suppliers/partners, or is this generally unimportant?
g. Do you believe this organisation shows more trust, commitment, and influence over other actors in the SC than others?
   i. *If so*: How do these factors change the relationship between the organisation and its suppliers?
   ii. *If not*: Are these unimportant factors? Why?
h. How does your organisation process and share information internally and externally?

2. Now, I would like to talk about how this organisation is preparing for unpredicted, disruptive events that may alter the day-to-day operations here and in the SC in general.
   a. Specifically, I urge you to think about how disruptions like COVID-19 and the war in Ukraine affected your organisation's structure and operations:

i. Before the event occurred, did your organisation ever identify that these scenarios are possible?
ii. What were the most difficult challenges you had to face?
iii. What lessons would you draw from overcoming these challenges?
iv. → Cooperatives: Do you believe that the specific characteristics of this organisation's structure and the decision-making process that you described before gave you an advantage over conventional retail?
v. During this time, did your organisation adopt any type of new technology or a new way to process information?
vi. Looking into the future, how is your organisation preparing for similar events to these? Would you prefer to adapt in advance and what would be the strategies to use?

b. Can you describe any unique features of your organisation's structure that support the long-term viability of your business model?

3. Finally, I would like to assess how this organisation seeks sustainable initiatives within itself and how it encourages others to follow its lead.
    a. In the decision-making process, do you tend to also consider the perspective of how this organisation's decisions affect the whole of the SC?
        i. → Cooperatives: Do you believe that because your organisation acts on an alternative network, it loses economies of scale? Do you think economies of scale are achieved by certain activities your organisation does?
        ii. Do you believe your influence has a significant effect on your suppliers' activities?
        iii. Does your organisation monitor the profit distribution in the SC?
    b. → Cooperatives: Does your organisation seek to connect local producers and the demand of your partners, as well as connect your partners with your members?
    c. Does your organisation make efforts to build and strengthen collaboration and coordination between your suppliers and partners by bringing together different types of actors in the SC? (e.g. by creating flows of interactions between two actors)
        i. *If so*: Do you believe the collaboration your organisation creates changes the SC and its interactions as a whole?
        ii. *If not*: Do you believe it is not your organisation's purpose to do this, or do you not have the resources for this?
    d. Now, I urge you to imagine all your existing suppliers and future suppliers that may not work with you now but may do so in the future. Does your organisation

seek to bring them together to achieve a collective mass?

   i. *If so*: How does it do this? Does it seek to preserve the products' origins?
   ii. *If not*: Do you believe it is not in the scope of your activity?

e. Looking to the future, how do you envision your organisation growing (e.g. monitoring new business models, trends, technology)?

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