



Master's degree thesis

LOG950 Logistics

AFSC Resilience Framework in Developing Country.

Mudassar Khalid

Number of pages including this page: 81

Molde, 27.11.2023



Mandatory statement

Each student is responsible for complying with rules and regulations that relate to examinations and to academic work in general. The purpose of the mandatory statement is to make students aware of their responsibility and the consequences of cheating. Failure to complete the statement does not excuse students from their responsibility.

<p>Please complete the mandatory statement by placing a mark <u>in each box</u> for statements 1-6 below.</p>		
1.	<p>I/we hereby declare that my/our paper/assignment is my/our own work, and that I/we have not used other sources or received other help than mentioned in the paper/assignment.</p>	<input checked="" type="checkbox"/>
2.	<p>I/we hereby declare that this paper</p> <ol style="list-style-type: none"> 1. Has not been used in any other exam at another department/university/university college 2. Is not referring to the work of others without acknowledgement 3. Is not referring to my/our previous work without acknowledgement 4. Has acknowledged all sources of literature in the text and in the list of references 5. Is not a copy, duplicate or transcript of other work 	<p>Mark each box:</p> <ol style="list-style-type: none"> 1. <input checked="" type="checkbox"/> 2. <input checked="" type="checkbox"/> 3. <input checked="" type="checkbox"/> 4. <input checked="" type="checkbox"/> 5. <input checked="" type="checkbox"/>
3.	<p>I am/we are aware that any breach of the above will be considered as cheating, and may result in annulment of the examination and exclusion from all universities and university colleges in Norway for up to one year, according to the Act relating to Norwegian Universities and University Colleges, section 4-7 and 4-8 and Examination regulations section 14 and 15.</p>	<input checked="" type="checkbox"/>
4.	<p>I am/we are aware that all papers/assignments may be checked for plagiarism by a software assisted plagiarism check</p>	<input checked="" type="checkbox"/>
5.	<p>I am/we are aware that Molde University College will handle all cases of suspected cheating according to prevailing guidelines.</p>	<input checked="" type="checkbox"/>
6.	<p>I/we are aware of the University College's rules and regulation for using sources</p>	<input checked="" type="checkbox"/>

Personal protection

Personal Data Act

Research projects that processes personal data according to Personal Data Act, should be notified to Norwegian Agency for Shared Services in Education and Research (SIKT) for consideration.

Have the research project been considered by SIKT?

yes no

- If yes:

Reference number: Ref. 537099

- If no:

I/we hereby declare that the thesis does not contain personal data according to Personal Data Act.:

Act on Medical and Health Research

If the research project is effected by the regulations decided in Act on Medical and Health Research (the Health Research Act), it must be approved in advance by the Regional Committee for Medical and Health Research Ethic (REK) in your region.

Has the research project been considered by REK?

yes no

- If yes:

Reference number:

Publication agreement

ECTS credits: 30

Supervisor: Heidi Hogset

Agreement on electronic publication of master thesis

Author(s) have copyright to the thesis, including the exclusive right to publish the document (The Copyright Act §2).

All theses fulfilling the requirements will be registered and published in Brage HiM, with the approval of the author(s).

Theses with a confidentiality agreement will not be published.

I/we hereby give Molde University College the right to, free of charge, make the thesis available for electronic publication:

yes no

Is there an agreement of confidentiality?

yes no

(A supplementary confidentiality agreement must be filled in)

- If yes:

Can the thesis be online published when the period of confidentiality is expired?

yes no

Date: 23.11.2023

Preface

Embarking on the journey of this master's thesis marked the culmination of my Master of Science in logistics program at Molde University College. This academic endeavor has proven to be both enriching and challenging, particularly as it delves into the intricacies of resilience within agri-food supply chains.

My chosen research area, which explores the motivations and willingness to improve within these supply chains, has unveiled a fascinating landscape of insights. The exploration of agri-food supply chains and their intrinsic resilience mechanisms has not only broadened my academic perspective but has also instilled a deeper appreciation for the complexities inherent in this dynamic field.

The realization of this thesis would not have been possible without the invaluable help and support I received from various quarters. I extend my sincere appreciation to my thesis supervisor, Heidi Hogset, whose guidance, support, and insightful discussions have been instrumental in shaping the trajectory of this research. Additionally, I express gratitude to the companies across three countries that participated in the survey, contributing essential perspectives to my study.

Lastly, heartfelt thanks go to my family and friends whose unwavering support and encouragement have been a source of strength throughout this academic journey. Their belief in my abilities and their encouragement have played a pivotal role in bringing this thesis to fruition.

As I conclude this chapter of my academic pursuit, I am filled with gratitude for the collective efforts that have shaped this research. I look forward to contributing the knowledge gained to the broader academic community and the field of agri-food supply chain resilience.

Abstract.....	5
Chapter 1 Introduction	7
1.1 Background.....	7
1.2 Case Studies.....	8
1.2.1 COVID-19 Pandemic in Norway.....	8
1.2.2 Flooding in Pakistan and Bangladesh.....	9
1.2.2 Russian-Ukraine War and Global Food Crisis	11
1.3 Research Problem.....	13
1.3.1 Research Questions	13
1.4 Research Significance.....	13
1.4 Limitations.....	13
2.1 Impact of Geopolitical Conflicts on Food Supply Chains	14
2.1.1 Resilience	14
2.1.2 Sustainability.....	15
2.1.3 Robustness	15
2.2 Adaptive Resilience and the Continuous Adaptive Cycle	15
2.3 Challenges in the Conservation Phase.....	16
2.4 The Release and Reorganization Phases.....	16
2.5 Factors Influencing AFSC Resilience.....	17
2.6 The Definition of AFSC Resilience.....	17
2.6.1 The Framework: Unique Resilience Elements	17
2.7 Categorizing Resilience Elements for AFSCs	18
2.8 Challenges in Agri-Food Supply Chains.....	18
2.9 Phase-Based Tactics and Alignment with the Adaptation Cycle	19
2.10 Technology and Innovation.....	19
2.10.1 Blockchain for Supply Chain Traceability	20
2.10. 2 Real-time monitoring with IoT.....	20
2.10.3 Artificial Intelligence (AI) for Predictive Analytics	21
2.11 Capacity Building and Knowledge Transfer	21
2.11.1 Importance of Capacity Building and Knowledge Transfer.....	22
2.11.2 Training, education and knowledge sharing	22
2.1.2 Public-Private Partnerships.....	23
2.12.2 Examples of Successful PPP Initiatives.....	23
2.13 Ecological Sustainability	24
2.13.1 Role of AFSCs in Environmental Conservation	25
2.13.1 Sustainable Farming Methods and Their Benefits.....	25
2.14 Waste Reduction, Circular Economy.....	25

2.15.2 Sustainability and Resilience Benefits	26
2.16 Policy and Regulatory Frameworks:	26
2.16.2 Case Studies of Effective Policies	27
2.16.3 Challenges and Considerations	28
3 Methodology	29
3.1 Research Design	29
3.2 Respondent	30
3.3 Data Collection	31
3.3.1 Semi-Structured Interviews:	31
3.3.2 Document Review:	31
3.4 Data Analysis	32
3.4.1 Data Transcription	32
3.4.2 Data Familiarization	33
3.4.3 Initial Coding	33
3.4.4 Theme Development	34
3.5 Data Interpretation	34
3.6 Framework Development	34
3.6 Limitations	38
4 Analysis	40
4.1 Introduction	40
4.2 Analysis of Supply Chain Resilience Themes with Likert Scale	52
5 Discussion.....	64
5.1 Key themes	65
5.1.1 Sourcing and Suppliers	65
5.1.2 Distribution Channels	67
5.1.3 Substitutes and Alternatives.....	68
5.1.4 Contracts and Financial Aspects.....	68
1. 5.1.5 Risk Management and Resilience	69
5.2 Implications	70
5.2.1 Environmental Implications.....	70
5.2.2 Social Implications.....	70
5.2.3 Economic Implications.....	71
6 Conclusion.....	71
7 Bibliography	73

8 Appendix	83
<i>Figure 1 Research Framework</i>	36
Figure 2 Sourcing and Suppliers	53
Figure 3 Distribution Channels	55
Figure 4 Substitutes and Alternatives	56
Figure 5 Contracts and Financial Aspects	57
Figure 6 Risk Management and Resilience	58
Figure 7 Assets and Resource Management	59
Figure 8 Market Position and Brand Loyalty	60
Figure 9 Information Sharing and Learning	61
Figure 10 External Resources and Communities	61
Figure 11 System wide Back Up.....	62
Figure 12 Self-Organization and Adaptability.....	63
Figure 13 System-Wide Backup	63
Figure 14 Skill Diversity for Resilience	64
Figure 17 Supply Chain Resilience Themes	65

Abstract

This research meticulously examines the intricate dynamics of fortifying resilience within the Agricultural and Food Supply Chain (AFSC) in the context of developing countries. Through a thorough thematic analysis, the study explores various dimensions, encompassing sourcing strategies, distribution channels, risk management practices, and the interplay with external resources. The insights derived emanate from in-depth interviews with key stakeholders in the AFSC, providing an in-depth understanding of the challenges faced and the strategies employed.

One of the focal points of the research delves into the criticality of raw material sourcing, uncovering the diverse approaches adopted by companies to secure their supply chains. The strategic blend of local and international suppliers emerges as a crucial determinant of resilience. The study explores how companies navigate the delicate balance between local sustainability and global accessibility, recognizing the unique implications each strategy carries for the overall resilience of the supply chain.

Distribution channels, identified as a key player for supply chain effectiveness, come under sharp focus. The research unveils a spectrum of strategies employed by companies, ranging from localized emphasis to expansive international approaches. This diversity in distribution channel strategies underscores the need for context-specific approaches, acknowledging the unique challenges and opportunities within the developing world. The implications of these strategies for supply chain resilience are carefully examined, providing valuable insights for industry practitioners and policymakers alike.

Risk management and resilience emerge as overarching themes, emphasizing the pivotal role of skilled professionals in steering supply chains through uncertainties. The study emphasized the importance of robust business continuity plans as indispensable roadmaps for guiding operations through turbulent times. Moreover, the concept of co-learning, rooted in collaborative knowledge exchange, surfaces as a powerful contributor to resilience. The research delves into how fostering a culture of co-learning can significantly enhance a supply chain's adaptive capacity, ensuring its ability to navigate disruptions effectively.

The study navigates the multifaceted landscape of external resources and communities, enlightening a spectrum of perspectives within the industry. While some companies lean on substantial external support during disruptions, others express reservations, showcasing the diverse array of strategies employed to address disruptions. The efficiency of product movement throughout the supply chain is scrutinized, revealing varying experiences among companies. This variability underscores the need for strategies to boost efficiency, particularly during disruptions, and offers valuable insights for industry practitioners seeking to optimize their supply chain processes.

Self-organization and adaptability surface as pivotal attributes contributing to resilience. The research showcases companies that demonstrate remarkable responsiveness to external influences, emphasizing the need for agility in the face of disruptions. The study concludes

by proposing a comprehensive AFSC Resilience Framework, custom-tailored to the unique dynamics of developing countries. This framework integrates sourcing strategies, optimization of distribution channels, robust risk management practices, and collaborative learning initiatives, providing a holistic guide for fortifying the resilience of the AFSC in the face of disruptions and uncertainties.

In summary, this research contributes in-depth insights to the field, offering a practical guide for policymakers, industry practitioners, and researchers engaged in fortifying the resilience of agricultural and food supply chains in developing countries. The findings highlight the need for context-specific strategies that recognize and address the unique challenges and opportunities within the developing world, ultimately contributing to the sustainability and resilience of the AFSC on a global scale.

Chapter 1 Introduction

By giving their expanding populations a consistent and safe food supply, agri-food supply chains (AFSCs) are essential to guaranteeing food security in emerging countries. These supply chains, which include the whole food production and consuming process, are critical to providing affordable and wholesome food availability. However, AFSCs in poor nations have a unique set of difficulties and vulnerabilities, which calls for a robust framework (Natarajarathinam et al. 2009).

The AFSCs in emerging nations encounter a variety of instability and disturbances. The integrity of these supply chains is seriously threatened by a number of reasons, such as harsh weather, evolving customer tastes, changes in energy costs, and climate change. Moreover, the unstable quality and availability of raw materials, coupled with the perishable nature of food items, add levels of complexity to their operations.

It is projected that AFSCs in developing nations would encounter more difficulties in the future. Extreme weather linked to climate change may disrupt food production and distribution, compromising food availability and quality (Macfadyen et al. 2015). AFSCs' limited resources are further strained by meat, dairy, and processed meals.

Furthermore, it is anticipated that these regions would see a considerable rise in population, with metropolitan areas seeing particularly rapid expansion (Johnson et al. 2015). Urbanization frequently results in changes to eating habits, including a greater need for processed foods, meat, and dairy products, which puts further pressure on AFSCs and their finite natural resources.

This convergence of challenges presents a substantial test for AFSCs in developing countries, akin to a "perfect storm." The imperative for increased food production coincides with an elevated susceptibility to disruptions (Macfadyen et al. 2015). Consequently, it is crucial to formulate a comprehensive resilience framework customized to the unique circumstances of these regions (Manuj & Mentzer, 2008). Such a framework should empower AFSCs not only to endure and adapt to disruptions but also to recover swiftly while sustaining essential functionality (Taylor & Fearn, 2006).

This research endeavor aligns with the imperative to enhance the resilience of food supply chains in the face of growing uncertainties (Pettit et al., 2010). By tailoring our framework to the context of developing countries, we aspire to offer practical insights and solutions that can bolster food security, mitigate disruptions, and ensure the consistent availability of food to vulnerable populations (Munoz & Dunbar, 2015). In essence, our work endeavors to fortify the foundations of food resilience in regions where it matters most.

1.1 Background

The 21st century has borne witness to a succession of global crises that have not only challenged the resilience of nations but have also reshaped our comprehension of adaptive capacity on a worldwide scale (Hobbs, 2020; Stone and Rahimifard, 2018; Bø et al. 2023).

Pandemics, natural catastrophes, and geopolitical wars are among these crises. They have highlighted the necessity of resilience in protecting communities and global systems.

This comprehensive research project examines resilience in the face of contemporary challenges, focusing on three distinct but interrelated case studies: COVID-19 in Norway, the ongoing and devastating flooding in Pakistan and Bangladesh, and the cascading effects of the Russian-Ukraine war, which led to a global food crisis. These case studies serve as poignant examples of the complex, multifaceted nature of resilience in the modern era, where global challenges are intricately interconnected and demand innovative solutions (Bø et al 2023).

1.2 Case Studies

1.2.1 COVID-19 Pandemic in Norway

The COVID-19 pandemic, originating in early 2020, had far-reaching effects on countries across the globe, testing their capacity to respond to a worldwide health crisis and uncovering vulnerabilities in various sectors (Capano et al., 2020). Norway, well-regarded for its robust healthcare system and social safety nets, was not exempt from the challenges brought about by the pandemic, with ramifications for its agri-food supply chain (AFSC).

Despite Norway's strong healthcare infrastructure, it became apparent that ensuring food security was a paramount concern as the pandemic placed considerable strain on supply chains (Bø et al. 2023). These challenges encompassed delays in the delivery of goods due to disruptions in transportation, labor shortages resulting from illness and quarantine measures, and shifts in consumer demand patterns.

The COVID-19 pandemic underscored the compelling need for resilient AFSCs, capable of swift adaptation to sudden shocks, all the while ensuring continued access to vital food supplies and affordability for the populace (Capano et al. 2020). Like many other nations, Norway had to reassess its strategies for food supply and distribution to bolster its resilience in the face of unexpected crises.

In response to these challenges, stakeholders in Norway, including researchers and policymakers, initiated endeavors to scrutinize the vulnerabilities exposed by the pandemic and to explore means of fortifying the nation's AFSC. Key components of this undertaking encompassed:

- **Local Food Production:** Norway embarked on an evaluation of its ability to produce food locally, with the goal of reducing dependence on international supply chains for essential food items.
- **Reduced Reliance on International Supply Chains:** The pandemic accentuated the significance of diversifying sources for critical food items, thereby reducing reliance on a limited number of international suppliers for essential food products (Bø et al., 2023)..
- **Contingency Planning:** The insights gleaned from the COVID-19 pandemic underscored the imperative of formulating robust contingency plans (Capano et al.

2020). These plans would equip Norway to respond effectively to future disruptions and mitigate the impact on food supply and affordability (Bø et al. 2023).

- **Resilience Enhancement:** Policymakers and researchers in Norway embarked on measures to bolster the resilience of the AFSC, ensuring a steady and secure food supply during emergencies.

The COVID-19 pandemic served as a valuable foundation for these endeavors, providing critical insights into the vulnerabilities of the nation's AFSC and the need for proactive measures. By recognizing these challenges and implementing strategies to fortify its food supply chain, Norway aimed to safeguard the well-being of its population and guarantee food availability, even in the face of unforeseen crises (Capano et al., 2020). These endeavors were aligned with the broader global discourse on enhancing the resilience of food supply chains in a post-pandemic world.

1.2.2 Flooding in Pakistan and Bangladesh

Pakistan and Bangladesh, both situated in South Asia, confront recurrent and severe flooding, primarily triggered by monsoon rains and compounded by the consequences of climate change-induced extreme weather events (Kundzewicz et al. 2019). These floods have far-reaching implications, including the disruption of agricultural endeavors, displacement of communities, and extensive harm to critical infrastructure, especially transportation and storage facilities within Agri-Food Supply Chains (AFSCs).

In both Pakistan and Bangladesh, the yearly monsoon season heralds copious rainfall, inevitably resulting in widespread flooding. The submergence of farmlands leads to substantial crop losses, impacting food production and the food security of millions of people. Furthermore, flooding frequently inflicts harm upon roads, bridges, and other transportation infrastructure, rendering the transportation of food from production zones to markets a formidable challenge (Mirza, 2011). Storage facilities are also exposed to the perils of flood damage, risking food spoilage and disruptions within the supply chain.

Ahmad and Saboor (2022) investigate Pakistan's food security and the necessity for public policy changes to meet population food and nutrition needs. The research shows that food security is a complex issue that requires a varied solution. Food and nutrition security are estimated using primary and secondary data and the FGT index. The survey says many Pakistanis are food insecure due to poverty, unemployment, and lack of food. Sustainable solutions and dietary diversity are key to Pakistan's food security. The research suggests that the government should increase food accessibility, health systems, and public policies to meet population food and nutrition demands. Research shows that Pakistan needs coordinated governmental strategies to meet food and nutrition requirements immediately. It advises Pakistani officials to implement a comprehensive food security strategy, promote sustainable agriculture, and create social safety nets for disadvantaged populations.

The post-disaster needs assessment conducted by the Government of Pakistan and supported by the Asian Development Bank, the European Union, the UN, and the World

Bank estimates the damage, loss, and needs caused by the June–October 2022 floods in 94 districts in the country in a report. A robust recovery and reconstruction vision and strategy are mentioned in the study. Key findings from the report, focusing on agrifood supply chain resilience:

- 25% of the floods' destruction and loss was in agriculture. Floods devastated crops, animals, fisheries, and irrigation infrastructure, interrupting food production and supply lines. The analysis predicts a 0.9 percent drop in farm sector value added of FY22 GDP and a 3.7 to 4.0 percentage point increase in national poverty, pushing 8.4 to 9.1 million people into poverty.
- The report estimates that the agriculture sector needs PKR 854 billion (US\$4.0 billion) in recovery and reconstruction, including short-term interventions like cash transfers, seeds and fertilizer distribution, and livestock vaccination, and medium- to long-term interventions like restoring irrigation systems, improving water management, enhancing crop diversification, and strengthening markets. The research recommends a robust recovery approach for agriculture to restore livelihoods, provide economic opportunities, promote social inclusion, and enhance resilience and sustainability. The strategy emphasizes building back better, people-centered recovery, and climate change adaptation. The approach focuses on promoting climate-smart agriculture practices, including drought-tolerant and flood-resistant crop varieties, water-efficient irrigation, and soil conservation.
 - Enhancing government, farmer, and private sector capacity and collaboration to plan, implement, and monitor recovery and reconstruction.
 - Promoting equitable and resilient agrifood systems by enhancing food quality and safety, food storage and distribution infrastructure, and food access for vulnerable communities.
 - Restoring wetlands, woodlands, and mangroves to prevent flooding and erosion and offer ecosystem services and benefits for agriculture and people (Planning Commission, Ministry of Planning & Development, Govt. of Pakistan 2022).

Safeguarding the resilience of AFSCs in these regions holds paramount importance for several compelling reasons:

Mitigating Disruptions in Food Production: Through the development of flood-resistant agricultural practices and technologies, these nations can alleviate the adverse consequences of floods on crop production. This might encompass the promotion of flood-resistant crop varieties or adjustments in planting schedules to align with the monsoon season (Kundzewicz et al. 2019).

Enhancing Transportation Infrastructure: The enhancement of transportation infrastructure's resilience, such as the construction of elevated roads and flood-resistant bridges, is instrumental in sustaining the flow of food from rural areas to urban centers.

Effective Storage and Preservation: The implementation of flood-resistant storage solutions and post-harvest management techniques is pivotal in averting food losses

attributed to flooding. This entails the utilization of elevated or flood-proof storage facilities and the advancement of food preservation methods.

Community Preparedness: Educating and preparing communities for flood-related contingencies is of paramount importance. This encompasses the establishment of early warning systems, evacuation strategies, and ensuring access to safe and nutritious food during and after flood events.

Climate-Resilient Agriculture: The promotion of climate-resilient agricultural practices, which consider evolving weather patterns, significantly contributes to the overall resilience of AFSCs (Mirza, 2011).

In summation, Pakistan and Bangladesh find themselves highly susceptible to flooding, presenting substantial perils to their AFSCs and food security. Addressing these challenges mandates a comprehensive strategy that extends beyond disaster response to incorporate proactive measures for reinforcing the resilience of AFSCs. This encompasses the adaptation of agricultural practices, the amelioration of infrastructure, and the nurturing of community resilience to mitigate the repercussions of floods on food availability and forestall post-disaster food crises.

1.2.2 Russian-Ukraine War and Global Food Crisis

The ongoing geopolitical tensions between Russia and Ukraine, which commenced in 2014, have given rise to profound and far-reaching implications for worldwide food security (Nasir et al., 2022; Glauber et al., 2023). Ukraine, frequently recognized as the primary grain source for Europe, holds a pivotal position in global grain production and exports (Hassen & Bilali, 2022). The conflict within the region disrupted agricultural pursuits, trade pathways, and food supply chains, thereby contributing to an escalation in food prices and instigating global apprehensions concerning food availability (Nasir et al. 2022; Glauber et al. 2023).

The enduring conflict between Russia and Ukraine has not only been a prominent topic in international news but has also seized the interest of researchers because of its profound and extensive consequences on worldwide food security. Ukraine, often described as the "breadbasket of Europe," serves as a linchpin within the intricate network of international agri-food supply chains (Hassen & Bilali, 2022).

Disruption of Agricultural Activities: One of the most critical dimensions of this crisis is its direct impact on agricultural activities. The conflict's devastation extends to farmland, resulting in extensive damage and significant interruptions in planting and harvesting. The agricultural sector faces a staggering blow, including the displacement of farmers, thereby impeding local food production (Nasir et al. 2022).

Impact on Trade Routes: Beyond the agricultural sector, the conflict has had a severe and lasting impact on global trade routes, emphasizing Ukraine's crucial role as a significant grain exporter. The disruption of grain exports from Ukraine sent shockwaves

through international food markets, resulting in not only heightened food prices but also considerable market volatility on a global scale (Glauber et al. 2023).

Food Supply Chain Disruptions: The intricate tapestry of food supply chains was also severely disrupted by the conflict. Key transportation infrastructure, including roads and railways, bore the brunt of the conflict's destruction. These supply chain interruptions have made it exceptionally challenging for food to reach markets and consumers efficiently, adding further complexity to the growing issue of food security (Nasir et al. 2022).

Global Food Price Increases: The marked reduction in the availability of Ukrainian grain on the global market, coupled with the increased uncertainty brought by the conflict, significantly contributed to the skyrocketing of food prices across the world (Nasir et al. 2022). These price hikes took a particularly harsh toll on vulnerable populations in various countries, leading to widespread food insecurity and significantly curtailing access to affordable, nutritious food (Glauber et al. 2023).

Geopolitical Implications: The Russian-Ukraine conflict has also highlighted the profound geopolitical dimensions of global food security. It served as a stark reminder of the vulnerability of food systems to geopolitical tensions and conflicts in key agricultural regions. As a result, it has prompted urgent discussions and actions in the international arena to address these vulnerabilities (Hassen & Bilali, 2022).

The consequences of the ongoing Russian-Ukraine war have intricately disrupted agri-food supply chains, with repercussions extending far beyond the immediate conflict zone and transcending international boundaries. This comprehensive literature review underscores Ukraine's indispensable role in global food security, the multi-faceted impact of the conflict on food systems, and the urgent need for sustained research and effective policy interventions to grapple with these pressing challenges.

The use of disruptions as exemplified by the real-world situations under study collectively emphasizes the critical importance of resilient Agri-Food Supply Chains (AFSCs) when facing diverse and interconnected challenges. These instances highlight the necessity for supply chains capable of withstanding shocks, adapting to evolving circumstances, and ensuring food security for populations during times of crisis. The focus on disruptions rather than isolated incidents underscores the interlinked nature of the issues faced by AFSCs. These disruptions can set off a chain reaction of consequences across the entire supply chain, affecting global trade routes, food prices, market stability, and food availability in various regions. Such interrelated disruptions underscore the inherent vulnerability of the world's food systems.

Therefore, considering these interconnected disruptions, the central objective of this research is to construct a comprehensive framework aimed at bolstering the resilience of AFSCs, particularly in developing countries. This framework is designed to address the unique vulnerabilities and intricacies characterizing these supply chains. It seeks to contribute to the global discourse on resilience by providing valuable insights and

actionable strategies for policymakers, practitioners, and researchers who are dedicated to ensuring the security and stability of food systems on a global scale.

1.3 Research Problem

Emerging nation agri-food supply chains (AFSCs) lack resilience, sustainability, and adaptability. Food security and sustainability require strong supply networks among these complicated concerns.

1.3.1 Research Questions

How well do current resilience models handle the constraints of developing country agri-food supply chains, and how can they be adapted or enhanced to increase resilience?

RQ2: What are the primary variables and contextual elements that affect the resilience and sustainability of developing country agri-food supply chains, and how can they be used to enhance them?

1.4 Research Significance

This research endeavor aligns with the imperative to enhance the resilience of food supply chains in the face of growing uncertainties. By tailoring our framework to the context of developing countries, we aspire to offer practical insights and solutions that can bolster food security, mitigate disruptions, and ensure the consistent availability of food to vulnerable populations. In essence, our work endeavors to fortify the foundations of food resilience in regions where it matters most.

1.4 Limitations

One potential limitation of this study pertains to the extent to which the findings and the developed framework can be generalized. Although the research aims to tackle the distinct challenges encountered by agri-food supply chains (AFSCs) in developing countries, it is crucial to acknowledge that these countries exhibit substantial variations in specific circumstances and contexts. Factors such as governance structures, economic conditions, and regional disparities may exert an influence on the suitability of the resilience framework. Furthermore, due to the wide array of issues confronted by these supply chains on a global scale, the research might not encompass all conceivable challenges and solutions relevant to AFSCs across all developing countries. Consequently, it is prudent to regard the proposed framework as a fundamental guiding tool, recognizing the necessity for further adjustments and tailoring to accommodate the unique conditions prevailing in individual countries and regions.

Chapter 2: Literature Review

The resilience of Agri-Food Supply Chains (AFSCs) in developing countries is a multifaceted subject that warrants meticulous examination. Our endeavor to gain insights into and fortify AFSC resilience in these regions involves a deep dive into the complexities of this matter. Our study primarily focuses on substantiating a resilience framework model

previously conceptualized in scholarly works (Stone & Rahimifard, 2018). Nonetheless, our investigation goes beyond this scope, encompassing a thorough assessment of the suitability of this resilience model within the unique contexts of developing countries, marked by specific challenges and socioeconomic constraints (Manikas et al. 2022).

2.1 Impact of Geopolitical Conflicts on Food Supply Chains

The Ukraine-Russia conflict, which commenced in 2014, has exerted extensive influence on worldwide food supply networks. This war disrupted agricultural operations in Ukraine, a key global source of food, and sent ripples throughout the international food distribution system. Developed nations like Norway, integral components of these interlinked supply chains, have not escaped the repercussions of such geopolitical disputes.

The significance of this geopolitical backdrop in the context of our research is profound. Grasping the ramifications of geopolitical conflicts, exemplified by the Ukraine-Russia conflict, on developed nations, becomes paramount in evaluating the susceptibilities and robustness of global food supply chains. This comprehension guides the strategies that Norway and other developed nations might employ to shield their food security amidst periods of global uncertainty.

Agri-Food Structures in Developing Countries

Their agricultural practices, infrastructure, and supply chain systems differ significantly from those in developed countries. Understanding these differences is crucial in designing effective resilience strategies that are tailored to the local context. This is essential for achieving food security in regions where AFSCs face distinct challenges and operate within specific socio-economic constraints (Stone & Rahimifard, 2018).

Define Resilience, Sustainability, and Robustness

Agri-food supply systems depend on resilience, sustainability, and robustness. It is imperative to elucidate their distinctions before delving deeper into the intricate nature of resilience in AFSCs.

2.1.1 Resilience

Resilience within Agri-Food Supply Chains (AFSCs) is a pivotal concept, signifying the paramount ability of these supply chains to respond to a myriad of disruptions and multifaceted challenges promptly and effectively. It extends beyond the mere capacity to endure adverse events and encompasses an organization's fundamental traits of agility, adaptability, and a profound aptitude for learning from disruptions to reinforce long-term sustainability within inherently dynamic and unpredictable systems (Stone & Rahimifard, 2018). In this comprehensive vision of resilience, AFSCs can manage and absorb change and are committed to ongoing development, allowing them to endure shocks and grow while supplying important food supplies. It's a cornerstone of contemporary food systems because resilience protects food security and reduces environmental and social consequences.

2.1.2 Sustainability

Contrary to resilience, sustainability in Agri-Food Supply Chains (AFSCs) is a normative measure of long-term performance that prioritizes environmental, economic, and social objectives. Aligned with the renowned definition encapsulated in the Brundtland Report, sustainability embodies the ethos of ensuring that the needs of the present generation are fulfilled without jeopardizing the potential of future generations to meet their own needs (Stone & Rahimifard, 2018). It's important to underscore that an organization can indeed demonstrate resilience, adeptly navigating and adapting to disruptions, yet still fall short of sustainability if its actions prioritize short-term survival and adaptation at the expense of broader and enduring environmental and social responsibilities. In essence, while resilience gears organizations to withstand shocks, sustainability sets the compass toward enduring harmony with the ecosystem and society, signifying the dual objectives of modern food systems.

2.1.3 Robustness

While related to resilience, robustness primarily places emphasis on the capacity to endure and withstand disturbances, presenting itself as a pivotal component within the broader concept of resilience. Within the intricate tapestry of resilient systems, robustness assumes the role of a steadfast pillar, emphasizing durability and steadfastness in the face of disruptions (Stone & Rahimifard, 2018). Unlike resilience, which inherently encompasses the ability to flexibly adapt and recover swiftly, robustness does not inherently prioritize rapid adaptation or the swiftness of recovery. It underscores the fundamental attribute of durability and the unwavering capability to withstand challenges without succumbing to their immediate effects, offering a valuable dimension to the multifaceted landscape of AFSC resilience.

2.2 Adaptive Resilience and the Continuous Adaptive Cycle

Resilience within AFSCs extends beyond the ability to absorb change; it encompasses adaptive or evolutionary resilience. This perspective recognizes complex social-ecological systems where interactions occur across multiple scales, time periods, and geographic locations (Stone & Rahimifard, 2018).

Adaptive Resilience: Adaptive resilience characterizes systems that continuously build resilience through adaptation and learning from ongoing shocks. It emphasizes the perpetual process of adjusting to disruptions rather than seeking a stable equilibrium (Folke et al. 2010).

Continuous Adaptive Cycle: The continuous adaptive cycle comprises four phases: Exploitation, Conservation, Release, and Reorganization (Walker et al. 2004).

Exploitation: This initial phase involves the utilization of readily available resources to establish primary business priorities. For instance, a new startup gaining market dominance serves as an illustration (Adger, 2000).

Conservation: As organizations grow, they bind increasing resources and expand connections, akin to intensifying agriculture and centralizing industries in AFSCs. Vulnerability to disruption is heightened in this phase (Adger, 2000).

Release: In the release phase, a significant disturbance can lead to severe resource loss. It does not necessarily imply business closure but necessitates adaptation (Walker et al., 2004).

Reorganization: The reorganization phase marks the restart of the cycle, where organizations make necessary changes to restore functionality and competitiveness. The cycle restarts as AFSCs evolve in response to disruptions and changing external conditions (Folke et al., 2010).

Understanding the continuous adaptive cycle is pivotal for comprehending how AFSCs respond to disruptions and adapt to changing conditions.

2.3 Challenges in the Conservation Phase

The conservation phase, characterized by growth and resource accumulation, presents several unique challenges to AFSCs: **Resource Binding:** Organizations amass substantial resources, including land, capital, and infrastructure. Effectively managing these bound resources is essential, as over-reliance on them can increase vulnerability (Skalkos, 2023). **Increased Interconnectedness:** Expanding organizations establish more extensive networks and connections, enhancing efficiency but also elevating exposure to disruptions (Monteiro & Barata, 2021). **Susceptibility to External Effects:** Ironically, during the conservation phase, organizations are most vulnerable to external impacts, as disruptions can disrupt finely tuned processes established for stability (Mehmood et al. 2021). **Loss of Flexibility:** Pursuit of efficiency may inadvertently lead to reduced flexibility, limiting the ability to adapt swiftly to unexpected changes or disturbances (Taşkınır & Bilgen, 2021). **Transition to the Release Phase:** Organizations must prepare for the possibility of transitioning to the release phase, which entails significant adaptation and resource reorganization (Stone & Rahimifard, 2018).

Addressing these challenges during the conservation phase is pivotal for the long-term resilience of AFSCs. Balancing resource binding, interconnectedness, and flexibility is key to navigating this critical stage effectively.

2.4 The Release and Reorganization Phases

Release Phase: During the release phase, organizations face the potential for severe resource loss and disruption. It does not necessarily imply business closure but necessitates adaptation and transformation. This phase may involve reevaluating organizational structures and strategies to regain stability (Srivastava & Dashora, 2022).

Reorganization Phase: Following a significant disturbance, the reorganization phase commences. It marks a period of adaptation, where organizations make necessary changes

to restore functionality and competitiveness. The cycle restarts as AFSCs evolve in response to disruptions and changing external conditions (Skalkos, 2022).

Understanding the dynamics of the release and reorganization phases is essential for AFSCs to navigate disruptions effectively and foster long-term resilience within AFSCs.

2.5 Factors Influencing AFSC Resilience

Several interconnected factors exert influence on the resilience of agri-food supply chains:

Resilience: The ability to absorb change, adapt, and recover swiftly is central to AFSC resilience. This core element encompasses the capacity to withstand disruptions and apply lessons learned to enhance competitiveness (Boyacı-Gündüz et al. 2021).

Adaptability: Adaptability reflects an organization's capability to modify its mode of operation in response to disruptions. It involves making tactical adjustments and changes to navigate changing operational environments effectively (Cappelli & Cini, 2020).

Transformability: Transformability pertains to the capacity to overhaul an untenable system of operation. It involves significant, system-wide changes and is a powerful control strategy within the adaptive cycle (Christopher & Peck, 2004).

Understanding these factors is crucial for organizations seeking to bolster their resilience within AFSCs. Resilience, adaptability, and transformability serve as effective control strategies across various phases of disruption (Chunsheng et al. 2020).

2.6 The Definition of AFSC Resilience

Resilience of Agri-Food Supply Chains (AFSC): The resilience of AFSC can be articulated as "the ability of all participants engaged in the agri-food supply chain to ensure a sufficient, dependable, and satisfactory provision of food" (Stone & Rahimifard, 2018). This description highlights the interconnectedness of stakeholders within the supply chain and underscores the significance of the approaches and tactics employed by one participant in shaping the overall resilience of the entire supply chain.

2.6.1 The Framework: Unique Resilience Elements

A comprehensive examination of the existing body of literature has unveiled several critical elements of resilience that organizations can employ to address and manage specific vulnerabilities within Agri-Food Supply Chains (AFSCs) (Aigbogun et al. 2014; Gunasekaran et al., 2011; Christopher and Peck, 2004; Allison et al., 2009; Ivanov et al. 2015). These elements of resilience span both the strategic and operational dimensions of AFSCs, underscoring the significance of flexibility, adaptability, and preparedness in confronting disruptions.

For instance, Aigbogun et al. (2014) emphasize the necessity of establishing robust supply chain networks capable of swift adaptation to changes, while Gunasekaran et al. (2011) underscore the importance of nurturing strong supplier relationships to enhance resilience.

Christopher and Peck (2004) argue that sharing information can bolster supply chain transparency, enabling organizations to detect disruptions at an earlier stage and respond more effectively.

In addition to the strategic and operational aspects, various researchers shed light on the cultural and behavioral facets of resilience within AFSCs (Kleindorfer and Saad, 2005; Christopher and Peck, 2004; Allison et al. 2009). These studies underscore the significance of cultivating a resilient organizational culture that promotes open communication, a willingness to take calculated risks, and a commitment to learning from previous disruptions.

Given the dynamic nature of AFSCs and the ever-evolving landscape of risks and vulnerabilities, organizations must continuously reassess their resilience strategies (Ivanov et al. 2015; Gunasekaran et al., 2011).

2.7 Categorizing Resilience Elements for AFSCs

Categorizing resilience elements in AFSCs is a valuable approach to discerning their roles and relevance within the supply chain:

Organizational Level: At the organizational level, resilience elements encompass risk-aware culture, redundancy, and early detection systems. These elements primarily pertain to internal strategies within an organization to navigate disruptions effectively (Paton et al. 2019).

Supply Chain Level: Resilience elements at the supply chain level include flexibility, agility, visibility, and adaptability. These elements are critical for managing disruptions that affect the entire supply chain (Adger, 2000).

Broad Elements and Specific Aspects: Resilience elements within Agri-Food Supply Chains (AFSCs) can be categorized into two main groups: those with a broad scope, such as a risk-aware culture and financial strength, and those that are more specific, targeting particular aspects of these broader elements. This categorization offers a more refined and detailed comprehension of their suitability and implementation.

By classifying these resilience elements, organizations gain the ability to customize their resilience strategies to address precise challenges and vulnerabilities effectively. Furthermore, it underscores the intricate relationship between these overarching and more detailed elements.

2.8 Challenges in Agri-Food Supply Chains

Globalization: The global expansion of food systems and the prevalence of major supermarket chains have heightened competitive pressures and placed stress on the margins of Agri-Food Supply Chains (AFSCs). This worldwide reach calls for a deep comprehension of the intricacies and interconnectedness that characterize contemporary food supply networks (Smith, Brown, & Wilson, 2013).

Temporal and Spatial Disparities: The various stages of the food supply chain, from production to consumption, are often widely dispersed in both time and space. These

temporal and spatial disparities mean that disruptions in one location or at one stage can have far-reaching and nonlinear effects on the entire supply chain (Stone & Rahimifard, 2018).

Climate-Related Disruptions: Recent examples of climate-related disruptions, such as extreme weather events in crucial agricultural regions, have significantly impacted food production. For instance, severe weather in Spain and Italy disrupted production by up to 60%, highlighting the vulnerability of AFSCs to climate-related challenges (Chapin, & Rockström, 2010).

These challenges underscore the need for proactive resilience-building strategies within agri-food supply chains to ensure the consistent and reliable delivery of food supplies to consumers.

2.9 Phase-Based Tactics and Alignment with the Adaptation Cycle

Resilience within AFSCs is not a one-size-fits-all approach but requires phase-based tactics aligned with the continuous adaptive cycle. Recognizing the correspondence between the four phases of disruption and the four stages of the adaptation cycle is vital:

- **Readiness:** Readiness encompasses an organization's capacity to foresee disruption and either prepare for it or avoid it. It aligns with the first phase of the adaptation cycle, which is exploitation (Stone & Rahimifard, 2018).
- **Response:** Response describes intrinsic or foreseen components that mitigate the effects of a disruption as it occurs. It aligns with the second phase of the adaptation cycle, conservation (Stone & Rahimifard, 2018).
- **Recovery:** Recovery involves the process through which an organization can make up for losses caused by a disruption and resume its primary objectives. It corresponds to the third phase of the adaptation cycle (Stone & Rahimifard, 2018).
- **Growth:** Growth signifies the adaptation of key priorities following disruption. It aligns with the fourth phase of the adaptation cycle, reorganization (Stone & Rahimifard, 2018).

Integrating resilience into all activities and recognizing its alignment with the adaptation cycle allows organizations to effectively navigate disruptions and foster long-term resilience within AFSCs. By understanding which resilience elements are most relevant in each phase, organizations can tailor their strategies accordingly.

2.10 Technology and Innovation

The role of technology and innovation is crucial in enhancing the resilience of Agri-Food Supply Chains (AFSCs). This section examines the use of technological breakthroughs in addressing difficulties and disruptions within AFSCs, specifically highlighting the applications of blockchain, Internet of Things (IoT), and Artificial Intelligence (AI). In addition, the presentation of case studies serves to illustrate the effective application of technology and innovation within AFSCs.

2.10.1 Blockchain for Supply Chain Traceability

The potential of blockchain technology to enhance transparency, traceability, and trust within agricultural and food supply chains (AFSCs) has garnered considerable attention. Technology facilitates the establishment of digital records that are resistant to tampering and unchangeable, documenting all transactions and the movement of commodities across the supply chain. Blockchain technology offers numerous advantages by facilitating a transparent and decentralised record of the supply chain.

- **Enhanced Traceability:** The utilization of blockchain technology enables stakeholders to effectively track and verify the source of items, spanning from their initial production to their final consumption. The skill holds significant value in situations involving foodborne illnesses or product recalls (Smith, Brown, & Wilson, 2013).
- **Reduced Counterfeiting:** The immutable nature of blockchain records makes it difficult for counterfeit products to enter the supply chain unnoticed, thus ensuring food authenticity (Stone & Rahimifard, 2018).
- **Improved Efficiency:** Smart contracts, a feature of blockchain, can automate certain supply chain processes, reducing paperwork and administrative overhead (Garcia & Martinez, 2016).

Case Study: Walmart has successfully integrated a system based on blockchain technology to monitor and trace the entire supply chain process of leafy greens (Sharma & Kumer, 2021). In a collaborative effort with IBM, the retail corporation employed blockchain technology to expediently ascertain the origin of contaminated romaine lettuce amid an outbreak of E. coli disease. The implementation of traceability measures facilitated Walmart in effectively removing the affected products from its retail shelves, hence mitigating potential health hazards.

2.10. 2 Real-time monitoring with IoT

Real-time visibility: IoT sensors can monitor temperature, humidity, and position. These sensors provide real-time product monitoring during transit and storage (Monteiro & Barata, 2021; Silva et al. 2023).

Predictive Maintenance: The utilization of Internet of Things (IoT) technology combined with predictive analytics has the capability to forecast potential equipment malfunctions. This proactive approach can effectively minimize periods of inactivity and guarantee the uninterrupted functionality of essential supply chain infrastructure (Srivastava & Dashora, 2022; Bigliardi et al. 2023).

Quality Control: The use of Internet of Things (IoT) data has the potential to facilitate the monitoring of perishable goods' quality, hence contributing to the assurance of products' compliance with safety and quality regulations (Ali et al. 2023; Stevens & Teal, 2023).

Case Study: As per the Journal of Scientific and Engineering Research (Tehrani & Ghofraniha, 2019), Maersk Line effectively utilizes Internet of Things (IoT) technology to monitor the environmental conditions of refrigerated containers during the transportation of perishable commodities. This technology provides real-time data on temperature, humidity, and container position, enabling proactive interventions to preserve the integrity of the products.

2.10.3 Artificial Intelligence (AI) for Predictive Analytics

Artificial Intelligence (AI) and machine learning algorithms are increasingly employed to analyze large datasets generated by AFSCs. AI-driven predictive analytics can help forecast disruptions, optimize supply chain operations, and improve decision-making:

Demand Forecasting: AI can analyze historical data, market trends, and external factors (e.g., weather) to improve demand forecasting accuracy (Skalkos, 2022).

Supply Chain Optimization: AI algorithms can optimize routing, inventory management, and order fulfillment to enhance supply chain efficiency and reduce costs (Monteiro & Barata, 2021).

Risk Assessment: AI can identify potential risks and vulnerabilities within the supply chain, enabling proactive risk mitigation strategies (Ali et al. 2023).

Case Study: The application of IBM Watson in the agricultural sector involves the utilization of the Watson Decision Platform for Agriculture, which leverages artificial intelligence (AI) to examine and interpret data derived from diverse sources such as weather predictions, soil characteristics, and crop-related information (Vijayanand, 2018). Farmers may gain information and recommendations to improve planting, irrigation, and harvesting. This increases agricultural production and resistance to environmental changes. These technological advancements can boost resilience by providing real-time information, improving traceability, and optimizing operations in Agri-Food Supply Chains (AFSCs).

Nevertheless, to achieve widespread adoption within the agriculture and food supply chain industry, it is imperative to tackle various problems like data privacy, interoperability, and the initial expenses associated with deployment. These technologies serve as prime examples of how AFSCs are always evolving to address and adapt to current challenges and disruptions.

2.11 Capacity Building and Knowledge Transfer

Capacity building initiatives and knowledge transfer programs play a crucial role in enhancing the resilience of Agri-Food Supply Chains (AFSCs), especially in developing nations. These programs provide stakeholders in the supply chain with the required skills, information, and resources to successfully respond to disruptions, improve sustainability, and adjust to evolving circumstances. This section examines the significance of capacity building and knowledge transfer in relation to the resilience of the AFSC. It delves into

their respective contributions to enhancing the organization's ability to withstand and adapt to challenges.

2.11.1 Importance of Capacity Building and Knowledge Transfer

- **Enhanced Preparedness:** Capacity building is a process that empowers many stakeholders with the necessary skills and knowledge to effectively evaluate potential risks, anticipate potential disruptions, and develop proactive strategies. By means of training and education, both individuals and organizations enhance their readiness to effectively address unexpected difficulties (Skalkos, 2022; Monteiro & Barata, 2021).
- **Improved Decision-Making:** Knowledge transfer programs facilitate the acquisition of useful information, data, and best practices. The ability to make informed decisions is of utmost importance in times of disruptions, and personnel who have received comprehensive training are more inclined to make sound decisions that contribute to the resilience of supply chains (Mehmood et al. 2021).
- **Resource Optimization:** Capacity building efforts aim to enhance the effectiveness of resource allocation and utilization. This encompasses the enhancement of logistical operations, waste reduction measures, and the establishment of appropriate protocols for the handling of agricultural goods across the entirety of the supply chain (Taşkıner & Bilgen, 2021).
- **Adaptation to Technology:** In an era of rapid technological advancement, capacity building facilitates the ability of stakeholders to successfully utilize digital tools and technology. Enhanced supply chain management can be achieved through the utilization of data analytics, Internet of Things (IoT) devices, and blockchain technology (Srivastava & Dashora, 2022).
- **Empowerment of Vulnerable Groups:** Knowledge transfer programs have the potential to enhance the agency and resilience of marginalized and disadvantaged populations, including smallholder farmers and women engaged in agricultural activities. These programs aim to provide these individuals with the necessary skills and knowledge to actively engage in the supply chain, thus enabling them to enhance their livelihoods (Kundzewicz et al. 2019).

2.11.2 Training, education, and knowledge sharing

Formal Education: University and vocational school degrees and certificates teach supply chain management, agribusiness, and food safety.

In agricultural and food processing, on-the-job training and apprenticeships provide significant practical skills and experience.

Workshops and seminars: These events allow stakeholders to network and learn about trends, technology, and best practices.

Extension Services: Government and non-governmental organizations offer agricultural guidance, training, and technical assistance to farmers, helping them adopt sustainable and resilient agricultural techniques.

Case Study: Farmer Field Schools in Asia: The implementation of Farmer Field Schools (FFS) as a knowledge transfer strategy has been extensively adopted across Asia. Farm Field Schools (FFS) aim to offer farmers valuable opportunities for experiential learning in agricultural settings. The subjects addressed encompass integrated pest management, crop diversification, and sustainable agricultural practices. Faecal fertiliser systems (FFS) have been associated with notable enhancements in crop productivity, less reliance on pesticides, and enhanced food security among small-scale agricultural practitioners. (Mbah & Amechi, 2008)

In summary, the implementation of capacity building and knowledge transfer initiatives plays a crucial role in enhancing the resilience of agricultural and food security systems, with a emphasis on nations in the process of development. These efforts provide stakeholders with the necessary skills and information to effectively navigate disruptions, make well-informed decisions, and embrace sustainable practices. In light of the dynamic problems encountered by AFSCs, the imperative to allocate resources towards enhancing capacity and facilitating knowledge transfer becomes progressively paramount in the aim of establishing a food supply chain that is both resilient and sustainable.

2.1.2 Public-Private Partnerships

PPPs enhance Agri-Food Supply Chains. Government, commercial enterprises, and organizations collaborate to enhance supply chain resilience and sustainability. PPPs have numerous functions:

Resource Mobilization: By combining resources from the public and private sectors, PPPs enable investments in infrastructure, technology, and research for AFSC resilience.

Risk Sharing: These partnerships distribute the responsibility for mitigating disruptions across various stakeholders, including governments, businesses, and non-profits.

Knowledge Transfer: PPPs facilitate the sharing of knowledge and innovative solutions, helping supply chain actors adapt to changing conditions effectively.

Policy Alignment: Collaborations with government agencies help align regulations with resilience objectives, promoting sustainable practices.

Capacity Building: PPPs often include training and knowledge transfer initiatives to enhance the capabilities of supply chain actors.

2.12.2 Examples of Successful PPP Initiatives

East Africa - Market Access Upgrade Program (MARKUP): MARKUP is a PPP initiative aimed at enhancing market access for smallholder farmers in East Africa. It brings together the East African Community, national governments, development partners,

and private sector organizations. Through infrastructure development, capacity building, and trade facilitation, MARKUP has improved farmers' access to regional and international markets, increasing their incomes and food security (East African Community, 2021).

United States - Produce Traceability Initiative (PTI): PTI is a collaboration between the U.S. government, major retailers, and produce companies. It focuses on traceability in the fresh produce supply chain to enhance food safety and trace back contaminated products more efficiently. PTI's standardized labeling and tracking system have bolstered the resilience of the U.S. fresh produce sector by improving response times during recalls and crises (Produce Marketing Association, 2021).

India - National Dairy Plan (NDP): The NDP is a PPP initiative between the Indian government, National Dairy Development Board, and World Bank. It focuses on modernizing the Indian dairy sector to improve milk production and dairy farmers' livelihoods. Through infrastructure development, breed improvement programs, and knowledge transfer, the NDP has increased the resilience of India's dairy supply chain and ensured a more consistent and quality milk supply (National Dairy Development Board, 2021).

Organization: African Union-CAADP Pan-African Comprehensive Africa Agriculture Development Programme (CAADP) promotes collaboration between African countries, regional economic bodies, and development partners. This effort aims to boost African agricultural output, food security, and resilience.

The multi-stakeholder strategy employed by CAADP has resulted in enhanced agricultural investment, policy alignment, and infrastructure development, hence bolstering the resilience of African Agricultural and Food Security Corridors (African Union, 2021).

In summary, Public-Private Partnerships play a crucial role in boosting the resilience of Agri-Food Supply Chains. These alliances effectively utilise the capabilities of governmental entities, commercial enterprises, and non-governmental organisations to tackle supply chain obstacles, distribute risks, and enhance the overall sustainability and food security of various areas and countries. Public-private partnerships (PPPs) play a crucial role in enhancing the resilience and flexibility of Agri-Food Supply Chains (AFSCs) by promoting collaboration and aligning shared objectives.

2.13 Ecological Sustainability

Agri-Food Supply Chains (AFSCs) are crucial to environmental protection and sustainable agriculture. This section examines the interplay between AFSCs environmental conservation, and sustainable agricultural practices, emphasizing their collective role in fostering resilience and preserving the natural environment.

2.13.1 Role of AFSCs in Environmental Conservation

- **Biodiversity Preservation:** The impact of AFSCs on biodiversity can be either detrimental or beneficial. The implementation of sustainable practices in supply chains, such as the reduction of monoculture farming, the preservation of natural habitats, and the minimization of pesticide use, contributes to the safeguarding of biodiversity. The preservation of this dialogue is of utmost importance for the development of robust ecosystems that possess the ability to adjust and thrive in response to fluctuating circumstances (Joshi, Singh, & Sharma, 2020)
- **Resource Efficiency:** Sustainable AFSCs reduce waste, energy, and water use. These methods lessen agriculture's environmental impact and save essential resources.
- **Climate Mitigation:** Agri-Food Supply Chains (AFSCs) are subject to the influence of climate change and also play a role in its occurrence. The implementation of sustainable practises, such as the reduction of greenhouse gas emissions in agricultural activities, the absorption of carbon in soils through the practice of agroforestry, and the use of renewable energy sources in supply chain operations, has the potential to effectively mitigate the negative consequences caused by these activities.

2.13.1 Sustainable Farming Methods and Their Benefits

Sustainable agricultural practices strengthen Agri-Food Supply Chains (AFSCs):

- Organic farming improves biodiversity, soil health, and chemical discharge.
- Agroforestry: Uses trees, conserves water, and generates cash.
- Crop Rotation and Diversification: Improves soil quality, reduces pest risks, and adapts to changing climates.
- No-Till Farming: Preserves soil moisture, reduces erosion, and sequesters carbon.
- Precision Agriculture: Optimizes resource use through technology, reducing waste and enhancing sustainability.

Incorporating these practices into AFSCs fosters environmental conservation, reduces vulnerability to shocks, and aligns with broader sustainability goals. These efforts safeguard vital resources for long-term food production and balance economic, environmental, and social aspects of food systems.

2.14 Waste Reduction, Circular Economy

Collaboration is key to waste reduction in agri-food supply chains, according to Aggarwal and Srivastava (2016). Indian agri-food supply chains benefit from stakeholder engagement to reduce inefficiencies and waste.

This collaborative approach allows for shared responsibilities and effective waste reduction initiatives.

Akkerman et al. (2010) underline the significance of addressing quality, safety, and sustainability within agri-food supply chains. Quality and safety are key to waste minimization. Ensure product quality and safety across the supply chain to decrease waste and improve sustainability. Minimizing waste helps the agri-food industry manage resources efficiently and sustainably.

In conclusion, building a circular economy and minimizing waste requires stakeholder engagement in agri-food supply chains and addressing quality, safety, and sustainability issues (Aggarwal & Srivastava, 2016; Akkerman et al., 2010). These tactics reduce waste, increase resource efficiency, and promote sustainability while ensuring product quality and safety.

2.15.2 Sustainability and Resilience Benefits

The adoption of circular economy principles in agri-food supply chains offers multifaceted benefits that significantly contribute to enhancing resilience and sustainability. A detailed analysis of the available references sheds light on these advantages:

Resilience through Collaboration: Aggarwal and Srivastava (2016) underscore the significance of cooperation within agri-food supply chains. They stress that collaborative strategies provide a solid understanding of how supply chains operate. By encouraging alliances and cooperative associations among different participants, agri-food supply chains can efficiently address difficulties and interruptions. This collaborative methodology contributes to the development of resilience by improving the capacity to adjust to unforeseen situations and upheavals. It establishes a network of assistance and assets that can be pivotal during supply chain interruptions, including extreme weather events, political uncertainties, or economic jolts.

Sustainability through Waste Reduction: Akkerman, Farahani, and Grunow (2010) emphasize the importance of quality, safety, and sustainability in food distribution within agri-food supply chains. They contend that a fundamental component of sustainability involves the reduction of waste, a principle central to circular economy practices. Recycling, reuse, and trash reduction may significantly reduce supply chain environmental effect. This improves the environment and encourages resource conservation.

The combined effect of resilience-building through collaboration and sustainability achieved by waste reduction illustrates the comprehensive advantages of incorporating circular economy principles in agri-food supply chains. These techniques maintain operations continuity in the face of unexpected problems and correspond with sustainable development goals by lowering supply chain environmental impact. This dual strategy is essential for agri-food supply chains to survive in a changing world.

2.16 Policy and Regulatory Frameworks:

Agri-Food Supply Chain resilience depends on government policies and regulations. We'll explain how these policies encourage or require resilience-building in this section. Case

studies of countries or regions with effective AFSC resilience policies will also be highlighted.

2.16.1 Role of Government Policies and Regulatory Frameworks

- **Incentivizing Resilience:** Government policies can provide incentives for AFSCs to adopt resilient practices. These incentives may include financial support, tax benefits, or subsidies for investments in technology, infrastructure, and training to enhance resilience (FAO, 2020).
- **Mandating Resilience Measures:** Regulatory frameworks can mandate specific resilience measures. For example, governments can require AFSCs to have disaster preparedness plans, diversify supply sources, or implement traceability systems to ensure food safety and continuity during disruptions (FAO, 2020).
- **Research and Development Funding:** Government funding for research and development in agriculture and food systems can lead to innovations that enhance AFSC resilience. Support for crop breeding, pest control, and sustainable farming practices contributes to long-term resilience (OECD, 2021).

2.16.2 Case Studies of Effective Policies

- **Singapore's 30x30 Strategy:** Singapore, a city-state with limited agricultural land, has implemented the "30x30" strategy. This policy aims to produce 30% of the country's nutritional needs locally by 2030. It includes incentives for high-tech urban farming and research on alternative protein sources, ensuring resilience to food supply disruptions (Singapore Food Agency, 2021).
- **European Union's Common Agricultural Policy (CAP):** CAP is a comprehensive policy framework that supports European farmers and agri-food producers. It encourages resource efficiency, sustainable farming, and market stability. CAP encourages resilience through financial support and incentives for eco-schemes (European Commission, 2021).
- **United States' Food Safety Modernization Act (FSMA):** The FSMA (Food Safety Modernization Act) stands as a regulatory framework dedicated to the prevention of food safety concerns. It enforces preventive controls, risk evaluations, and traceability protocols for those involved in food production and processing. The primary objective of FSMA is to bolster resilience by diminishing the chances of foodborne disease outbreaks and interruptions within the supply chain, as outlined by the FDA in 2021.
- **Kenya's National Climate Change Action Plan:** Kenya's agricultural plan takes a proactive stance on the challenges presented by climate change. It encourages drought-resistant agricultural types and agroforestry. The initiative also emphasizes equipping farmers with climate-adaptive skills and knowledge. (Government of Kenya, 2021).
- **Australia's National Food Plan:** Australia's policy is dedicated to the development of a robust and sustainable food supply system. This comprehensive approach encompasses various initiatives aimed at bolstering food security, promoting innovation in agriculture, and fortifying the infrastructure of the supply

chain. The central theme that resonates throughout the plan is the significance of resilience in safeguarding the consistent availability of food. (Australian Government, 2012).

2.16.3 Challenges and Considerations

While government policies and regulatory frameworks are essential for enhancing AFSC resilience, several challenges and considerations must be addressed:

- **Balancing Regulation:** Achieving equilibrium between the enforcement of resilience measures and the reduction of regulatory encumbrances on enterprises is of paramount importance to secure both compliance and efficacy.
- **Adaptability:** Policies should be adaptable to changing circumstances and emerging threats, such as climate change, to remain effective in the long term.
- **Resource Allocation:** Governments must allocate sufficient resources for enforcement, monitoring, and support to ensure policy effectiveness.
- **Global Coordination:** As AFSCs are often interconnected globally, coordination between countries is necessary to address international challenges and disruptions effectively.

Government policies and regulations shape AFSC resiliency. Effective policies may encourage and mandate resilience-building, improve food security and sustainability. Case studies show that context-specific interventions are needed to improve AFSC resilience in different countries and regions.

In conclusion, this comprehensive literature review has provided a solid foundation for addressing the pivotal research question (RQ1): "To what extent does the empirical evidence support the applicability and efficacy of the resilience model in agri-food supply chains, considering developing countries?" Throughout this review, we have delved deep into the multifaceted landscape of resilience within agri-food supply chains, particularly emphasizing its relevance in the context of developing nations.

In a nutshell, our exploration encompassed defining resilience, sustainability, and robustness in Agri-Food Supply Chains (AFSCs) and elucidating the concept of adaptive resilience. We discussed challenges in the conservation phase, factors influencing AFSC resilience, a comprehensive framework of resilience elements, and the role of technology, innovation, capacity building, public-private partnerships, ecological sustainability, social ethics, and circular economy practices. We also examined policy and regulatory frameworks. This review serves as a robust platform for future research to enhance food supply chain resilience, contributing to secure, sustainable, and resilient food systems globally.

3 Methodology

3.1 Research Design

This research study has adopted a qualitative research approach to craft an Agricultural and Food Supply Chain (AFSC) Resilience Framework tailored specifically to the distinct context of a developing country. The selection of a qualitative research methodology has been a deliberate and strategic choice, driven by its unique capability to unravel intricate phenomena and explore the nuanced complexities of multifaceted issues (Creswell & Creswell, 2018). This approach has proven to be particularly well-suited for our exploration of supply chain resilience within the intricate landscape of agro-based food companies operating in the challenging environments of developing countries.

The decision to embrace qualitative research is underpinned by our profound understanding of its suitability for dissecting the intricate dynamics that characterize agricultural and food supply chains in developing nations. Given the context-sensitive nature of supply chain resilience and the multitude of multifaceted influencing factors at play, qualitative research offers the requisite flexibility to unearth critical elements and innovative strategies that are inherently unique to this environment. This approach has been indispensable for our endeavor to conduct an in-depth exploration of the subject matter and gain a comprehensive understanding of the intricate complexities associated with supply chain resilience in the context of developing countries.

The application of qualitative research methods in this study has been meticulously executed with the aim of capturing a wide array of insights and experiences from agro-food company owners. This methodological approach has played a pivotal role in shaping the development of an AFSC Resilience Framework that seamlessly aligns with the specific and unique requirements of the developing country that is the focal point of our investigation. It has allowed us to remain adaptable and responsive to emerging themes and unexpected revelations, ultimately resulting in the formulation of a robust and contextually relevant framework.

Our primary research method has revolved around the purposeful conduct of semi-structured interviews with agro-food company owners/managers who have been carefully selected for their expertise in supply chain management within the developing country (Kallio, Pietilä, Johnson, & Kangasniemi, 2016). The adoption of semi-structured interviews as our primary data collection instrument is grounded in its effectiveness in providing participants with the platform to openly share their wealth of knowledge, personal experiences, and nuanced perspectives on supply chain resilience. These interviews have effectively created a space for participants to articulate their understandings, insights, and reflections, thereby making a substantial contribution to the process of framework development.

In conjunction with these interviews, a methodical examination of a diverse range of relevant documents and materials has been undertaken. This comprehensive document review process has served to complement the insights derived from the interviews and has

played a vital role in providing a holistic view of the contemporary practices within the agricultural and food supply chain sector of the selected developing country. This multifaceted approach, which harmoniously combines interviews with document analysis, has been instrumental in ensuring the collection of a broad spectrum of information. It has, in turn, facilitated a holistic understanding of the state of supply chain resilience and the specific factors that exert influence within our chosen context.

To interpret the data collected, we have employed a robust thematic analysis approach. Thematic analysis, a recognized methodology, offers the capacity to systematically identify and explore recurring patterns, themes, and critical insights within the collected data (Braun & Clarke, 2019). This methodological rigor ensures that the data undergoes a thorough examination with the specific objective of extracting key themes that will serve as the building blocks contributing directly to the development of the AFSC Resilience Framework.

In summary, this study, with its qualitative research design and thematic analysis approach, not only aligns with the goal of crafting an effective and well-considered AFSC Resilience Framework but also underscores its commitment to the principle of achieving comprehensive insights. By amplifying the voices and experiences of food company owners and meticulously analyzing pertinent documents, this research design is closely aligned with the overarching objective of providing profound, relevant, and actionable strategies. These strategies are meticulously tailored to effectively address the unique and intricate challenges faced by food companies in the realm of supply chain resilience within the specific context of a developing country.

3.2 Respondent

Our research has been greatly enriched by the inclusion of seven highly knowledgeable agro-food company supply chain Managers, meticulously chosen for their extensive expertise and their pivotal roles in managing complex food supply chains. What distinguishes our study is the active involvement of these industry experts, each hailing from one of the three carefully selected countries: Pakistan, Norway, and Bangladesh. These choices were deliberate, driven by the unique characteristics and relevance each country brings to our research.

From Pakistan, one company produces crackers, cream variants, plain and ingredient-based biscuits. Two others produce packaged spice mixes, primarily used in South Asian dishes. From Norway, one company is involved in effective distribution of products to the grocery, retail convenience goods and institutional catering sectors. Another one sells food, snacks, confectionery, biscuits, health, personal care, textiles, detergents and painting equipment. From Bangladesh, one company is leading food producing company offering healthy, nutritious and hygienic products that include Spices, Snacks, Cookies, Bread, beverage, Jam, Grocery etc. The other is a producer of core products: Sweet, Biscuits, Cookies, Bread, Curd, Yogurt, Cheese, etc.

Pakistan, with its predominantly agrarian economy, serves as an ideal representation of a developing country heavily dependent on agriculture. It offers valuable insights into the challenges and opportunities associated with agri-food supply chains in a nation where farming is a primary occupation and a significant contributor to the economy.

In contrast, Norway, despite having minimal agricultural land (approximately 3% of its territory), stands as the world's largest producer of salmon. This provides a compelling case for examining supply chain dynamics in a developed country that relies heavily on aquaculture and innovative farming techniques in the agro-food sector.

Lastly, Bangladesh, with its unique socio-economic landscape and position as one of the world's most densely populated countries, adds an intriguing dimension to our research. It offers insights into how agri-food supply chains operate in a developing country facing challenges related to land scarcity, population density, and climate variability.

The active participation of these agro-food company owners from Pakistan, Norway, and Bangladesh ensures that the information gathered is not only profoundly relevant but also exceptionally diverse, encompassing a spectrum of global contexts and supply chain scenarios.

3.3 Data Collection

3.3.1 Semi-Structured Interviews:

To achieve a comprehensive understanding of supply chain resilience within the agricultural and food sectors of our selected developing country, we will employ semi-structured interviews as our primary data collection method (Creswell & Creswell, 2018). Each agro-food company owner, selected for their unique expertise and experience, will participate in individual interviews aimed at delving deep into their day-to-day practices, experiences, and personal insights regarding supply chain resilience (Scholten & Schilder, 2015). This qualitative approach is particularly suited for uncovering the multifaceted nature of the challenges and opportunities these agro based food companies encounter in their supply chain operations. Through open-ended dialogues with the participants, we intend to gather rich, context-specific information that goes beyond mere surface observations (Creswell & Creswell, 2018).

3.3.2 Document Review:

In conjunction with our interviews, we conducted a comprehensive examination of a variety of pertinent documents to augment the depth and breadth of our data collection. These documents encompassed a range of records, including exhaustive supply chain management reports and any pre-existing strategies and frameworks adopted by the participating food companies to reinforce their supply chain resilience (Qu & Dumay, 2011). This meticulous document review provided invaluable insights that complemented the information obtained from interviews and offered a detailed perspective into the existing strategies and processes within these companies.

Furthermore, we extensively delved into external sources of significance, which included academic research articles, industry reports, and case studies focused on supply chain resilience within the agricultural and food sector of developing countries. These external documents broadened our horizons, shedding light on best practices and emerging trends in the field of supply chain resilience (Rapley & Rees, 2018). These documents also served as a point of comparison, allowing us to contextualize the experiences and strategies of the participating food companies within the broader research landscape. This cross-referencing approach with existing research was aimed at ensuring the validity and reliability of our collected data (Zohrabi, 2013).

The amalgamation of semi-structured interviews and the review of external documents resulted in the creation of a comprehensive dataset that spanned a spectrum of viewpoints and practices within the agricultural food sector. This combined approach was instrumental in ensuring that we captured the intricacies and subtleties of supply chain resilience. Moreover, it allowed us to account for the distinctive challenges and opportunities present within the developing country that was the focus of our study.

Throughout the data collection process, we remained steadfast in our commitment to upholding the reliability and validity of our research, thereby underpinning the credibility and rigor of our findings. This entailed the meticulous application of robust interview techniques, systematic data management practices, and a thorough scrutiny of the gathered documents, all of which contributed to the overall reliability of our data (Creswell & Creswell, 2018). Furthermore, the validation of our findings through participant feedback and their alignment with external sources further fortified the overall validity of our research. These considerations collectively enhanced the robustness of our approach and its ability to yield valuable insights into the development of the AFSC Resilience Framework.

3.4 Data Analysis

The data we collected from our semi-structured interviews and document review went through a methodical and systematic thematic analysis, a respected approach renowned for uncovering the nuanced narratives and patterns that qualitative data often holds (Braun & Clarke, 2006). This analytical process consisted of several comprehensive steps, each executed with precision and scrupulous attention to detail.

3.4.1 Data Transcription

As we embarked on our data analysis process, we approached the task of transcribing the interviews with a rigorous commitment to precision. This transcription process assumed a pivotal role, not only in ensuring the utmost accuracy and authenticity of our data but also in paying due reverence to the intricate narratives woven by our participants, adhering to a foundational tenet of qualitative research (Nowell et al., 2017). Through transcription, we diligently preserved the exact words and expressions articulated by our participants, affording us the opportunity to delve into their responses with profound depth and nuanced understanding.

Transcription, a widely recognized practice in qualitative research, provided us with a robust means to unveil the subtle intricacies interwoven within the participants' narratives (Kowal & O'Connell, 2014). It served as a steadfast platform for systematic coding and data analysis by safeguarding an unadulterated record of the participants' perspectives and experiences. Thus, this transcription step not only upheld the unwavering integrity of our collected data but also laid a sturdy foundation for the subsequent phases of our data analysis, encompassing coding and thematic development.

3.4.2 Data Familiarization

Following transcription, we engaged in a thorough immersion within the data through repeated readings. This phase, aimed at achieving familiarity with the content, was of paramount significance, providing the researcher with a nuanced understanding of the material, its contextual backdrop, and the uniqueness of each participant's responses (Braun & Clarke, 2019).

The practice of conducting multiple readings of the transcribed interviews is a well-established tradition in qualitative research, serving as a means to uncover deeper insights from the data (Nowell et al. 2017). These successive readings lay the foundation for subsequent data analysis steps, ensuring an intimate knowledge of the collected information (Creswell & Creswell, 2018). This level of familiarity is essential for identifying the patterns and themes that emerge from the data, which is intrinsic to the thematic analysis approach employed in this study.

Through dedicated investment in this familiarity phase, the researcher was well-prepared to discern and interpret the emerging themes, thus facilitating the development of a comprehensive AFSC Resilience Framework.

3.4.3 Initial Coding

Following this, the data went through a systematic coding process, an integral element of thematic analysis. In this phase, the researcher systematically pinpointed and labeled sections of text that carried recurring themes, concepts, or patterns (Nowell et al. 2017). Coding entailed a meticulous procedure of breaking down the data into manageable units, which facilitated the identification of pertinent themes (Joffe, 2011).

The creation of codes encompassed a dual approach that amalgamated inductive and deductive methods. Inductive coding enabled the emergence of codes directly from the data, anchoring the analysis in the genuine experiences and narratives of the participants (Braun & Clarke, 2019). Conversely, deductive coding drew upon the existing body of knowledge in the realms of supply chain resilience and agricultural practices, aligning the findings with the broader theoretical framework.

This dual-coding approach enhanced the analysis by amalgamating the depth of the participants' perspectives with the well-established knowledge in the field. It paved the way for a comprehensive exploration of the data, guaranteeing that no valuable insights

were omitted during the development of the AFSC Resilience Framework (Nowell et al. 2017).

3.4.4 Theme Development

Once a comprehensive set of codes had been meticulously generated, they were systematically arranged into higher-order themes. The construction of themes was an iterative undertaking in which the researcher discerned connections between codes and clustered them based on common attributes (Nowell et al. 2017). These themes encapsulated the core of the participants' experiences, practices, and viewpoints concerning supply chain resilience in the agricultural and food sector of the developing country.

The process of crafting themes not only streamlined the data but also furnished an insightful framework for comprehending the intricate nature of supply chain resilience within the scope of our study. This thematic analysis enabled us to unveil the underlying patterns and shared perspectives among the food company owners, contributing significantly to the subsequent formulation of the AFSC Resilience Framework (Braun & Clarke, 2019).

3.5 Data Interpretation

In the concluding phase of thematic analysis, the identified themes are examined within the context of developing the AFSC Resilience Framework. This interpretive step involves delving into the deeper meanings embedded within the themes and contemplating how they enrich the comprehensive comprehension of supply chain resilience (Braun & Clarke, 2019). By scrutinizing the connections and implications of these themes, we can construct a conceptual framework that not only mirrors the participants' experiences but also provides practical insights and recommendations for enhancing supply chain resilience in the agricultural and food sector of the developing country (Terry, 2016).

Thematic analysis not only unveils the intricate tapestry of data but also furnishes a structured approach for formulating the AFSC Resilience Framework. This ensures that our research findings remain firmly rooted in the perspectives and experiences of the participants while contributing to the broader understanding of supply chain resilience in the specific context of a developing country. The analytical process is iterative, allowing for the refinement of themes and their seamless integration into the framework.

By adhering to this comprehensive approach to data analysis, our study will maximize the depth and richness of the findings, ultimately leading to the creation of a valuable and insightful framework for enhancing agricultural and food supply chain resilience in the chosen developing country.

3.6 Framework Development

The development of the AFSC Resilience Framework is a meticulous and multi-faceted process that leverages the insights and findings derived from the semi-structured

interviews and document reviews. This framework is conceived as a comprehensive roadmap designed to enhance the resilience of agricultural and food supply chains within the context of our chosen developing country.

1. Data Integration: To commence the framework development process, the data obtained through semi-structured interviews and document reviews will be systematically integrated. This integration is a critical step to ensure that all pertinent information, ranging from the rich narratives of agro food company owners to the existing strategies and plans, is synthesized effectively (Creswell & Creswell, 2017). By merging these data sources, we create a comprehensive foundation that encapsulates the experiential and practical dimensions of supply chain resilience.

2. Identification of Key Themes: During the analysis phase, our thematic analysis brought to light recurring themes and essential concepts (Braun & Clarke, 2019). These themes play a pivotal role in understanding supply chain resilience, covering crucial dimensions like risk management, adaptability, and collaboration (Pettit et al. 2010). Think of these themes as the foundational elements that shape our framework, each one addressing a distinct facet of supply chain resilience within the unique context of the agricultural and food sector in our developing country.

3. Categorization and Structuring: After pinpointing the key themes, we classify them into various dimensions within our framework. These dimensions encompass critical aspects such as risk assessment, operational flexibility, and collaboration strategies, among others. The framework's structuring phase is all about arranging these dimensions in a coherent and logical manner. This design is carefully crafted to offer a comprehensive perspective on supply chain resilience. It not only presents a holistic view but also serves as a practical guide for food company owners, leading them through a systematic process to enhance their resilience.

4. Inclusion of Best Practices: An essential element of the AFSC Resilience Framework is the integration of best practices. These best practices draw from both our research findings and existing literature, as informed by Christopher and Peck (2004). They are designed to serve as tangible guidelines for food company owners. By aligning the real-life experiences of participants with these established best practices, the framework equips them with actionable strategies to enhance their supply chain resilience.

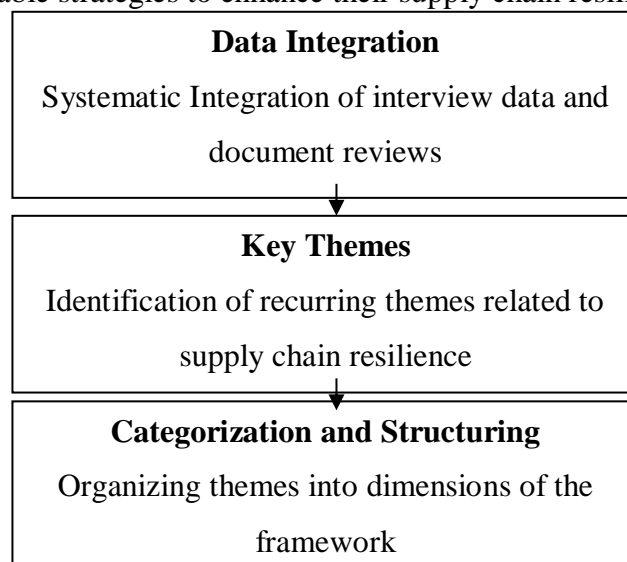




Figure 1 Research Framework

5. Risk Assessment and Mitigation Strategies: Within the framework, special attention was dedicated to risk assessment and mitigation strategies. These strategies are informed by the insights shared by participants regarding the challenges they face in the supply chain and the measures they have taken to overcome them (Ponomarov & Holcomb, 2009). Risk assessment tools and mitigation strategies were outlined, providing a proactive approach to managing vulnerabilities within the supply chain (Manuj & Mentzer, 2008).

6. Collaborative Approaches: Collaboration is a central theme in enhancing supply chain resilience (Scholten & Schilder, 2015). As such, the framework will emphasize collaborative approaches by suggesting methods for building strong partnerships with suppliers, customers, and other stakeholders. The experiences of food company owners will illuminate the significance of collaboration, and the framework will offer guidelines for fostering these collaborative relationships.

7. Implementation Strategies: Beyond providing a conceptual model, the AFSC Resilience Framework outlined practical steps for implementation. It addresses how food company owners can apply the framework in their operations, measure progress, and adapt it to their specific contexts. These implementation strategies will make the framework a dynamic tool rather than a static document (Ritchie & Brindley, 2007).

8. Continuous Improvement: Supply chain resilience is an evolving concept (Pettit et al., 2010). The framework therefore encouraged continuous improvement by emphasizing the importance of regular assessments, evaluations, and adjustments. This feature ensures that food companies remain adaptable in the face of changing circumstances.

In essence, the AFSC Resilience Framework represented a holistic and actionable guide that amalgamates the experiences of food company owners, best practices from existing

literature, and the strategic dimensions of enhancing supply chain resilience. By meticulously developing this framework, our research aims to not only advance the academic discourse surrounding supply chain resilience but, more importantly, to offer a practical tool that empowers food company owners in the agricultural and food sector of the chosen developing country.

Stakeholder Collaboration: The process of validation encompasses the collaboration with the very stakeholders who constitute the heart of this research – the food company owners. These experts, with their intricate knowledge of the agricultural and food supply chain in our chosen developing country, will be invited to partake in the validation process (Bryman, 2016). Their input is invaluable in ensuring the practical applicability and relevance of the framework to their operational context.

Feedback and Input: During the validation stage, participants presented with the draft version of the AFSC Resilience Framework. They had the opportunity to provide feedback, insights, and suggestions regarding the framework's content, structure, and usability (Bryman, 2016). Their feedback collected through structured discussions and interviews.

Incorporating Expert Opinions: The feedback received from the agro-food company owners meticulously analyzed and synthesized. Their expert opinions incorporated into the framework to address any gaps, refine existing strategies, and ensure that it aligns with their operational realities (Creswell & Creswell, 2018). This collaborative approach aims to transform the framework into a tailored tool that resonates with the daily challenges and aspirations of those working in the agricultural and food sector.

Iterative Process: The validation process is an iterative one. Multiple iterations may be required to fine-tune the framework according to the preferences and needs of the participants. The framework will evolve as it undergoes successive rounds of feedback and revision, ensuring that it becomes a practical, dynamic, and enduring resource for food company owners.

Ethical Considerations: Throughout the validation process, ethical considerations will be rigorously upheld. Informed consent will be obtained from all participants, reiterating the voluntary nature of their involvement (Creswell & Creswell, 2018). Their identities and specific organizational details will be treated with the utmost confidentiality to maintain privacy and security.

Ensuring Reliability and Validity: The engagement of participants in the validation process not only enriches the framework but also contributes to the reliability and validity of the research findings. By incorporating the perspectives of stakeholders, we ensure that the framework addresses real-world challenges and offers practical solutions, thereby enhancing its utility (Bryman, 2016).

In conclusion, the validation phase is an integral component of our research methodology. It epitomizes our commitment to collaborative research and ensures that the AFSC

Resilience Framework is a co-creation with the individuals for whom it is intended. This dynamic process aims to produce a resilient framework for enhancing agricultural and food supply chains in the developing country that is both academically rigorous and practically impactful.

3.6 Limitations

While our research endeavors to provide valuable insights into enhancing supply chain resilience in the agricultural and food sector of the developing country, it is crucial to acknowledge certain limitations that may influence the generalizability and comprehensiveness of our findings. These limitations should be considered in the interpretation of our research outcomes.

Sample Size: A notable limitation of our study is the relatively small sample size, consisting of six food company owners. While this sample is carefully selected to ensure the inclusion of experienced and knowledgeable participants, it remains a modest representation of the food industry in the chosen developing country. The limited number of participants might restrict the extent to which our findings can be generalized to a broader context (Creswell & Creswell, 2018).

Focus on Agro- Food Company Owners: Our study primarily focuses on capturing the perspectives and experiences of food company owners, who play a pivotal role in the agricultural and food supply chain. However, it is essential to recognize that the supply chain's resilience is a complex ecosystem influenced by various stakeholders, including suppliers, distributors, retailers, and consumers. By concentrating on food company owners, we may not encompass the entire spectrum of factors and dynamics that influence supply chain resilience.

Contextual Specificity: The research is conducted in the context of a specific developing country, and the findings and the AFSC Resilience Framework developed may be influenced by the unique characteristics and challenges of that region. The framework's applicability to other developing countries may require adjustments to address the contextual variations that exist in different geographic and economic settings (Creswell & Creswell, 2018).

Temporal Constraints: The study is conducted over a defined period, and supply chain resilience is subject to evolving external conditions and challenges. The research findings capture a specific moment in time and may not account for changes or emerging issues that occur after the study's completion (Bryman, 2006).

External Factors: The external environment, including economic, political, and environmental factors, can significantly impact supply chain resilience. These external factors are beyond the scope of this research but should be considered in the broader context of supply chain management (Creswell & Creswell, 2018).

Resource Limitations: Our research is conducted with the available resources and within the confines of the defined scope. Additional resources and a more extensive research

scope could provide a more comprehensive understanding of supply chain resilience (Bryman, 2006).

Despite these limitations, our research aims to provide a valuable contribution to the enhancement of supply chain resilience within the agricultural and food sectors of the developing country. Recognizing these constraints helps to frame the applicability and relevance of our findings and the AFSC Resilience Framework within the defined context and scope of this study.

4 Analysis

4.1 Introduction

Effective supply chain management is integral to the seamless operation of businesses. This multifaceted discipline encompasses activities ranging from raw material procurement to manufacturing and the efficient delivery of finished products. Within a dynamic business landscape, supply chains confront uncertainties and disruptions, from natural disasters to market fluctuations.

To gain insights into strategies employed by companies in addressing these challenges, seven interviews were conducted with Agri-food sector supply chain professionals. Thematic analysis of the feedback sought to understand risk assessment, disruption mitigation, and recovery strategies.

These interviews facilitated the sharing of expert insights. Findings underscore the potential of such insights to aid businesses in navigating the complexities of supply chain operations and ensure uninterrupted service to consumers.

1. Sourcing and Suppliers

One of the prominent themes that surfaced in our interviews was the vital role of sourcing raw materials and inputs (Aigbogun et al., 2014). Our discussions with supply chain professionals unveiled that companies in the Agri-food industry draw their raw materials from a diverse pool of suppliers, some of which are situated internationally (Kleindorfer & Saad, 2005).

"We maintain a diverse supplier network, sourcing raw materials and inputs both locally and globally. Our major ingredients are primarily obtained from national-level suppliers, but for specific raw materials unavailable in India, we source them globally," shared one interviewee.

Another participant added, "We have a well-established network of suppliers for sourcing our raw materials and inputs. Most of our major ingredients are obtained from national-level suppliers. However, for specific raw materials that are not readily available in our local market, we have a select group of global suppliers."

A different perspective was provided by another interviewee, stating, "We have a distributed supplier side. With a lot of suppliers for raw material and up to packaging. For major ingredients, we have suppliers on the national level. But for some raw materials, we have suppliers globally because these materials are not available in Pakistan."

While certain firms prefer to maintain a broad base of suppliers (Christopher & Peck, 2004), others have ventured into international markets to expand their sourcing options. It became evident that the ability to swiftly transition between suppliers during disruptions varies among companies, with some executing this process effortlessly, while others encounter substantial challenges (Monteiro & Barata, 2021).

In the context of the Agricultural and Food Supply Chain (AFSC), the sourcing of raw materials emerges as a critical component of overall operations (Aigbogun et al. 2014). Our interviews shed light on the fact that AFSC companies rely on a mix of both local and international suppliers to ensure a consistent flow of raw materials (Kleindorfer & Saad, 2005).

Distribution Channels

Distribution channels are a pivotal element within supply chain management, significantly impacting the agricultural and food supply chain (AFSC) (Stone & Rahimifard, 2018). Interviews conducted in the AFSC reveal a combination of distribution channels utilized by companies to ensure efficient product delivery, encompassing traditional distributors, online stores, and partnerships with other businesses (Zhao, 2021). The selection of these channels profoundly influences supply chain effectiveness and resilience.

Table 1 Distribution Channels

Question	International (%)	Local (%)	Both (%)
What are your distribution channels? (Geographic Scope)	1 (14%)	2 (29%)	4 (57%)

This table shows that:

- 57% of companies reported having both international and local distribution channels.
- 29% had only local distribution.
- 14% were only international.

"Because selling is very diversified now, we should have multiple channels. We usually have a conventional mode of trade, which is distributor wholesaler and then retailer. Now we have modern distribution, and every channel has its own market share growing such as direct sales to stores and e-commerce platforms, so we are using all of them. We have both international and local markets, but the international market is small," shared one interviewee.

Another participant highlighted, "Online stores, distributors, partnerships."

An alternate viewpoint was presented by another interviewee, expressing "It's the traditional structure with retailers and distributors. Another channel is business to business. We have online too but it's too small."

In the AFSC, companies employ diverse distribution strategies. Some opt to expand their distribution reach by targeting international markets, thereby accessing new consumer bases (Zhao et al., 2022). This international expansion offers growth prospects,

diversification, and a potential reduction in reliance on local markets, enhancing supply chain resilience and mitigating regional vulnerabilities (Stone & Rahimifard, 2018).

Conversely, not all AFSC companies pursue international expansion (Zhao et al., 2023). Some continue to prioritize local distribution channels, emphasizing proximity and fostering relationships with local partners, thereby focusing on reliability and a well-established local network of distributors (Zhao et al. 2022).

The choice of distribution channels in the AFSC intimately relates to risk management and supply chain resilience. An analysis of the literature suggests that companies diversifying their distribution channels are better equipped to adapt to unforeseen crises and disruptions (Zhao et al. 2023). Multiple distribution avenues allow for a shift towards more resilient channels when local options face compromise.

In summary, distribution channels are a fundamental pillar of supply chain management in the AFSC. The selection of distribution strategies, whether local or international, plays a pivotal role in determining supply chain resilience and adaptability in response to unexpected events and market dynamics. These findings underscore the significance of distribution channels in the AFSC and emphasize the need for a well-balanced mix of traditional and modern approaches to enhance overall supply chain performance and resilience.

3. Substitutes and Alternatives

In the agricultural and food supply chain (AFSC), the use of substitute products and alternative distribution channels stands out as a crucial factor influencing supply chain resilience and adaptability (Zhao et al. 2023).

Table 2 Substitutes and Alternatives

Question	Yes (#)	Yes (%)	No (#)	No (%)
Do you have substitutes for your core products to offer?	3	43%	4	57%
Do you have alternative distribution channels?	4	57%	3	43%

This table shows that:

- 43% of the 7 respondents said they offer substitutes, while 57% said they do not.
- It also shows 57% have alternative distribution channels, while 43% do not.

Through an in-depth thematic analysis of interviews within the AFSC, it is evident that companies in this sector exhibit varying practices regarding access to substitute products and alternative distribution channels. "We have a range of substitute products available for our core offerings. Our customers often make spontaneous purchasing decisions in our product category, and they are not overly brand conscious. This buying behavior allows them to readily consider substitute products in case of unavailability." Some AFSC entities strategically incorporate substitute products within their portfolio, serving as a safety net to maintain customer loyalty, especially during unforeseen disruptions. The availability of

these substitutes ensures customers can continue accessing products with similar taste and quality, mitigating the impact of potential supply chain disruptions. This approach underscores a customer-centric ethos, emphasizing the paramount importance of preserving customer trust and satisfaction.

However, it is essential to recognize that not all AFSC companies offer substitute products as part of their offerings. This diversity underscores the unique characteristics or production methods associated with certain AFSC products. "Yes, in vegetable oils, there are substitutes. For example, if we don't have sunflowers, we take its substitute such as repsona. But for a short period of time." In such cases, the focus shifts toward reinforcing supply chain resilience through alternative means, including robust contingency plans, adaptive logistics, and diversification of distribution channels (Zhao et al. 2023).

The interviews also highlight the critical aspect of adaptability in modifying the mode and timing of deliveries, as presented by Zhao and colleagues (2023). This adaptability hinges on factors such as the company's product portfolio, available resources, and the characteristics of its customer base. Some companies report the ability to swiftly adjust delivery methods to ensure uninterrupted service to customers, a capability particularly crucial during unexpected crises.

In conclusion, the availability of substitute products and alternative distribution channels is integral to the complex landscape of supply chain resilience and adaptability within the AFSC. Companies are encouraged to assess their product portfolios thoroughly, considering the specific needs of their customer base to determine their capacity to provide substitutes and adapt their delivery methods. These findings underscore the critical importance of nurturing and upholding customer satisfaction and trust. Furthermore, they emphasize the need for agile supply chain strategies capable of swift responses to disruptions and the ever-evolving dynamics of the market.

4. Contracts and Financial Aspects

Contracts and financial considerations take center stage in supply chain management, emerging as a significant theme through interviews with agricultural and food supply chain (AFSC) companies.

Table 3 Contracts and Financial Aspects

Question	Yes	Yes (%)	No	No (%)
Do you have contract terms that you can delay the production in case of disruptions?	3	43%	4	57%
In case of cash shortage, how fast can you access liquid assets? (Easy Access)	6	86%	1	14%

This table shows that:

- 43% said they have contract provisions for production delays during disruptions, 57% said they do not.
- A majority, 86%, reported having easy access to liquid assets when cash shortages occur.

Table 4 – Contract Terms

Question	Credit Terms (%)	Advance Payment (%)	Combination (%)
What is the mode of transactions/contract terms?	3 (43%)	1 (14%)	3 (43%)

This table shows that:

- 43% use credit terms only; 14% use advance payments only
- 43% use a combination of both credit terms and advance payments.

In our discussions, a prevailing approach within the AFSC is the adoption of contract-based credit terms, as highlighted by one interviewee: "Advance payments or credit base, no cash deliveries in our field of business." These contractual agreements serve as the foundation for financial transactions, delineating the dynamics and responsibilities among diverse supply chain partners. Critical details within these contracts, including payment terms, quality standards, and delivery schedules, provide a structured framework for the operational rhythm of the supply chain.

Another noteworthy financial aspect discussed was the agility to defer production during disruptions. This adaptability in production scheduling, as mentioned by an interviewee, serves as a pivotal risk management strategy, providing companies with a competitive edge in maintaining uninterrupted operations during tumultuous times: "No, we usually don't have contract terms, but we always maintain some stock so that our production isn't stuck in disruptions."

The access to liquid assets during periods of financial constraint emerged as a crucial facet in our interviews: "Mostly it's on credit terms with both markets, but it is also transforming into advance payments and cash on deliveries with small distributors." Undeniably, cash flow constitutes the lifeblood of supply chain management, and the capability to tap into liquid assets becomes a pivotal determinant in a company's adept navigation through financial challenges. Establishing financial reserves to cushion unforeseen expenses or disruptions becomes an essential practice in maintaining stability and resilience.

Transaction modes, including credit terms and Incoterms, were highlighted as significant components within the financial domain of supply chain management: "Contract-based credit terms and Incoterms." Credit terms distinctly delineate the timing and conditions of payments within the supply chain, wielding a profound impact on the financial fluidity

among stakeholders. In contrast, Incoterms intricately specify the roles and risks assumed by buyers and sellers in international trade, influencing various financial and logistical facets of cross-border transactions.

In summation, contracts and financial considerations represent foundational elements within supply chain management in the AFSC. The interviews underscore the critical significance of well-structured contracts, the flexibility to adapt production timelines, access to liquid assets, and the deliberate selection of transaction modes. These financial strategies and practices become indispensable in navigating the intricacies and challenges inherently woven into the fabric of the agricultural and food supply chain.

5 Risk Management and Resilience

Risk management and resilience emerge as pivotal pillars in the realm of supply chain management within the agricultural and food supply chain (AFSC), drawing insights from a comprehensive series of interviews.

Binary response question related responses are presented below:

Table 5 Risk Management in Hiring

Question	Important (%)	Somewhat Important (%)	Not Important (%)
How do you weigh risk management skills when hiring for managerial positions?	6 (86%)	0 (0%)	1 (14%)

This table shows that:

- 86% said risk management skills are important for managerial hires
- 14% said not important.

Table 6 Joint Decision Making

Question	High Degree (%)	Moderate Degree (%)
What is the degree of joint decision making?	3 (43%)	4 (57%)

This table shows that:

- 43% have a high degree of joint decision making
- 57% have a moderate degree

The discussions emphasized the profound importance of having managers with astute risk management acumen: "Yes, but we have a plan for 1-4 months, not so much long-term

planning. In case of disruptions, we also go for short-term planning to mitigate. But up to 24 months is very difficult in our segment." Professionals' adept at identifying, assessing, and mitigating risks play a crucial role in shielding the supply chain from potential disruptions. These risk managers bear the formidable responsibility of crafting strategies that effectively navigate the labyrinth of uncertainties.

The interviews also shed light on the critical value attributed to the concept of business continuity plans: "For specific product segments, we maintain contract terms that allow us to delay production in response to disruptions, particularly if our customers encounter financial difficulties. These terms provide a degree of flexibility to adjust to changing circumstances." Business continuity plans, akin to a well-drawn roadmap, are indispensable for steering operations through turbulent waters, ensuring the continuity of business activities. Well-structured and regularly updated business continuity plans equip companies to navigate tumultuous periods and curtail the impact of disruptions on the supply chain.

Furthermore, the interviews resonated with the critical significance of co-learning, risk assessment, and the development of response strategies rooted in the annals of past disruptions: "Yes, but overall, generic documentation is present; it varies case to case. And collaboration is present on the top level. And their advisory goes down the line." Co-learning involves the collaborative exchange of knowledge and insights among partners within the supply chain, fostering a concerted and collective approach to risk management. The systematic appraisal of risks and the implementation of response strategies gleaned from prior experiences elevate the resilience of the supply chain.

In summation, risk management and resilience stand as indispensable cornerstones underpinning effective supply chain management within the AFSC. The strategic recruitment of skilled risk managers, the deployment of adaptable workforce strategies, the cultivation of robust business continuity plans, and the inculcation of a culture of co-learning and incessant improvement constitute key elements in cementing the resilience of the agricultural and food supply chain. These practices serve as a bulwark enabling companies to nimbly navigate disruptions and sustain the equilibrium of the supply chain, even in the throes of challenging circumstances.

6. Assets and Resource Management

Asset and resource management emerged as a central and indispensable theme within the purview of supply chain management in the agricultural and food supply chain (AFSC).

Table 7 Leadership Commitment

Question	Committed (%)	Somewhat Committed (%)	Not Committed (%)
How is your leadership committed to avoid unnecessary waste?	5 (71%)	1 (14%)	1 (14%)

This table shows that:

- 71% said leadership is fully committed to avoiding waste.
- 14% said somewhat committed.
- 14% said not committed.

During the interviews, the companies under scrutiny underscored the strategic significance of tangible assets, notably production plants and warehouses (Devaux et al., 2018). These assets constitute the linchpin of the supply chain, playing a pivotal role in guaranteeing the uninterrupted availability of products. To fortify and safeguard these critical assets, companies meticulously formulated and implemented contingency plans. These contingency plans represent a structured framework designed to shield and preserve these assets during periods of disruption, ultimately ensuring the unceasing functionality of production facilities and warehouses.

A striking facet observed in the company's operating within the AFSC was the cultivation of an open culture (Cohen & Roussel, 2013). This open culture, marked by the ethos of shared decision-making and knowledge exchange, emerged as fertile ground for collaboration and the dissemination of invaluable insights and experiences. Such a culture is paramount for mounting effective responses to risks and disruptions. It acts as a catalyst for employees to contribute their reservoir of insights and expertise, thereby fostering informed and adaptive decision-making.

In summation, the meticulous management of assets and resources assumes a pivotal role in the landscape of supply chain management within the AFSC. The surveyed companies not only recognize the gravity of safeguarding tangible assets through meticulously crafted contingency plans but also embrace a communication framework that ensures the seamless flow of information. Furthermore, the embrace of an open culture serves as a beacon guiding collaborative decision-making and the perpetual pursuit of knowledge. These ingrained practices bear the hallmark of indispensability in fortifying the resilience of the agricultural and food supply chain, bestowing upon it the capacity to endure disruptions with unwavering fortitude.

7. Market Position and Brand Loyalty

Market position and brand loyalty are pivotal factors in the agricultural and food supply chain (AFSC), as revealed in our interviews.

Companies disclosed a wide spectrum of market positions, with some enjoying strong brand loyalty, providing a competitive edge: "Our market position is strong, with a moderate level of brand loyalty." Customers tended to prefer their products over others, contributing to their competitive standing. Conversely, some companies faced tougher competition due to lower brand loyalty, highlighting the challenges in retaining customers.

The significance of maintaining strong relationships with suppliers and distributors emerged as a key strategy for supporting growth and market position in the AFSC. A participant emphasized this: "We have competition, but because we have been in the

market for a long time, it is strong." Collaborative relationships with partners are crucial for ensuring a smooth supply chain and reliable access to resources. These relationships enhance the overall resilience of the supply chain by improving coordination and responsiveness.

Additionally, insights from interviews include perspectives like: "The products are very common in the supermarkets, and they are performing. If you go to the market, you see branded products with our brand name are so many, so it's a strong market position." Moreover, in certain product categories, customers are not very brand conscious, and buying decisions are often spontaneous, allowing flexibility for substitute products in case of unavailability.

In summary, market position and brand loyalty are crucial determinants in the AFSC. They significantly impact a company's competitive standing, with varying levels of brand loyalty among companies. To promote growth and market stability, building strong relationships with suppliers and distributors is vital. These relationships play an instrumental role in ensuring a well-functioning supply chain, thereby contributing to the overall resilience and performance of the agricultural and food supply chain.

8. Information Sharing and Learning

The significance of information sharing and learning within the agricultural and food supply chain (AFSC) was underscored in our interviews.

Table 8 Information Sharing

Question	Share with Partners Only (%)	Share with Competitors Also (%)
Do you know about the customer trends and pass it to other actors?	2 (29%)	5 (71%)

This table shows that:

- 71% of companies stated they share customer trend information with both partners and competitors.
- 29% share only with partners.

Information sharing emerged as a cornerstone of efficient supply chain management in the AFSC. Companies in this sector utilize diverse channels to ensure the seamless flow of information across the supply chain. As one participant highlighted, "Strong. We use all channels of communication." This free flow of information is vital for the efficient coordination of operations, ensuring a responsive and smoothly operating supply chain in the face of dynamic challenges (Wolfert, Verdouw, & Beulens, 2010).

Moreover, interviews revealed a noteworthy practice of sharing customer trends not only with partners but also with competitors. This collaborative approach enhances the ability to respond to shifts proactively and effectively in the market. As another participant

mentioned, "The visibility of product and processes across the supply chain is high, and information flows smoothly." Collaborating with both partners and competitors enables companies in the AFSC to swiftly adapt to evolving customer preferences and the ever-changing dynamics of the market.

In summary, information sharing and learning are central and irreplaceable themes in the AFSC. The efficient sharing of information through diverse channels serves as the linchpin for operational coordination and the establishment of a responsive supply chain.

Additionally, the practice of sharing customer trends with both partners and competitors equips companies not only to adapt but also to thrive in the dynamic and challenging market landscape. This collaborative approach significantly contributes to the resilience and overall prosperity of the agricultural and food supply chain.

9. External Resources and Communities

The interviews with companies in the agricultural and food supply chain (AFSC) unveiled diverse perspectives on the role of external resources and communities when dealing with disruptions.

Some companies expressed a strong belief in the substantial potential of external resources and communities to be invaluable in surmounting disruptions. They emphasized the importance of receiving support from entities such as the government, the public, and the local economy during times of business crises. As one participant highlighted, "Yes, I will say so. Because in some countries in disruptions, the government can put a ban on exports critical for production, and they can make disruptions worse. Also, government and institutions can help overcome disruptions to maintain flow."

Conversely, other companies adopted a more cautious stance, indicating that they perceived limited support from external resources and communities when confronted with disruptions. They cited difficulties in accessing assistance or resources from these external sources, leading to a sense of constrained support during crises. Another participant noted, "Obviously, there is a role, and an area of improvement is always there. They are there to provide utilities, infrastructure, and approvals and certifications you can produce by yourself but without them, you cannot sell."

In summary, the perspectives on the role of external resources and communities within the AFSC demonstrated a divergence among the interviewed companies. While some held an optimistic view of the potential for substantial support from external sources, others expressed reservations regarding the actual extent of assistance they could receive in times of disruptions. These varying viewpoints highlight the intricate interplay between AFSC companies and their external environments.

10. Efficiency and Timeliness

The interviews conducted with companies in the agricultural and food supply chain (AFSC) unveiled shared concerns regarding the efficiency of product movement throughout the supply chain and the ability to achieve objectives both during and after

disruptions. However, the responses from these companies exhibited a wide spectrum of experiences and approaches.

Certain companies reported remarkable levels of efficiency in navigating their products through the supply chain (Chunsheng et al. 2020; Skalkos, 2023). They consistently upheld streamlined processes, exhibited swift turnaround times, and demonstrated effective resource utilization, even when disruptions occurred. As one participant noted, "Here I will say it is planning in connection with raw material coming in and planning according to the customers in order to manage expectations on the customer side. So, I will say communication on both sides of the supply chain. Pushing your suppliers to be on time and communicating with your customers about the crisis and possible lead times to manage on-time deliveries."

On the contrary, some companies encountered obstacles in sustaining efficiency and timeliness in their operations, particularly in the face of disruptions (Manikas et al., 2022). They found themselves needing more time to recuperate from disruptions and restore regular operations. Another participant mentioned, "We make a plan to procure from the neighboring countries, if possible, to reduce lead time."

The contrasting experiences of these companies emphasize the intricate nature of efficiency and timeliness management within the AFSC, especially when disruptions are a factor. This disparity underscores the significance of implementing strategies and practices capable of enhancing efficiency and timeliness, even in challenging circumstances.

Efficiency and timeliness constitute pivotal factors for success within the AFSC, and comprehending the underlying reasons for the divergence in experiences between companies offers valuable insights for advancing supply chain management in the industry. This underscores the imperative need for further research and the development of strategies to augment efficiency and timeliness, particularly when confronted with disruptions.

11. Self-Organization and Adaptability

The interviews unveiled a spectrum of self-organization within the agricultural and food supply chain (AFSC), highlighting varying degrees of adaptability to external influences and the willingness to pivot when necessary (Skalkos, 2023; Chunsheng et al. 2020). The capacity for self-organization and adaptability emerged as a central theme within the AFSC.

Certain companies showcased a remarkable degree of self-organization and adaptability. They displayed a responsiveness to external factors and a readiness to swiftly modify their operations and strategies when faced with disruptions (Chunsheng et al. 2020). As one participant noted, "For specific product segments, we maintain contract terms that allow us to delay production in response to disruptions, particularly if our customers encounter financial difficulties. These terms provide a degree of flexibility to adjust to changing circumstances." These companies demonstrated their proficiency in self-organization,

quick decision-making, and the effective implementation of changes. Their agility in addressing unforeseen events enabled them to navigate disruptions relatively seamlessly.

The disparities in self-organization and adaptability among these companies underscore the significance of these attributes in supply chain management within the AFSC. Companies capable of effective self-organization and adaptability are better equipped to sustain their operations and confront challenges head-on.

Comprehending the characteristics and strategies that contribute to self-organization and adaptability offers valuable insights for enhancing supply chain resilience and performance within the agricultural and food supply chain. Another participant highlighted, "We have a designated replacement in place, ensuring a smooth transition of responsibilities in case of absence."

12. System-Wide Backup and Facilities

The interviews shed light on a prevailing practice among companies operating within the agricultural and food supply chain (AFSC). This practice involved the establishment and maintenance of system-wide backup and storage facilities, which emerged as a pivotal aspect in ensuring uninterrupted operations, particularly in the face of disruptions (Skalkos, 2023; Chunsheng et al. 2020). This facet of supply chain management emphasized the significance of preparedness and resilience within the AFSC.

Numerous companies within the AFSC acknowledged the imperative need for system-wide backup and storage facilities to fortify their supply chain operations (Skalkos, 2023). These facilities served as a strategic buffer against disruptions, providing companies with the means to store essential resources, raw materials, and finished products. The existence of these backup facilities ensured that companies could sustain their production and distribution, even when their primary facilities encountered challenges.

The presence of system-wide backup and storage facilities assumed particular importance during unforeseen global events, such as the disruptive impact of the COVID-19 pandemic (Chunsheng et al. 2020). Companies that had diligently established and maintained these backup facilities were better equipped to navigate the crisis by upholding a continuous flow of products and materials.

In sum, the incorporation of system-wide backup and storage facilities exemplifies a forward-thinking approach to risk management within the AFSC. This practice represents an indispensable facet of resilience, playing a pivotal role in upholding the functionality of the supply chain, especially when confronted with disruptions.

13. Skill Diversity for Resilience

The interviews conducted revealed a critical aspect of supply chain management within companies operating in the agricultural and food supply chain (AFSC) (Skalkos, 2023; Chunsheng et al., 2020). This significant aspect pertained to skill diversity and emerged as

a central theme, emphasizing the pivotal role of a varied skill set in bolstering supply chain resilience and fortifying its capacity to withstand disruptions.

A multitude of companies recognized the indispensable nature of maintaining a diverse array of skills within their workforce (Skalkos, 2023). Skill diversity, encompassing expertise in various domains, including logistics, procurement, production, and risk management, enabled these companies to adapt swiftly and effectively to unforeseen disruptions. This diverse skill set allowed them to absorb shocks stemming from disruptions and facilitated a more rapid recovery.

When disruptions unfolded, companies armed with a diverse workforce found themselves better equipped to deploy individuals possessing the requisite skills to address specific challenges (Chunsheng et al., 2020). Whether it entailed reconfiguring the supply chain, modifying production processes, or seeking alternative sourcing options, the spectrum of skills played a pivotal role.

In essence, the presence of a wide array of skills within the workforce significantly contributed to the resilience of the supply chain (Chunsheng et al. 2020). It empowered companies to adapt, recover, and maintain the continuity of their operations in the face of disruptions.

4.2 Analysis of Supply Chain Resilience Themes with Likert Scale

We identified some critical themes in our interview analysis, extracting key insights from discussions with representatives of seven companies. To streamline the data, textual responses were transformed into a Likert scale, assigning positive values for the highest ranking (5) and negative values for the lowest (1). This conversion facilitates a more convenient and standardized assessment of opinions.

Theme 1: Sourcing and Suppliers

The responses regarding global sourcing and diverse suppliers displayed unanimous high ratings, with a mean of 5.00 and negligible standard deviation. However, speed in supplier selection showed slight variability (Mean = 3.71, SD = 0.49), indicating diverse opinions among participants. Substitutes for core products were consistently rated high, with a mean of 5.00 and SD = 0.

- 100% maintain diverse supplier bases combining domestic and international.
- 57% reported the ability to switch suppliers quickly during disruptions, 43% said it is difficult.

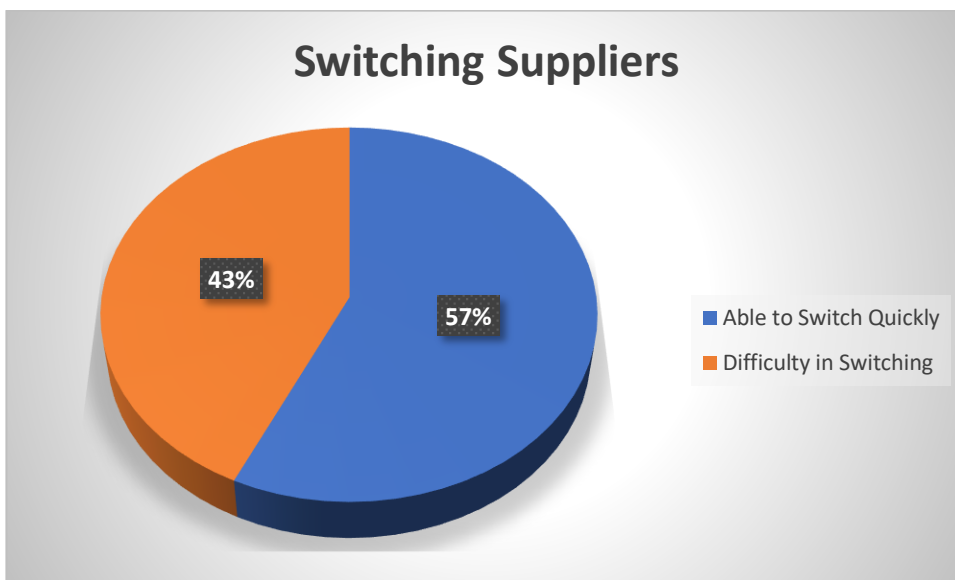


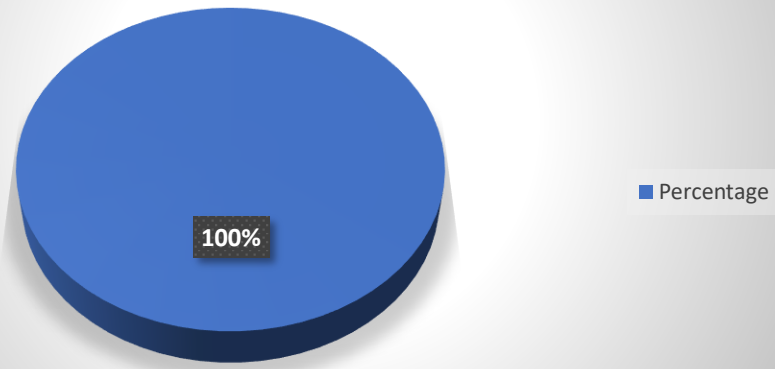
Figure 2 Sourcing and Suppliers

Theme 2: Distribution Channels

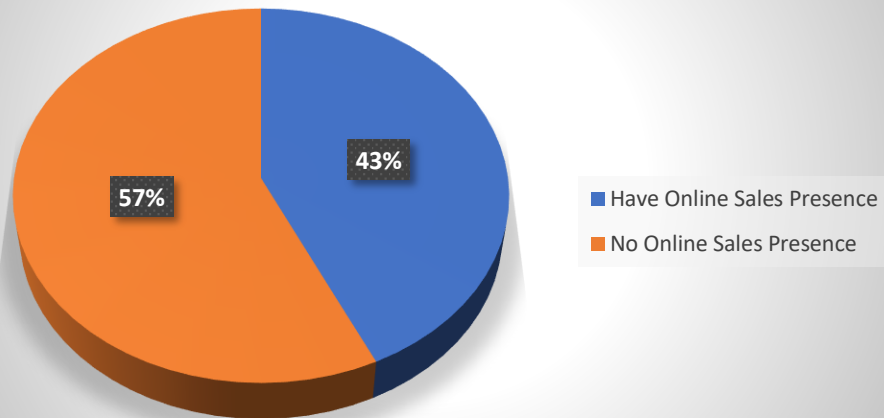
Participants overwhelmingly endorsed traditional and modern channels and the online presence (Mean = 5.00, SD = 0), while the business-to-business channel exhibited some variability (Mean = 1.57, SD = 1.51). This suggests a divergence of opinions on the efficacy of this channel in ensuring supply chain resilience.

- 100% of companies use traditional distribution channels like wholesalers, distributors, and retailers.
- 43% have an online sale presence.
- 57% utilize both international and domestic channels, 29% domestic only, 14% international only.

Use Traditional Channels (Wholesalers, Distributors, Retailers)



Online Sales Presence



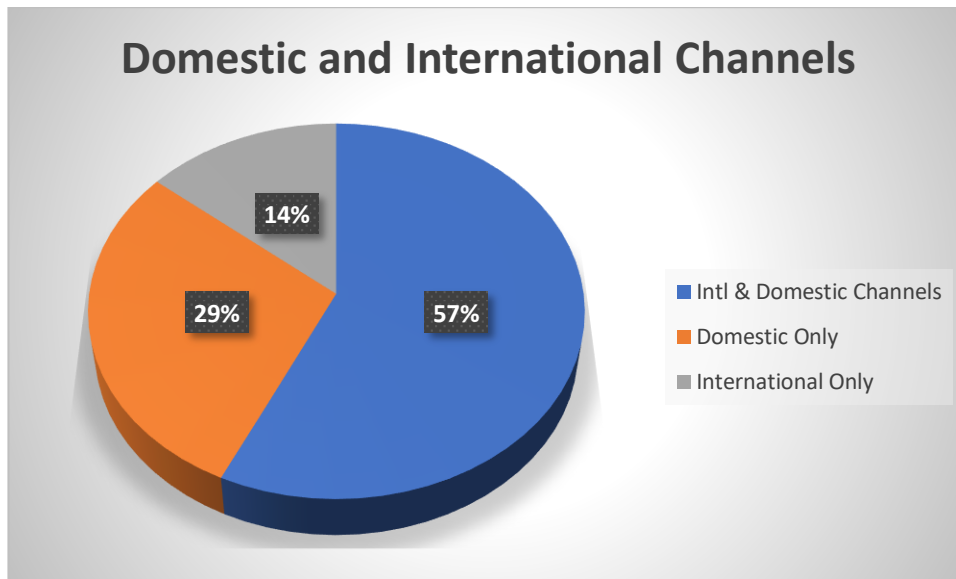


Figure 3 Distribution Channels

Theme 3: Substitutes and Alternatives

Alternative distribution channels garnered mixed responses (Mean = 2.14, SD = 1.95), indicating varied perceptions among participants. Contract terms for delayed production also exhibited variability (Mean = 3.29, SD = 2.14), suggesting differing viewpoints on the importance of these terms in enhancing resilience.

- 43% offer substitute products to maintain customer retention during disruptions.
- 57% have established alternative distribution channels to improve adaptability.
As such:
 - 57% do not have substitutes for core product offerings.
 - 43% do not have alternative distribution channels established.

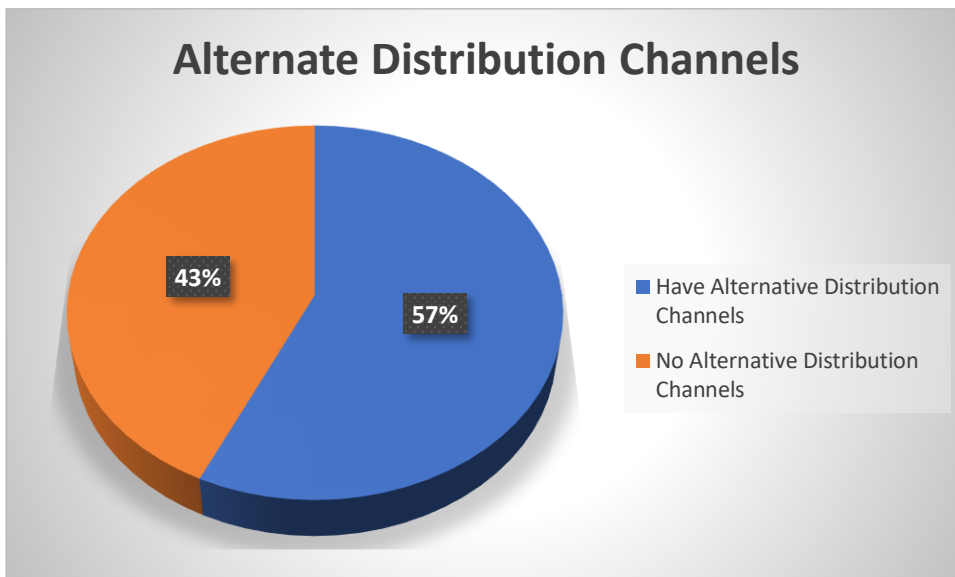
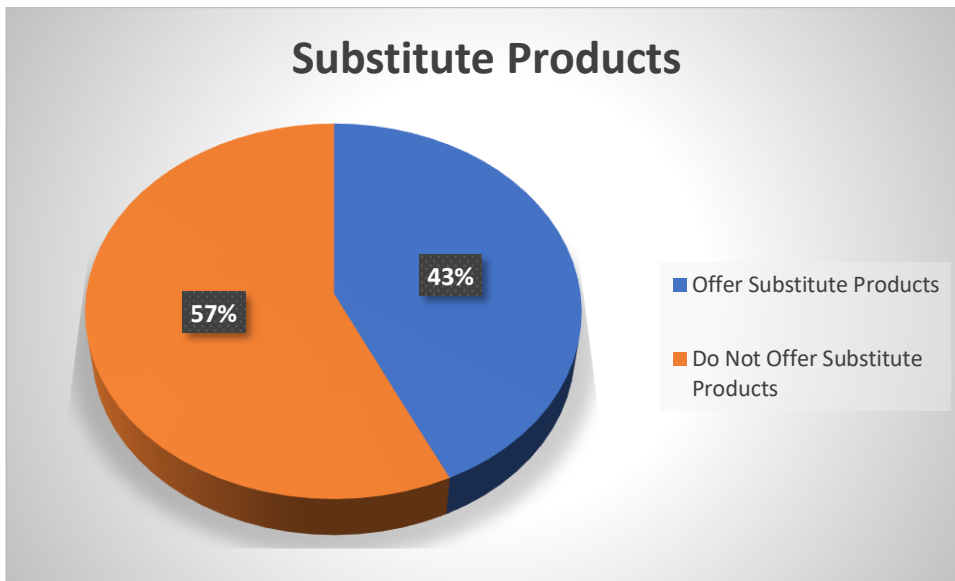


Figure 4 Substitutes and Alternatives

Theme 4: Contracts and Financial Aspects

Themes related to flexibility in mode and timing of deliveries received high ratings (Mean = 4.71, SD = 0.49), underlining their significance for supply chain resilience. Credit terms in transactions and collective databases saw greater variability (Mean = 2.71, SD = 2.14), suggesting diverse opinions on their impact.

- 43% can delay production contractually during disruptions, 57% cannot.
- 86% said they can access liquidity rapidly during cash shortfalls.
- 43% of companies do not possess contract terms to permit production delays during disruptions.
- 14% reported challenges in accessing liquidity rapidly amidst cash shortfalls.

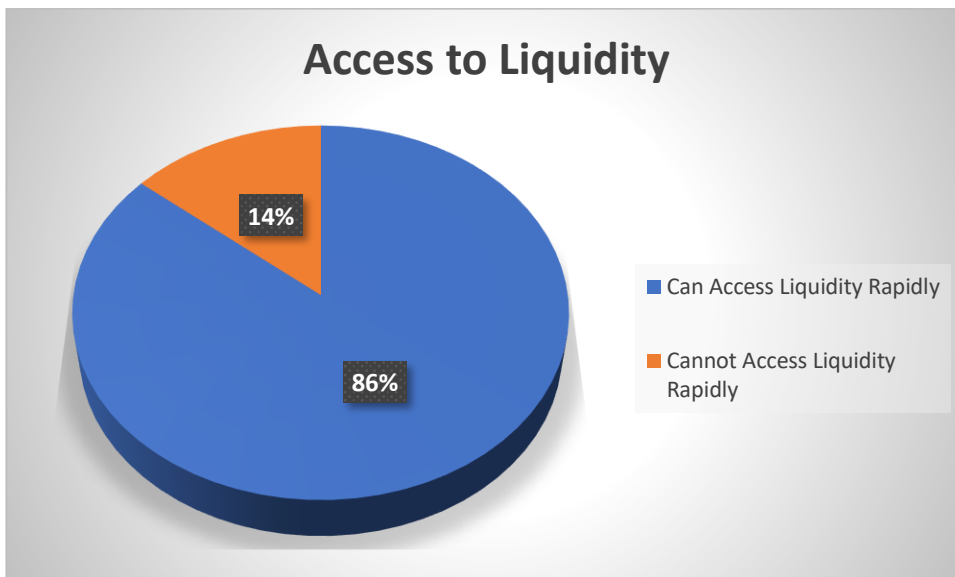
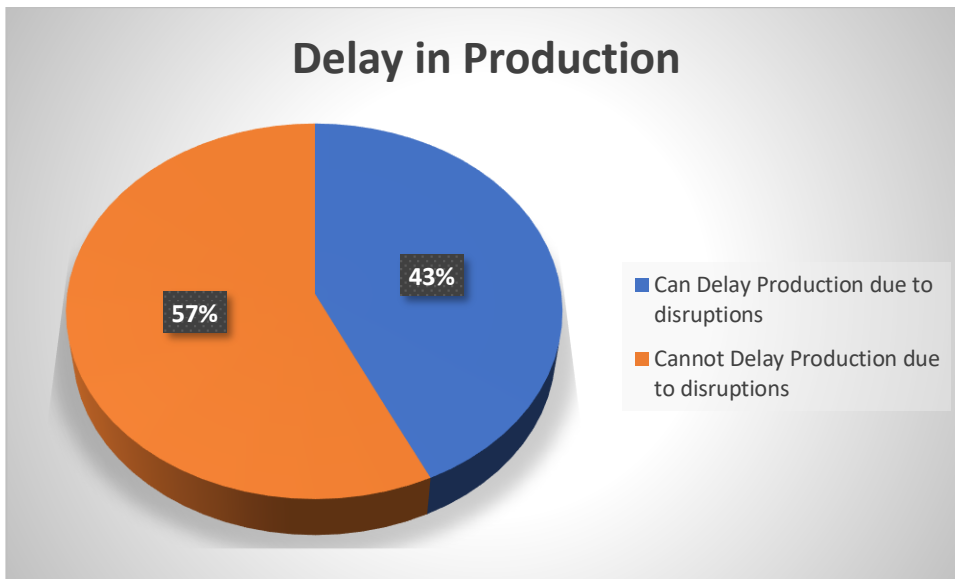


Figure 5 Contracts and Financial Aspects

Theme 5: Risk Management and Resilience

Responses to hiring for risk management and employee layoff displayed unanimity with high ratings (Mean = 5.00, SD = 0), emphasizing their critical role in resilient supply chains.

- 100% emphasized risk management skills as an important hiring consideration for managerial roles.
- 100% stated they avoid laying off employees with cross-functional expertise during disruptions.

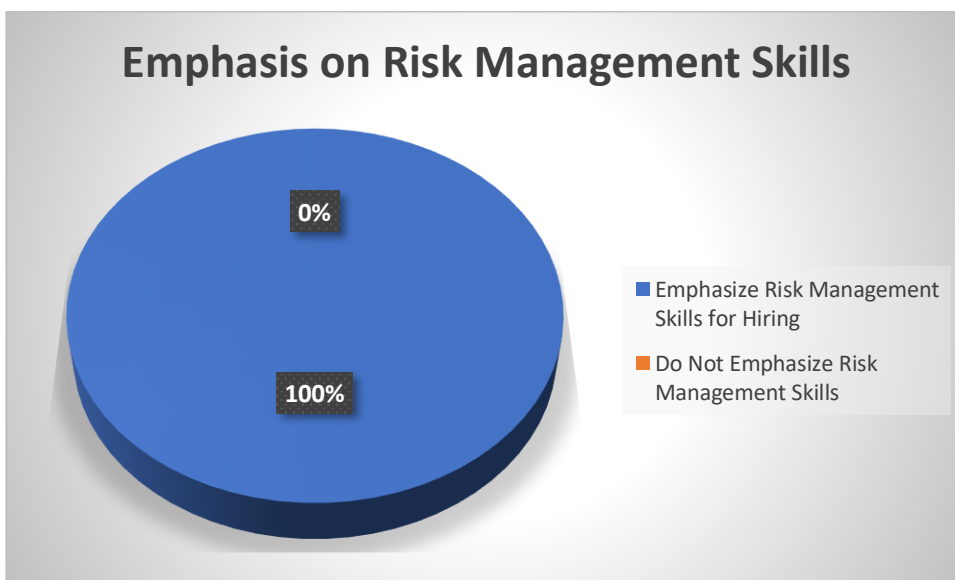


Figure 6 Risk Management and Resilience

Theme 6: Assets and Resource Management

Various aspects, such as strong market position and business continuity plans, demonstrated high mean scores with low standard deviations, suggesting a consensus among participants regarding their importance for supply chain resilience.

- 86% described their market position as strong; 14% a good market position.
- 71% encountered high acceptability if they offered substitute products while facing shortages.

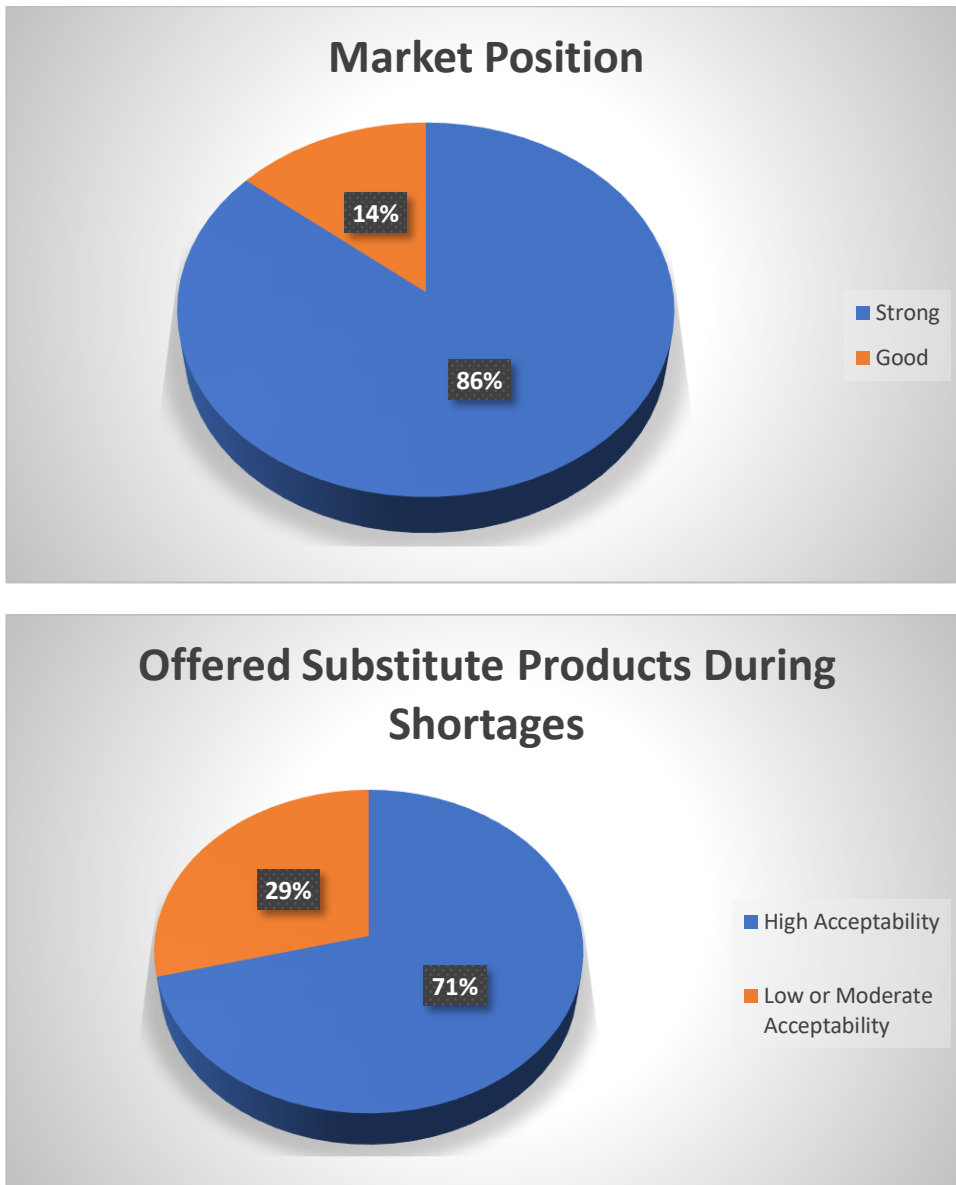


Figure 7 Assets and Resource Management

Theme 7: Market Position and Brand Loyalty

Positive relationships with suppliers and retailers and a preference for a single supplier received unanimous high ratings (Mean = 5.00, SD = 0), highlighting their perceived importance for supply chain resilience.

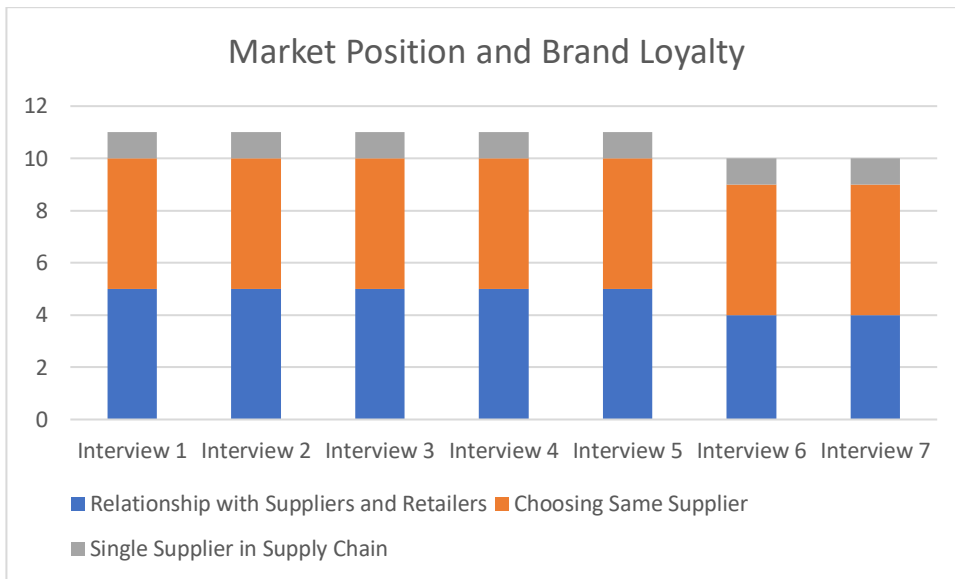


Figure 8 Market Position and Brand Loyalty

Theme 8: Information Sharing and Learning

While customer trends awareness and system-wide backup demonstrated consistency in high ratings (Mean = 5.00, SD = 0), other aspects showed variability, indicating differing opinions among participants.

- 100% maintain awareness regarding evolving customer trends and preferences
- Only 29% indicated sharing customer insights with partners exclusively while 71% share data across industry ecosystem.



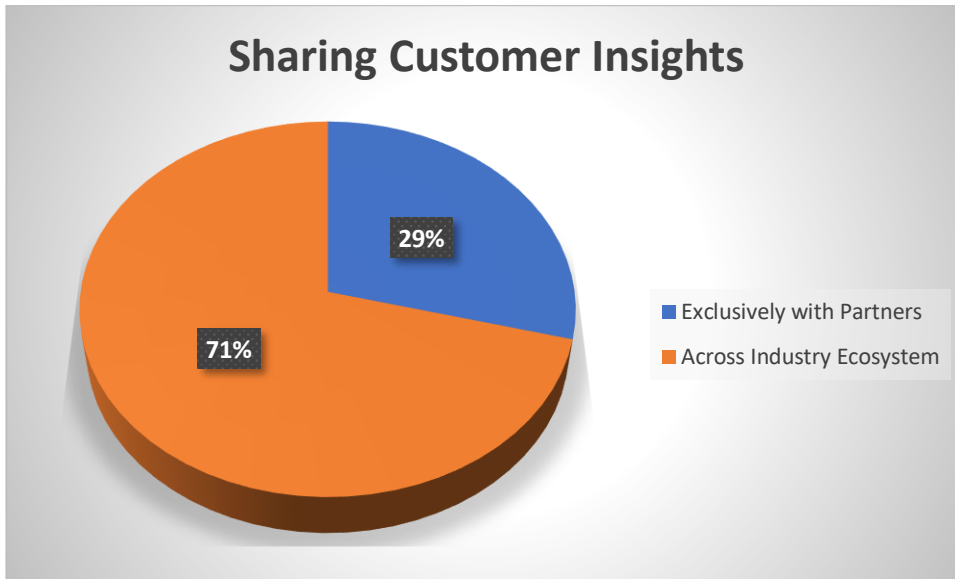


Figure 9 Information Sharing and Learning

Theme 9: External Resources and Communities

Government and public support received unanimous high ratings (Mean = 5.00, SD = 0), while external resources for overcoming disruptions exhibited some variability (Mean = 4.43, SD = 1.51).

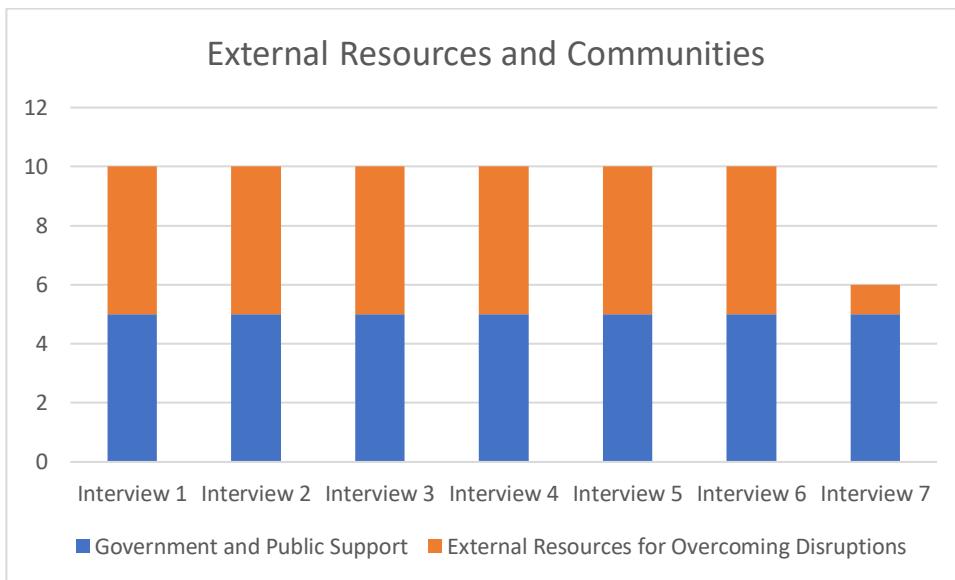


Figure 10 External Resources and Communities

Theme 10: Efficiency and Timeliness

Efficient product travel and efforts to reduce lead time received high ratings with low standard deviations, indicating a consensus among participants.

- 71% found it difficult to meet objectives in a timely fashion during disruptions.

- 29% were able to attain timeliness.

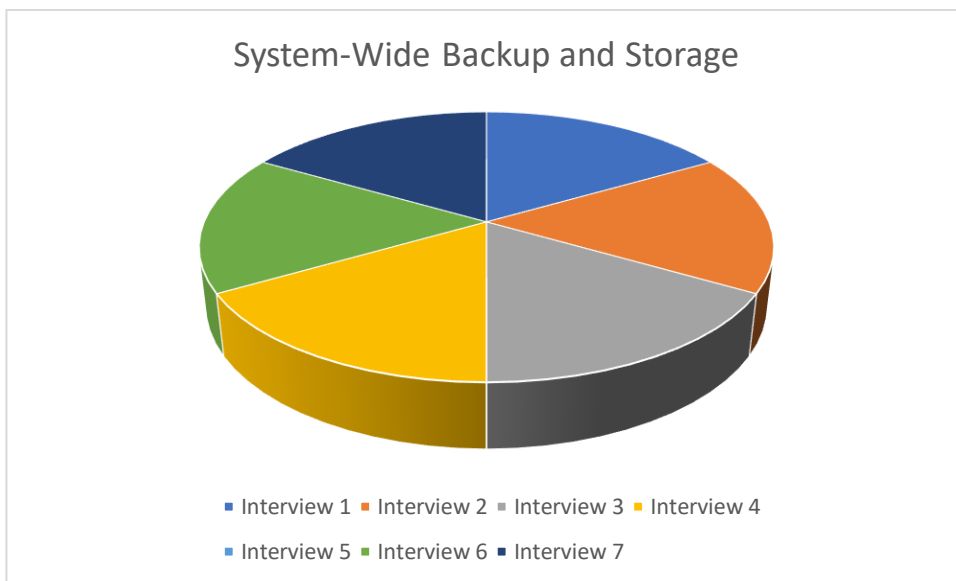
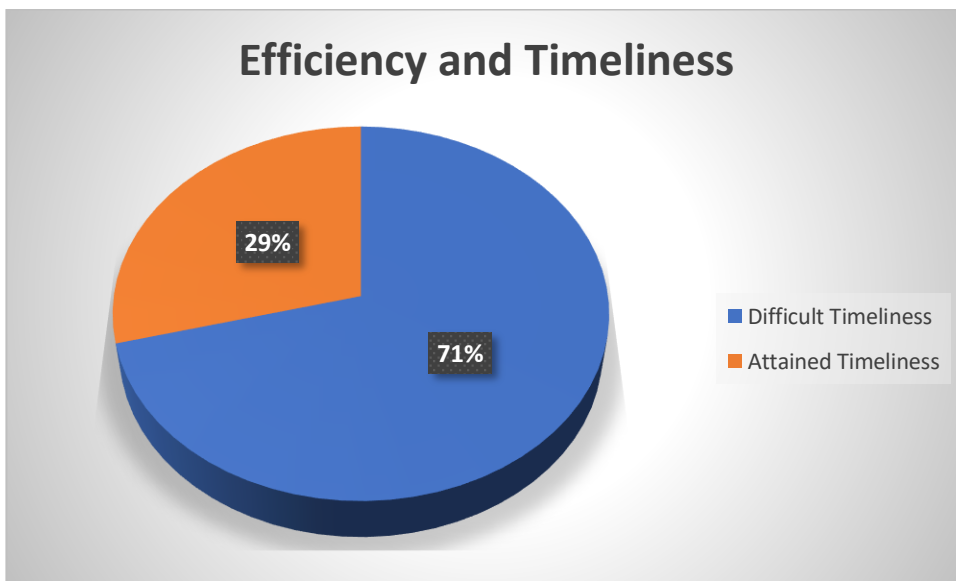


Figure 11 System wide Back Up

Theme 11: Self-Organization and Adaptability

Various aspects of self-organization and adaptability demonstrated high mean scores with low standard deviations, emphasizing their perceived importance for supply chain resilience.

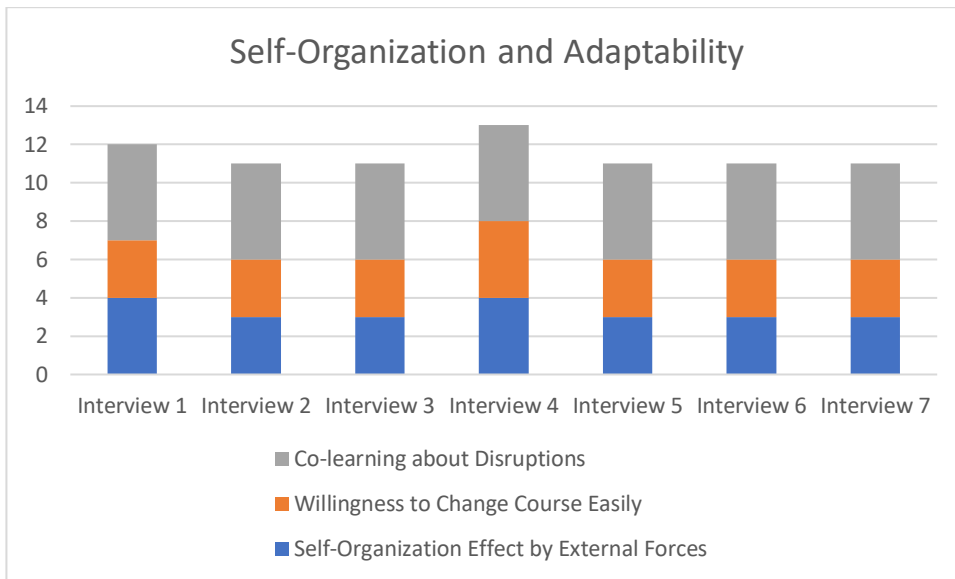


Figure 12 Self-Organization and Adaptability

Theme 12: System-Wide Backup

The aspect of system-wide backup and storage received unanimous low ratings (Mean = 1.00, SD = 0), suggesting a consensus on its limited perceived relevance.

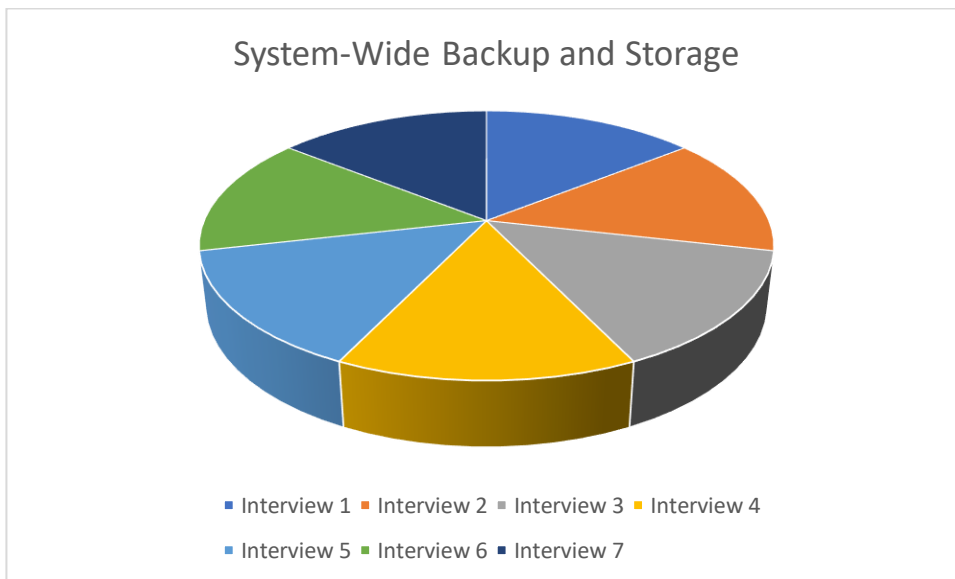


Figure 13 System-Wide Backup

Theme 13: Skill Diversity for Resilience

Skill diversity exhibited high mean scores with a low standard deviation (Mean = 4.71, SD = 0.49), indicating a shared perspective on its significance for supply chain resilience.

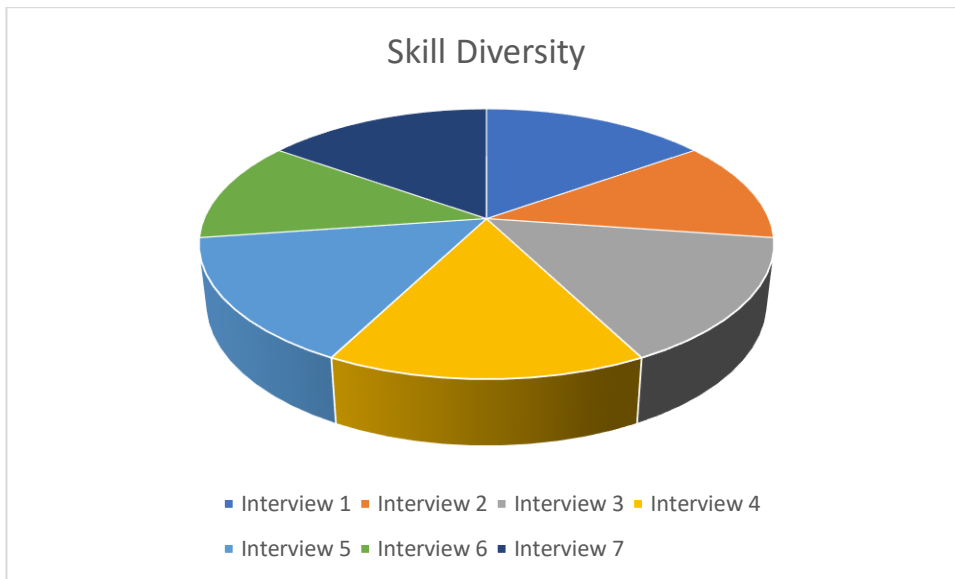


Figure 14 Skill Diversity for Resilience

This analysis provides valuable insights into the diverse perceptions and consensuses among participants regarding the various themes of supply chain resilience.

5 Discussion

The discussion section of this research paper, titled "AFSC Resilience Framework in Developing Countries," is devoted to delving into the research question "What are the key determinants and contextual factors that significantly influence the resilience and sustainability of agri-food supply chains in developing countries, and how can these factors be leveraged to strengthen these supply chains?" Within this section, we aim to comprehensively explore the major themes. This examination is based on a series of interviews with key stakeholders deeply entrenched in agri-food supply chains within developing countries.

The intricate dynamics of distribution channels form a linchpin in enhancing the resilience and sustainability of agri-food supply chains. The efficient movement of products, from raw materials to end consumers, is a pivotal aspect of these supply chains. It is these channels that bear the responsibility of efficiently adapting to disruptions and addressing the evolving demands of the market. In the context of developing countries, characterized by resource constraints and distinctive challenges, the strategic choices made regarding distribution channels wield substantial influence over the overall adaptability and performance of these supply chains.

Within this discussion, we undertake a meticulous examination of the insights garnered from the interviews, focusing on the intricate nuances of distribution channels and their manifold implications for the resilience and sustainability of supply chains. We scrutinize the role of diversification in sales avenues, the intricate challenges posed by international distribution, the interplay between brand loyalty and substitutability, the rising significance

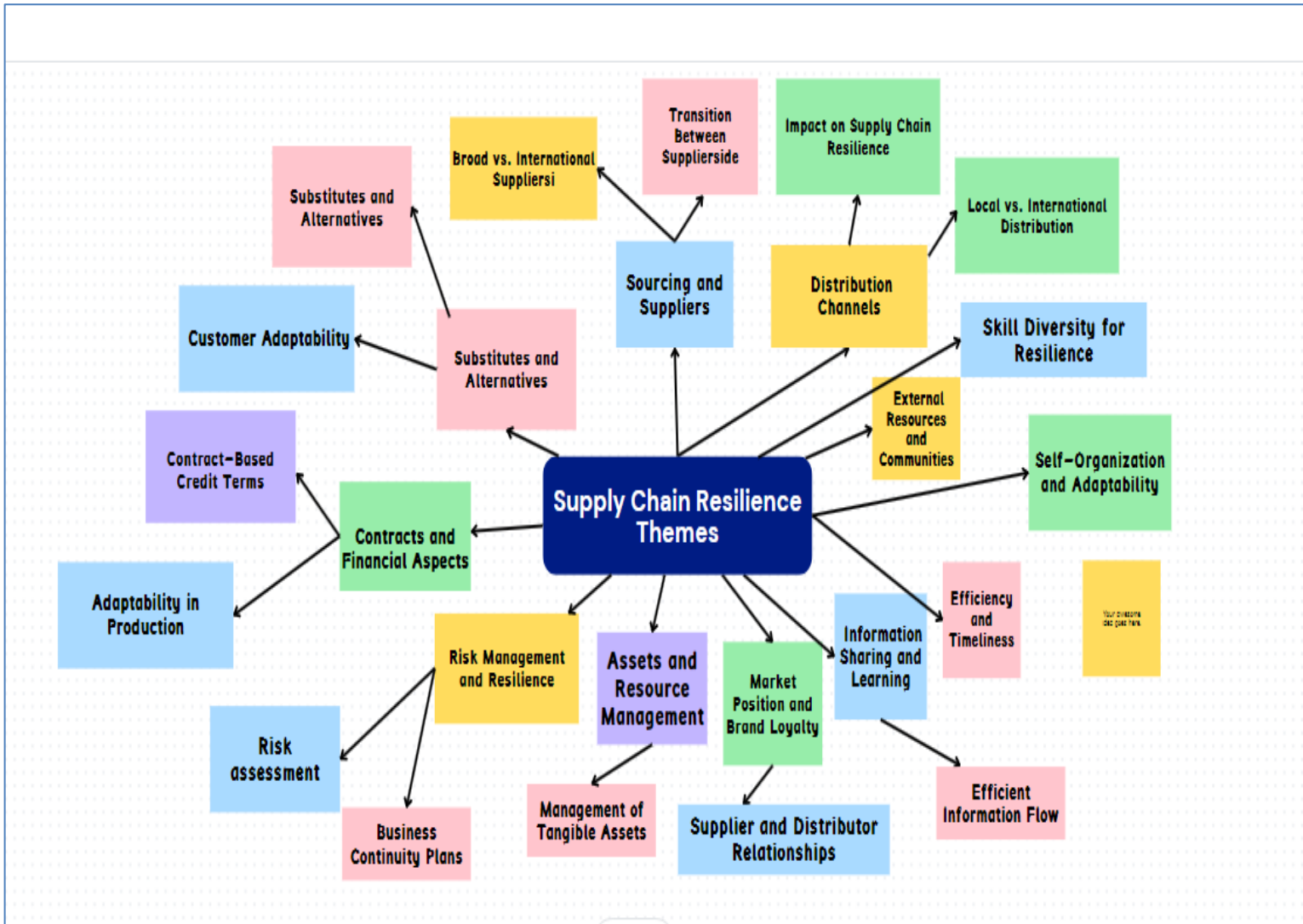


Figure 15 Supply Chain Resilience Themes

of digital transformation, and the innovative strategies that reimagine the distribution landscape. Each of these insights contributes a valuable puzzle piece towards the comprehensive comprehension of how agri-food supply chains in developing countries can bolster their resilience and sustainability by optimizing their distribution channels.

5.1 Key themes

5.1.1 Sourcing and Suppliers

The "Sourcing and Suppliers" theme delves into the critical aspects of sourcing raw materials and the relationship with suppliers in the context of agri-food supply chains in developing countries. The quotes from interviews 1 to 7 provide valuable insights into the sourcing strategies and the associated challenges and opportunities.

The interviews consistently highlight the paramount significance of maintaining a diversified supplier base. Interviewee 1 aptly emphasizes this, stating, "We have a distributed supplier side. With a lot of suppliers for raw material and up to packaging. For

major ingredients we have suppliers on the national level. But for some raw materials we have suppliers globally because these materials are not available in Pakistan." This assertion underscores the vitality of cultivating a wide-ranging supplier ecosystem, comprising both local and international sources, to ensure a continuous influx of raw materials.

Interviewee 2 corroborates the importance of supplier diversity, elaborating, " It depends on the nature of the product like some products are not readily available in Pakistan, so they must be imported like some spices in India, but for rice we have own manufacturing facilities and our own farms. For dessert and other products, we have some suppliers but for some critical raw sources we are dependent on imports like from Afghanistan specially for nuts and other stuff. " In this instance, the interviewee underscores the critical role of a varied supplier network, especially when dealing with goods not readily accessible within the local domain.

The interviews underline the need for adaptability in sourcing strategies. Interviewee 1 articulates this point cogently, asserting, "With supplier selection, product selection also matters a lot. There are some products with limited suppliers so we should have inventory cover for that to sustain disruptions. But if we have product flexibility then we go for supplier selection." This insight underscores the significance of malleable sourcing strategies, especially when managing products reliant on a restricted set of suppliers.

Echoing this sentiment, Interviewee 2 states, "Again, it depends on the product type, but we have a large supplier base, so we change quickly, and our supplier bases are both locally and internationally." Here, the interviewee highlights the adaptable nature of supply chain managers who diversify their sourcing strategies through collaborative partnerships or in-house production, particularly when dealing with products tethered to a single supplier.

Furthermore, Interviewee 6 introduces an essential contextual dimension, stating, "The agility in transitioning between suppliers during disruptions proves to be quite challenging." This statement underscores the intricacies involved in supplier transition during tumultuous times, shedding light on the contextual elements within developing countries. These factors include limited supplier alternatives and potential delays when altering supplier relationships.

In a related context, Interviewee 7 adds, "Even when a surplus of supplier options exists, the standing of our current suppliers, their reputation and reliability, remains a deciding factor in our choices." This statement accentuates the fact that even in environments with a profusion of potential suppliers, the reputation and dependability of established suppliers significantly influence decisions. This illustrates the contextual factors that sway such crucial determinations.

In summation, the amalgamation of these quotes underscores the vital role of a diverse supplier network, the requisite flexibility within sourcing strategies, and the contextual intricacies that mold supplier selections. In the landscape of developing countries, where

access to local raw materials may be restricted, these determinants and contextual factors bear immense significance in fortifying resilience and sustainability in agri-food supply chains.

5.1.2 Distribution Channels

Interviewee 1 underscores the significance of diversifying distribution channels, emphasizing, " Because selling is very diversified now so we should have multiple channels. We usually have conventional mode of trade which is distributor wholesaler and then retailer. Now we have modern distribution, and every channel has its own market share growing such as direct sales to stores and e-commerce platforms, so we are using all of them." This multi-pronged approach, including distributor wholesaler, retailer, and modern distribution, enables supply chain managers to reach diverse markets efficiently. They also recognize the growing importance of e-commerce and direct sales to stores, reflecting the adaptability and responsiveness of these supply chains.

Interviewee 2 mirrors this flexibility, stating, "In the past we mostly relied on distributors to sell our products, which are still widely used as well. But now for international sales we are going for online stores and direct sales to foreign customers but in some countries, we are also partners with local businesses." The ability to adapt to changing market dynamics and embrace digital channels is crucial for sustaining agri-food supply chains in developing countries.

Interviewee 2 points out a crucial challenge in terms of international deliveries, stating, "How easily you can change the mode of delivery? It is very difficult when it comes to international deliveries but locally, we can change it because of many third-party options." This highlights the complexities of international distribution channels, where adaptability may be hindered by factors such as cross-border logistics and regulations.

In contrast, Interviewee 3 mentions using air, road, and boat as distribution channels and does not currently have alternative distribution channels. This indicates a reliance on traditional distribution modes, possibly due to factors specific to their operations or geographic location.

Interviewee 4 highlights the significance of online stores as a distribution channel. This digital approach aligns with the modern trend of e-commerce, which can help agri-food supply chains reach wider audiences and adapt to changing market demands.

In Interview 5, the interviewee outlines their distribution channels, including traditional structures with retailers and distributors. They also highlight the existence of a B2B channel. While they mention that online presence is relatively small, having a B2B channel can be vital for maintaining supply chain resilience, particularly when catering to business customers.

Interviews 6 and 7 introduce innovative distribution approaches. Interviewee 6 highlights the use of eco-friendly stores and local retailers committed to sustainability. Meanwhile, Interviewee 7 focuses on cutting-edge digital platforms and direct partnerships with

retailers. These sustainability and technology-driven distribution strategies demonstrate the adaptability of supply chains to evolving market trends and the importance of aligning distribution channels with environmental and technological shifts.

In essence, the discussions from these interviews underscore the significance of diversifying distribution channels, adapting to international challenges, considering local preferences and brand loyalty, and embracing innovative distribution methods. In developing countries, a nimble and responsive approach to distribution channels can significantly enhance the resilience and sustainability of agri-food supply chains.

5.1.3 Substitutes and Alternatives

In the agri-food supply chain, the use of substitutes for core products and alternative distribution channels plays a pivotal role in enhancing resilience. Interviews shed light on this aspect in both developed and developing world contexts.

In cases where customers are less brand-conscious and make spontaneous buying decisions, the availability of substitutes becomes crucial. This consumer behavior underscores the need for a diverse product portfolio and the capacity to seamlessly shift to substitute products during disruptions, aligning with the resilience model's principles of contingency planning and adaptability.

This theme contributes to resilience by enhancing adaptability and resource diversification, making it relevant in both developed and developing world supply chain contexts.

5.1.4 Contracts and Financial Aspects

Contracts and financial aspects play a pivotal role in bolstering the resilience of agri-food supply chains. The insights gathered from the interviews with industry experts and organizations shed light on the significance of this theme in the context of supply chain management.

The first aspect of the "Contracts and Financial Aspects" theme emphasizes the importance of flexible contractual agreements in navigating supply chain disruptions. One respondent noted, "We buy them from diverse suppliers," highlighting the strategy of diversifying suppliers to maintain adaptability. However, another respondent voiced caution, stating, "We are not keen on that because in disruptions, everyone is waiting for things in factories or in shops on time." This dichotomy showcases the varying approaches within the agri-food supply chain, where some prioritize supplier diversification for resilience, while others remain cautious about its implementation.

The second aspect explores the management of liquidity and payment terms during disruptions. Respondents provided insights into their liquidity accessibility, with one stating, "Not easy, not difficult," and another expressing, "Very easy." These differing liquidity experiences illustrate the varying degrees of financial preparedness within the industry. Furthermore, supplier performance and risk management were found to be crucial, as one respondent noted, "If the suppliers are not meeting delivery targets, then

they are performing badly," underlining the importance of monitoring supplier performance for resilient supply chains.

1. 5.1.5 Risk Management and Resilience

The "Risk Management and Resilience" theme encapsulates the essence of ensuring agri-food supply chains' stability, even when faced with unforeseen challenges. The interviews with industry experts shed light on several critical aspects, emphasizing the significance of risk management. As one interviewee aptly stated, "Risk management is important," highlighting the overarching importance of identifying and mitigating potential disruptions within the supply chain.

Risk identification plays a pivotal role in this theme. It serves as the cornerstone of a resilient supply chain. One respondent underscore this by pointing out that "If the suppliers are not meeting delivery targets, then they are performing badly." This demonstrates the emphasis on identifying and addressing risks promptly, aligning with the principle that early detection of potential disruptions is vital for effective risk management.

The theme also emphasizes the role of employee skill sets and adaptability as essential components of risk management and resilience. "It's very important, also if they have adaptability," notes one respondent. In the agri-food sector, where markets can be highly dynamic, the adaptability of the workforce is crucial. This underscores the need to not only hire individuals with strong risk management skills but also to ensure that employees possess the flexibility and adaptability needed to respond to unforeseen challenges.

Furthermore, risk mitigation and business continuity planning are discussed in detail within this theme. "Yes, it helps to go through bad situations," says one interviewee, highlighting the role of these measures in mitigating disruptions. The commitment of leadership to risk management and the collaborative practice of co-learning and joint decision-making during disruptions are vital components. "Committed," as one respondent puts it when discussing leadership's dedication to risk management. Moreover, co-learning and joint decision-making are crucial, as "more brain means more input for decision-making," particularly in times of crisis.

In essence, "Risk Management and Resilience" serves as a compass for agri-food supply chain resilience, with an overarching focus on the importance of risk identification, mitigation, adaptability, and comprehensive business continuity planning. These aspects, coupled with strong leadership commitment and a culture of co-learning, are the cornerstones for navigating disruptions and ensuring the uninterrupted functionality of agri-food supply chains. The interviews shed light on valuable insights that reinforce the industry's commitment to resilience.

We identified thirteen critical themes in our interview analysis, extracting key insights from discussions with representatives of seven companies. To streamline the data, textual responses were transformed into a Likert scale, assigning positive values for the highest

ranking (5) and negative values for the lowest (1). This conversion facilitates a more convenient and standardized assessment of opinions.

It's evident that, Practices in agri-food supply chain resilience exhibit notable distinctions when comparing the context of developing and developed countries. In developed nations, the supply chains are privileged with well-established infrastructure, widespread technology adoption, and comprehensive risk management strategies. Developed countries have access to abundant resources, maintain redundancy in critical infrastructure, and enjoy greater financial stability. Consequently, their approaches gravitate towards enhancing efficiency, fostering innovation, and ensuring sustainability. In contrast, developing nations encounter unique challenges. Limited infrastructure, underdeveloped technology adoption, and financial constraints may impede the implementation of advanced supply chain strategies. Therefore, practices in agri-food supply chain resilience within developing countries tend to prioritize adaptability, optimization of resources, and the establishment of external networks and communities. These disparities underscore the contrasting resource availability and underscore the necessity for custom-tailored approaches to agri-food supply chain resilience across varied global contexts.

5.2 Implications

In the context of enhancing agri-food supply chain resilience, it is vital to explore the multifaceted implications that extend beyond mere operational and strategic considerations. The insights gleaned from the interviews provide a real-world perspective on how these dimensions interconnect with the resilience model we are employing.

5.2.1 Environmental Implications

Our conversations with industry experts unveiled a significant environmental facet. Supply chain resilience practices have a tangible impact on environmental sustainability. For example, the adoption of alternative facilities, storage, and system-wide backups can effectively mitigate the ecological footprint associated with supply chain disruptions. By reducing the urgency to expedite deliveries, these strategies inadvertently contribute to a reduction in carbon emissions and a more sustainable utilization of resources. This aligns harmoniously with the concept of 'green resilience,' emphasizing the integration of environmentally friendly practices into resilience strategies.

5.2.2 Social Implications

From a social perspective, the interviews highlighted how resilience efforts have direct consequences for local communities and the workforce. Beyond the realm of operational strategy, nurturing strong and enduring relationships with suppliers and maintaining job security during disruptions take on a profound social dimension. This principle adheres closely to the notion of 'social resilience,' emphasizing the vital role of supply chains in supporting communities, workers, and local economies. This is especially significant in the context of developing countries where engagement with local communities can foster social cohesion and enhance the overall resilience of the supply chain.

5.2.3 Economic Implications

Economic considerations are seamlessly woven into the core of our resilience model. The interviews brought forth how financial aspects, such as efficient payment terms and liquidity, exert a palpable influence on the functioning of supply chains. In developed countries, these financial stability and risk management strategies are deeply ingrained in operational practices. Conversely, developing nations may encounter heightened challenges in this domain. Thus, a thorough comprehension of economic implications is indispensable in tailoring our model to a diverse array of global contexts. A robust financial strategy, when integrated into our model, not only equips organizations to navigate disruptions more effectively but also ensures their enduring viability in the long run.

In summation, the three dimensions—environmental, social, and economic—resonate with and complement the resilience model we are deploying. By incorporating these facets, we not only fortify the operational aspects of supply chains but also contribute substantively to the broader goals of environmental sustainability, societal well-being, and economic vitality. This holds true regardless of whether we are operating in a developed or developing context.

6 Conclusion

In conclusion, our in-depth study of agri-food supply chain resilience, anchored in interviews with key industry experts from Pakistan, Norway, and Bangladesh, has shed light on critical factors influencing supply chain performance in developing and developed contexts. It is evident that while both developing and developed countries face disruptions, the strategies employed and challenges encountered are distinct. Developing countries, such as Pakistan and Bangladesh, grapple with issues related to infrastructure, resource availability, and market access. In contrast, developed nations like Norway navigate disruptions through advanced technology adoption and innovation.

Recommendations:

- **Tailored Resilience Strategies:** Companies operating in developing countries need to tailor their supply chain resilience strategies to address challenges specific to their regions. This may include investment in infrastructure development, resource management, and enhancing market access.
- **Leverage Innovation:** Developed countries can further enhance resilience by leveraging innovation and technology. For example, Norway's success in salmon production is underpinned by cutting-edge aquaculture practices. Innovations such as sustainable farming techniques can bolster resilience against environmental disruptions.
- **Collaboration and Knowledge Sharing:** Across the board, fostering collaboration and knowledge sharing among supply chain partners is critical. This entails the creation of platforms for sharing best practices and joint decision-making during disruptions, as witnessed in the case of both Pakistan and Norway.

- **Invest in Employee Skill Development:** Skill development should be prioritized in hiring and training new employees in managerial positions. Ensuring that staff members are equipped with risk management skills can greatly contribute to resilience.
- **Diverse Sourcing and Contingency Planning:** Diversifying critical assets, engaging in contingency planning, and maintaining open communication with suppliers and distributors can mitigate disruptions. This practice, observed in all three countries, should be embraced globally.

In essence, our study underscores the importance of context-specific approaches to agri-food supply chain resilience. Whether in developing or developed countries, proactive measures and adaptive strategies are crucial to mitigating disruptions, ensuring efficient operations, and ultimately securing food supply chain sustainability.

7 Bibliography

- Adger, W. Neil. 2000. "Social and Ecological Resilience: Are They Related?" *Progress in Human Geography* 24 (3): 347–64. <https://doi.org/10.1191/030913200701540465>.
- Aggarwal, Shikha , and Manoj Kumar Srivastava. 2016. "Towards a Grounded View of Collaboration in Indian Agri-Food Supply Chains: A Qualitative Investigation." *British Food Journal* 118 (5): 1085–1106. <https://doi.org/10.1108/BFJ-08-2015-0274>.
- Ahmad, Touqeer, and Abdul Saboor. 2022. "Food Security in Pakistan and Need for Public Policy Adjustments." *Policy Perspectives* 19 (2). <https://doi.org/10.13169/polipers.19.2.ra5>.
- Akkerman, Renzo, Poorya Farahani, and Martin Grunow. 2010. "Quality, Safety and Sustainability in Food Distribution: A Review of Quantitative Operations Management Approaches and Challenges." *OR Spectrum* 32 (4): 863–904. <https://doi.org/10.1007/s00291-010-0223-2>.
- Ali, Imran, Ismail Golgeci, and Ahmad Arslan. 2023a. "Achieving Resilience through Knowledge Management Practices and Risk Management Culture in Agri-Food Supply Chains." *Acquire.cqu.edu.au*, March. <https://doi.org/10.1108/scm-02-2021-0059>].
- . 2023b. "Achieving Resilience through Knowledge Management Practices and Risk Management Culture in Agri-Food Supply Chains." *Acquire.cqu.edu.au* 28 (March): 284–99. <https://doi.org/10.1108/scm-02-2021-0059>].
- Ben Hassen, Tarek, and Hamid El Bilali. 2022. "Impacts of the Russia-Ukraine War on Global Food Security: Towards More Sustainable and Resilient Food Systems?" *Foods* 11 (15): 2301. <https://doi.org/10.3390/foods11152301>.
- BLAVATNIK SCHOOL of GOVERNMENT. 2023. "Variation in Government Responses to COVID-19." *Www.bsg.ox.ac.uk*. June 29, 2023. <https://www.bsg.ox.ac.uk/research/publications/variation-government-responses-covid-19>.
- Bø, Eirill, Inger Beate Hovi, and Daniel Ruben Pinchasik. 2022. "COVID-19 Disruptions and Norwegian Food and Pharmaceutical Supply Chains: Insights into Supply Chain Risk Management, Resilience, and Reliability." *Sustainable Futures* 5 (December): 100102. <https://doi.org/10.1016/j.sfr.2022.100102>.

- Boyacı-Gündüz, Cennet Pelin, Salam A. Ibrahim, Ooi Chien Wei, and Charis M. Galanakis. 2021. "Transformation of the Food Sector: Security and Resilience during the COVID-19 Pandemic." *Foods* 10 (3): 497.
<https://doi.org/10.3390/foods10030497>.
- Braun, Virginia , and Victoria Clarke. 2006. "Using Thematic Analysis in Psychology." *Qualitative Research in Psychology Qualitative Research in Psychology* **Publishes Research on Approaches and Analytic Techniques to Qualitative Research in Psychology, Including Their Role, Educational Methods and Training Programs.** *Follow Find out More* 3 (2): 77–101.
<https://doi.org/0.1191/1478088706qp063oa>.
- Braun, Virginia, and Victoria Clarke. 2019. "Reflecting on Reflexive Thematic Analysis." *Qualitative Research in Sport, Exercise and Health* 11 (4): 589–97.
<https://www.tandfonline.com/doi/abs/10.1080/2159676X.2019.1628806>.
- Bryman, A. 2016. *Social Research Methods*. Oxford University Press.
- Burch, David, and Geoffrey Lawrence. 2005. "Supermarket Own Brands, Supply Chains and the Transformation of the Agri-Food System." *The International Journal of Sociology of Agriculture and Food* 13 (1): 1–18.
<https://doi.org/10.48416/ij saf.v13i1.312>.
- Capano, Giliberto, Michael Howlett, Darryl S.L. Jarvis, M. Ramesh, and Nihit Goyal. 2020. "Mobilizing Policy (In)Capacity to Fight COVID-19: Understanding Variations in State Responses." *Policy and Society* 39 (3): 285–308.
<https://doi.org/10.1080/14494035.2020.1787628>.
- Cappelli, Alessio, and Enrico Cini. 2020. "Will the COVID-19 Pandemic Make Us Reconsider the Relevance of Short Food Supply Chains and Local Productions?" *Trends in Food Science & Technology* 99 (May): 566–67.
<https://doi.org/10.1016/j.tifs.2020.03.041>.
- Christopher, Martin, Robert Lawson, and Helen Peck. 2004. "Creating Agile Supply Chains in the Fashion Industry." *International Journal of Retail & Distribution Management* 32 (8): 367–76. <https://doi.org/10.1108/09590550410546188>.
- Christopher, Martin, and Helen Peck. 2004a. "Building the Resilient Supply Chain." *The International Journal of Logistics Management* 15 (2): 1–14.
<https://doi.org/10.1108/09574090410700275>.
- . 2004b. "Building the Resilient Supply Chain." *The International Journal of Logistics Management* 15 (2): 1–14. <https://doi.org/10.1108/09574090410700275>.

- . 2004c. “Building the Resilient Supply Chain.” *The International Journal of Logistics Management* 15 (2): 1–14. <https://doi.org/10.1108/09574090410700275>.
- Chunsheng, Li, Christina W.Y. Wong, Ching-Chiao Yang, Kuo-Chung Shang, and Taih-cherng Lirn. 2019a. “Value of Supply Chain Resilience: Roles of Culture, Flexibility, and Integration.” *International Journal of Physical Distribution & Logistics Management* 50 (1): 80–100. <https://doi.org/10.1108/ijpdlm-02-2019-0041>.
- . 2019b. “Value of Supply Chain Resilience: Roles of Culture, Flexibility, and Integration.” *International Journal of Physical Distribution & Logistics Management* 50 (1): 80–100. <https://doi.org/10.1108/ijpdlm-02-2019-0041>.
- Clavijo-Buritica, Nicolás, Laura Triana-Sanchez, and John Willmer Escobar. 2023. “A Hybrid Modeling Approach for Resilient Agri-Supply Network Design in Emerging Countries: Colombian Coffee Supply Chain.” *Socio-Economic Planning Sciences* 85 (C): 101–431. <https://ideas.repec.org/a/eee/soceps/v85y2023ics0038012122002324.html>.
- Dharmaraj, V., and C. Vijayanand. 2018. “Artificial Intelligence (AI) in Agriculture.” *International Journal of Current Microbiology and Applied Sciences* 7 (12): 2122–28. <https://doi.org/10.20546/ijcmas.2018.712.241>.
- Endres, Jody M., A. Bryan Endres, and Jeremy J. Stoller. 2013. “Building Bio-Based Supply Chains: Theoretical Perspectives on Innovative Contract Design.” *UCLA Journal of Environmental Law and Policy* 31 (1). <https://doi.org/10.5070/l5311019151>.
- Esteso, Ana, M. M. E. Alemany, Fernando Ottati, and Ángel Ortiz. 2023. “System Dynamics Model for Improving the Robustness of a Fresh Agri-Food Supply Chain to Disruptions.” *Operational Research* 23 (2). <https://doi.org/10.1007/s12351-023-00769-7>.
- Folke, C, S Carpenter, B Walker, M Scheffer, T Chapin, and J. Rockström. 2017. “Resilience Thinking: Integrating Resilience, Adaptability and Transformability.” *Ecology and Society*. 2017. <https://www.semanticscholar.org/paper/Resilience-thinking%3A-integrating-resilience%2C-and-Folke-Carpenter/178f1bbc4ffe48b1f4be9b67d281c727a16e531>.
- Glauser, JOSEPH , DAVID Laborde, and JOHAN Swinnen. 2023. “The Russia-Ukraine War’s Impact on Global Food Markets: A Historical Perspective.” Ifpri.org. International Food Policy Research Institute. 2023.

- <https://www.ifpri.org/blog/russia-ukraine-wars-impact-global-food-markets-historical-perspective>.
- Hobbs, Jill E. 2020. "Food Supply Chains during the COVID-19 Pandemic." *Canadian Journal of Agricultural Economics/Revue Canadienne D'agroeconomie* 68 (2): 171–76. <https://doi.org/10.1111/cjag.12237>.
- Ioannis, Manikas, Malindretos George, and Moschuris Socrates. 2019. "A Community-Based Agro-Food Hub Model for Sustainable Farming." *Sustainability* 11 (4): 1017. <https://doi.org/10.3390/su11041017>.
- Isakson, S.R. 2017. "Food and Finance: The Financial Transformation of Agro-Food Supply Chains." *The Journal of Peasant Studies* / 41 (5): 749–75. <https://www.farmlandgrab.org/post/view/23971-food-and-finance-the-financial-transformation-of-agro-food-supply-chains>.
- Jati, Roko Patria. 2004. "Joffe Yardley 2004 Content Thematic Analysis." *Sage*, January. https://www.academia.edu/38033117/Joffe_Yardley_2004_Content_Thematic_Analysis.
- Joffe, Helene. 2011. "Thematic Analysis." *A Guide for Students and Practitioners*, 209–23. https://www.academia.edu/26140328/Thematic_Analysis.
- Joshi, Sudhanshu, Rohit Kumar Singh, and Manu Sharma. 2023. "Sustainable Agri-Food Supply Chain Practices: Few Empirical Evidences from a Developing Economy." *Global Business Review* 24 (3): 451–74. <https://ideas.repec.org/a/sae/globus/v24y2023i3p451-474.html>.
- Kallio, Hanna, Anna-Maija Pietilä, Martin Johnson, and Mari Kangasniemi. 2016. "Systematic Methodological Review: Developing a Framework for a Qualitative Semi-Structured Interview Guide." *Journal of Advanced Nursing* 72 (12): 2954–65. <https://doi.org/10.1111/jan.13031>.
- Kleindorfer, Paul R., and Germaine H. Saad. 2009a. "Managing Disruption Risks in Supply Chains." *Production and Operations Management* 14 (1): 53–68. <https://doi.org/10.1111/j.1937-5956.2005.tb00009.x>.
- . 2009b. "Managing Disruption Risks in Supply Chains." *Production and Operations Management* 14 (1): 53–68. <https://doi.org/10.1111/j.1937-5956.2005.tb00009.x>.
- Kowal, S., and D.C. O'Connell. 2014. "Transcription as a Crucial Step of Data Analysis." In *The SAGE Handbook of Qualitative Data Analysis*.

- [https://www.ufs.ac.za/docs/librariesprovider68/resources/methodology/uwe_flick_\(ed\)-_the_sage_handbook_of_qualitative\(z-lib-org\)-\(1\).pdf?sfvrsn=db96820_2](https://www.ufs.ac.za/docs/librariesprovider68/resources/methodology/uwe_flick_(ed)-_the_sage_handbook_of_qualitative(z-lib-org)-(1).pdf?sfvrsn=db96820_2).
- Kumar, Pravin, and Rajesh Kumar Singh. 2022. "Strategic Framework for Developing Resilience in Agri-Food Supply Chains during COVID 19 Pandemic." *International Journal of Logistics Research and Applications* 25 (11). <https://trid.trb.org/view/2026356>.
- Kundzewicz, Zbigniew W., Shinjiro Kanae, Sonia I. Seneviratne, John Handmer, Neville Nicholls, Pascal Peduzzi, Reinhard Mechler, et al. 2013. "Flood Risk and Climate Change: Global and Regional Perspectives." *Hydrological Sciences Journal* 59 (1): 1–28. <https://doi.org/10.1080/02626667.2013.857411>.
- Macfadyen, Sarina, Jason M. Tylianakis, Deborah K. Letourneau, Tim G. Benton, Pablo Tiftonell, Michael P. Perring, Carla Gómez-Creutzberg, et al. 2015. "The Role of Food Retailers in Improving Resilience in Global Food Supply." *Global Food Security* 7 (December): 1–8. <https://doi.org/10.1016/j.gfs.2016.01.001>.
- Manikas, Ioannis, Balan Sundarakani, Foivos Anastasiadis, and Beshir Ali. 2022. "A Framework for Food Security via Resilient Agri-Food Supply Chains: The Case of UAE." *Sustainability* 14 (10): 6375. <https://doi.org/10.3390/su14106375>.
- Manuj, Ila, and John T. Mentzer. 2008a. "GLOBAL SUPPLY CHAIN RISK MANAGEMENT." *Journal of Business Logistics* 29 (1): 133–55. <https://doi.org/10.1002/j.2158-1592.2008.tb00072.x>.
- . 2008b. "GLOBAL SUPPLY CHAIN RISK MANAGEMENT." *Journal of Business Logistics* 29 (1): 133–55. <https://doi.org/10.1002/j.2158-1592.2008.tb00072.x>.
- Mateo-Fornés, Jordi, Wladimir Soto-Silva, Marcela C. González-Araya, Lluís M. Plà-Aragonès, and Francesc Solsona-Tehas. 2021. "Managing Quality, Supplier Selection, and Cold-Storage Contracts in Agrifood Supply Chain through Stochastic Optimization." *International Transactions in Operational Research*, October. <https://doi.org/10.1111/itor.13069>.
- Mbah, Evangeline Nwakaego, and Onwubuya Elizabeth Amechi. 2008. "Farmer Field School (FFS) and Junior Farmer Field and Life School (JFFLS) as Challenges to Agricultural Extension Development and Practice in Nigeria." *Journal of Agricultural Extension* 14 (1): 62–71. <https://doi.org/10.4314/jae.v14i1.64069>.
- McCullough, E.B., P.L. Pingali, and K.G. Stamoulis. 2008. *The Transformation of Agri-Food Systems: Globalization, Supply Chains and Smallholder Farmers*. Routledge

- & *CRC Press*. Routledge Tayllor and Francis Group.
<https://www.routledge.com/The-Transformation-of-Agri-Food-Systems-Globalization-Supply-Chains-and/McCullough-Pingali-Stamoulis/p/book/9781844075690>.
- Mehmood, Amina, Shehzad Ahmed, Evi Viza, Anna Bogush, and Rana Muhammad Ayyub. 2021. "Drivers and Barriers towards Circular Economy in Agri-Food Supply Chain: A Review." *BUSINESS STRATEGY & DEVELOPMENT*, June. <https://doi.org/10.1002/bsd2.171>.
- Mirabelli, Giovanni, and Vittorio Solina. 2020. "Blockchain and Agricultural Supply Chains Traceability: Research Trends and Future Challenges." *Procedia Manufacturing* 42: 414–21. <https://doi.org/10.1016/j.promfg.2020.02.054>.
- MMQ, Mirza. 2011. "Climate Change, Flooding in South Asia and Implications." National Institute of Environmental Health Sciences. 2011. https://tools.niehs.nih.gov/cchhl/index.cfm/main/detail?reference_id=1609.
- Monteiro, José, and João Barata. 2021a. "Artificial Intelligence in Extended Agri-Food Supply Chain: A Short Review Based on Bibliometric Analysis." *Procedia Computer Science* 192 (January): 3020–29. <https://doi.org/10.1016/j.procs.2021.09.074>.
- . 2021b. "Artificial Intelligence in Extended Agri-Food Supply Chain: A Short Review Based on Bibliometric Analysis." *Procedia Computer Science* 192 (January): 3020–29. <https://doi.org/10.1016/j.procs.2021.09.074>.
- . 2021c. "Artificial Intelligence in Extended Agri-Food Supply Chain: A Short Review Based on Bibliometric Analysis." *Procedia Computer Science* 192 (January): 3020–29. <https://doi.org/10.1016/j.procs.2021.09.074>.
- Munoz, Albert, and Michelle Dunbar. 2015. "On the Quantification of Operational Supply Chain Resilience." *International Journal of Production Research* 53 (22): 6736–51. <https://ideas.repec.org/a/taf/tprxxx/v53y2015i22p6736-6751.html>.
- Nasir, Muh Amat, Agus Dwi Nugroho, and Zoltan Lakner. 2022. "Impact of the Russian–Ukrainian Conflict on Global Food Crops." *Foods* 11 (19): 2979. <https://doi.org/10.3390/foods11192979>.
- Natarajarathinam, Malini, I. Capar, and A. Narayanan. 2009. "Managing Supply Chains in Times of Crisis: A Review of Literature and Insights." *International Journal of Physical Distribution & Logistics Management* 39 (7): 535–73. <https://www.semanticscholar.org/paper/Managing-supply-chains-in-times-of->

- crisis%3A-a-review-Natarajarathinam-Capar/3b5a81511627548586cdbaa22191c5026ed08cfe.
- Nowell, Lorelli S., Jill M. Norris, Deborah E. White, and Nancy J. Moules. 2017. "Thematic Analysis: Striving to Meet the Trustworthiness Criteria." *International Journal of Qualitative Methods* 16 (1): 1–13. <https://doi.org/10.1177/1609406917733847>.
- Obonyo, E., M. Formentini, S.W. Ndiritu, and D. Naslund. 2023. *Information Sharing in African Perishable Agri-Food Supply Chains: A Systematic Literature Review and Research Agenda-Reference-Cited By-全球学者库*. Emerald. Emerald. <http://globalauthorid.com/WebPortal/ArticleView?wd=20438966E5589074EE4509AFEB36D8A566E90F69C17DE556709C41ABCB8E3610>.
- Pardaev, Khusniddin, Shavkat Hasanov, Shukrullo Muratov, and Fotima Saydullaeva. 2023. "Mitigating Impact of Risks on Economic Integration between Entities in Agrifood Supply Chain." Edited by D. Bazarov. *E3S Web of Conferences* 365: 04002. <https://doi.org/10.1051/e3sconf/202336504002>.
- Pettit, Timothy J., Keely L. Croxton, and Joseph Fiksel. 2013. "Ensuring Supply Chain Resilience: Development and Implementation of an Assessment Tool." *Journal of Business Logistics* 34 (1): 46–76. <https://doi.org/10.1111/jbl.12009>.
- Pettit, Timothy J., Joseph Fiksel, and Keely L. Croxton. 2010a. "ENSURING SUPPLY CHAIN RESILIENCE: DEVELOPMENT of a CONCEPTUAL FRAMEWORK." *Journal of Business Logistics* 31 (1): 1–21. <https://doi.org/10.1002/j.2158-1592.2010.tb00125.x>.
- . 2010b. "ENSURING SUPPLY CHAIN RESILIENCE: DEVELOPMENT of a CONCEPTUAL FRAMEWORK." *Journal of Business Logistics* 31 (1): 1–21. <https://doi.org/10.1002/j.2158-1592.2010.tb00125.x>.
- Planning Commission, Ministry of Planning Development , Govt. of Pakistan. 2022. "MAIN REPORT Ministry of Planning Development & Special Initiatives." <https://thedocs.worldbank.org/en/doc/4a0114eb7d1cecbbf2f65c5ce0789db-0310012022/original/Pakistan-Floods-2022-PDNA-Main-Report.pdf>.
- Puška, A., Safet Kozarević, and Jasmina Okičić. n.d. "Investigating and Analyzing the Supply Chain Practices and Performance in Agro-Food Industry." *International Journal of Management Science and Engineering Management*, 15 (1): 9–16. <https://www.semanticscholar.org/paper/Investigating-and-analyzing-the-supply->

- chain-and-in-Pu%C5%A1ka-Kozarevi%C4%87/96fa1cbf9a9db9f83a899955cc79db319b66fe3a.
- Qu, Sandy, and John Dumay. 2011. "The Qualitative Research Interview." Ssrn.com. 2011. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2058515.
- Rapley, Tim, and Gethin Rees. 2018. *The SAGE Handbook of Qualitative Data Collection Methods*. sagepub.com. SAGE Publications Ltd. <https://methods.sagepub.com/book/the-sage-handbook-of-qualitative-data-collection/i2585.xml>.
- Ritchie, B., and C. Brindley. 2007. "Supply Chain Risk Management and Performance: A Guiding Framework for Future Development." *International Journal of Operations & Production Management* 27 (3): 303–22. <https://www.semanticscholar.org/paper/Supply-chain-risk-management-and-performance%3A-A-for-Ritchie-Brindley/bd2f897ef0d66a8af465422ced18c1951cd26cc1>.
- Schmitt, Amanda J., and Mahender Singh. 2011. "A Quantitative Analysis of Disruption Risk in a Multi-Echelon Supply Chain." *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.1463417>.
- Scholten, Kirstin, and Sanne Schilder. 2015. "The Role of Collaboration in Supply Chain Resilience." *Supply Chain Management: An International Journal* 20 (4): 471–84. <https://doi.org/10.1108/scm-11-2014-0386>.
- Serhiy, Y, Mary Ponomarov, and Holcomb. 2009. "Understanding the Concept of Supply Chain Resilience." *The International Journal of Logistics Management* 20 (1): 219–31. <https://srv2.freepaper.me/n/7dk1f66x18S9pHklGUOW3g/PDF/d7/d79909318d20b3fc73f3e82c7aef1496.pdf>.
- Sharma , Anandika , Anupam Sharma , Rohit Kumar Singh, and Tarunpreet Bhatia. 2023. "Blockchain Adoption in Agri-Food Supply Chain Management: An Empirical Study of the Main Drivers Using Extended UTAUT." *Business Process Management Journal* 29 (March): 737–56. <https://www.x-mol.net/paper/article/1636393090550394880>.
- Sharma, Minky , and Pawan Kumar. 2021. "Adoption of Blockchain Technology: A Case Study of Walmart." *Blockchain Technology and Applications for Digital Marketing* , January, 210–25. <https://doi.org/10.4018/978-1-7998-8081-3.ch013>.

- Skalkos, Dimitris. 2022. "Innovative Agrifood Supply Chain in the Post-COVID 19 Era." *Sustainability* 14 (9): 5359. <https://doi.org/10.3390/su14095359>.
- . 2023. "Prospects, Challenges and Sustainability of the Agri-Food Supply Chain in the New Global Economy II." *Sustainability* 15 (16): 12558. <https://doi.org/10.3390/su151612558>.
- Smith, B. Gail. 2008. "Developing Sustainable Food Supply Chains." *Philosophical Transactions of the Royal Society B: Biological Sciences* 363 (1492): 849–61. <https://doi.org/10.1098/rstb.2007.2187>.
- Srivastava , Ayushi , and Kavya Dashora. n.d. "Application of Blockchain Technology for Agrifood Supply Chain Management: A Systematic Literature Review on Benefits and Challenges." *Benchmarking an International Journal* 29: 3426–42. <https://doi.org/0.1108/BIJ-08-2021-0495>.
- Stevens, Andrew W, and Jim Teal. 2023. "Diversification and Resilience of Firms in the Agrifood Supply Chain." *American Journal of Agricultural Economics*, March. <https://doi.org/10.1111/ajae.12398>.
- Stone, Jamie, and Shahin Rahimifard. 2018a. "Resilience in Agri-Food Supply Chains: A Critical Analysis of the Literature and Synthesis of a Novel Framework." *Supply Chain Management: An International Journal* 23 (3): 207–38. <https://doi.org/10.1108/scm-06-2017-0201>.
- . 2018b. "Resilience in Agri-Food Supply Chains: A Critical Analysis of the Literature and Synthesis of a Novel Framework." *Repository.lboro.ac.uk*, May. <https://doi.org/10.1108/SCM-06-2017-0201>].
- . 2018c. "Resilience in Agri-Food Supply Chains: A Critical Analysis of the Literature and Synthesis of a Novel Framework." *Repository.lboro.ac.uk*, May. <https://doi.org/10.1108/SCM-06-2017-0201>].
- . 2018d. "Resilience in Agri-Food Supply Chains: A Critical Analysis of the Literature and Synthesis of a Novel Framework." *Supply Chain Management: An International Journal* 23 (3): 207–38. <https://doi.org/10.1108/scm-06-2017-0201>.
- Taşkıner, Tuğçe, and Bilge Bilgen. 2021. "Optimization Models for Harvest and Production Planning in Agri-Food Supply Chain: A Systematic Review." *Logistics* 5 (3): 52. <https://doi.org/10.3390/logistics5030052>.
- Taylor, David H., and Andrew Fearne. 2006. "Towards a Framework for Improvement in the Management of Demand in Agri-Food Supply Chains." *Supply Chain*

- Management: An International Journal* 11 (5): 379–84.
<https://doi.org/10.1108/13598540610682381>.
- Tehrani, Nik , and Jahan Ghofraniha. 2019BC. “IoT Sensors Used for Marine Cargo Shipments.” *Journal of Scientific and Engineering Research* 6 (9): 11–43.
<http://jsaer.com/download/vol-6-iss-9-2019/JSAER2019-6-9-11-13.pdf>.
- Terry, Gareth, Nikki Hayfield, Victoria Clarke, and Virginia Braun. 2016. “[Citations: Alpha Order] [Spelling UK Ize] [Recto Running Head: Thematic Analysis] 2 Thematic Analysis.” *UWE Repository*. <https://uwe-repository.worktribe.com/preview/888534/Terry%20et%20al.%20in%20Willig%20and%20Stainton%20Rogers.pdf>.
- Walker, Brian, C. S. Holling, Stephen R. Carpenter, and Ann P. Kinzig. 2004. “Resilience, Adaptability and Transformability in Social-Ecological Systems.” *Ecology and Society* 9 (2). <https://doi.org/10.5751/es-00650-090205>.
- Wheatley, C., and D. Peters. 2003. “Who Benefits from Enhanced Management of Agri-Food Supply Chains?” In *Agriproduct Supply-Chain Management in Developing Countries*. Canberra 2004: Australian Centre for International Agricultural Research. <https://era.daf.qld.gov.au/id/eprint/7742/1/PR119.pdf#page=113>.
- Wolfert, J., C. N. Verdouw, and A. J. M. Beulens. 2010. “Information Sharing & ICT in Agri-Food Supply Chain Networks – a View from Different Perspectives.” Library.wur.nl. Aachen: Shaker Verlag. 2010.
<https://library.wur.nl/WebQuery/wurpubs/395313>.
- Yontar, Emel. 2023. “Critical Success Factor Analysis of Blockchain Technology in Agri-Food Supply Chain Management: A Circular Economy Perspective.” *Journal of Environmental Management* 330 (March): 117173.
<https://doi.org/10.1016/j.jenvman.2022.117173>.
- Zhao, Guoqing. 2021. “Increase Supply Chain Performance by Addressing Knowledge Governance, Resilience Capabilities, and Risks: Empirical Evidence from the Agri-Food Industry.” *University of Plymouth Research Theses*.
<https://doi.org/10.24382/926>.
- Zhao, Guoqing, Mar Vazquez-Noguerol, Shaofeng Liu, and Carlos Prado. 2023. “Agri-Food Supply Chain Resilience Strategies for Preparing, Responding, Recovering, and Adapting in Relation to Unexpected Crisis: A Cross-Country Comparative Analysis from the COVID-19 Pandemic.” *Journal of Business Logistics*, September. <https://doi.org/10.1111/jbl.12361>.

Zhao, Guoqing, Femi Olan, Shaofeng Liu, Jorge Hernandez Hormazabal, Carmen Lopez, Nasiru Zubairu, Jinhua Zhang, and Xiaoning Chen. 2022. "Links between Risk Source Identification and Resilience Capability Building in Agri-Food Supply Chains: A Comprehensive Analysis." *IEEE Transactions on Engineering Management*, 1–18. <https://doi.org/10.1109/tem.2022.3221361>.

Zohrabi, Mohammad. 2013. "Mixed Method Research: Instruments, Validity, Reliability and Reporting Findings." *Theory and Practice in Language Studies* 3 (2): 254–62. <https://doi.org/10.4304/tpls.3.2.254-262>.

8 Appendix

Theme	Mean	SD
1. Sourcing and Suppliers		
Global Sourcing	5.00	0
Diverse Suppliers	5.00	0
Speed in Supplier Selection	3.71	0.48795
Substitutes for Core Products	5.00	0
2. Distribution Channels		
Traditional and Modern Channels	5.00	0
Business to Business Channel	1.57	1.511858
Online Presence	3.86	1.9518
3. Substitutes and Alternatives		
Alternative Distribution Channels	2.14	1.9518
Contract Terms for Delayed Production	3.29	2.13809
4. Contracts and Financial Aspects		
Flexibility in Mode of Delivery	4.71	0.48795
Flexibility in Timing of Deliveries	3.71	0.48795
Access to Liquid Assets	4.43	0.786796

Credit Terms in Transactions	2.71	2.13809
Collective Database of Strategies	2.71	2.13809
Replacement in Absence	5.00	0
5. Risk Management and Resilience		
Hiring for Risk Management	5.00	0
Layoff of Employees Performing Multiple Roles	1.00	0
6. Assets and Resource Management		
Strong Market Position	4.86	0.377964
Acceptance of Substitute Products	4.71	0.755929
Business Continuity Plan	5.00	0
Joint Decision Making	4.71	0.48795
Leadership Commitment to Avoid Waste	4.43	0.534522
Critical Tangible Assets	5.00	0
Open Culture for Learning and Decision Making	5.00	0
Resources to Monitor Past Decisions	5.00	0
Excess Capacity for Abnormal Requirements	3.86	1.9518
Excess Storage and Transportation	3.86	1.9518
IT System for Warnings	5.00	0
Security System for Defense	5.00	0
Mutual Risk and Asset Sharing	1.00	0
Information Sharing in Supply Chain	4.14	0.899735
Commonalities with Partners	1.57	1.511858

7. Market Position and Brand Loyalty		
Relationship with Suppliers and Retailers	4.71	0.48795
Choosing Same Supplier	5.00	0
Single Supplier in Supply Chain	1.00	0
8. Information Sharing and Learning		
Customer Trends Awareness	5.00	0
Self-Organization in Supply Chain	4.71	0.48795
Willingness to Change Course Easily	4.71	0.48795
Co-learning about Disruptions	5.00	0
9. External Resources and Communities		
Government and Public Support	5.00	0
External Resources for Overcoming Disruptions	4.43	1.511858
10. Efficiency and Timeliness		
Efficient Product Travel	4.43	0.9759
Meeting Objectives During Disruption	4.29	1.496026
Meeting Objectives Post Disruption	4.71	0.48795
Supply Chain Wide Procedures for Recovery	1.00	0
Efforts to Reduce Lead Time	4.86	0.377964
Visibility in Supply Chain	5.00	0
Customer Trends Confidentiality	5.00	0

Self-Organization Effect by External Forces	3.29	0.48795
Willingness to Change Course Easily	3.14	0.377964
Co-learning about Disruptions	5.00	0
11. Self-Organization and Adaptability		
Self-Organization Effect by External Forces	3.29	0.48795
Willingness to Change Course Easily	3.14	0.377964
Co-learning about Disruptions	5.00	0
12. System-Wide Backup		
System-Wide Backup and Storage	1.00	0
12.Skill Diversity for Resilience		
Skill Diversity	4.71	0.48795

Interview 1:

Company: Snacks manufacturing company in Pakistan

Person: AGM supply chain

Core products: Snacks, assorted Biscuits, Cookies.

1) How do you source your raw material and inputs?

We have a distributed supplier side. With a lot of suppliers for raw material and up to packaging. For major ingredients we have suppliers on the national level. But for some raw materials we have suppliers globally because these materials are not available in Pakistan.

2) What are your distribution channels?

It varies. Because selling is very diversified now so we should have multiple channels. We usually have conventional mode of trade which is distributor wholesaler and then retailer. Now we have modern distribution, and every channel has its own market share growing such as direct sales to stores and e-commerce platforms, so we are using all of them. We have both international and local markets, but the international market is small.

3) How quickly you can choose between different suppliers when you face a disruption?

With supplier selection, product selection also matters a lot. There are some products with limited suppliers so we should have inventory cover for that to sustain disruptions. But if we have product flexibility then we go for supplier selection.

4) Do you have substitutes for your core products to offer?

The customers are not very brand conscious in our product category. And there is no preplanned buying, but it is mostly spontaneous so that's why customers can go for substitute product in case of unavailability.

5) Do you have alternative distribution channels?

yes

6) Do you have contract terms with your partners that you can delay the production in case of disruptions?

For some product segments we have specially in case of stock out if customer is facing financial setback, then we have a specific portion.

7) How easily you can change the mode of delivery?

Easily (4)

8) How easily you can change the timing of deliveries?

3 not very easy

9) In case of cash shortage how fast you can access liquid assets?

5 very easy

10) What is the mode of transactions e.g on credit terms?

Advance payments or credit base no cash of deliveries in our field of business.

11) Do you have a collective database of strategies which could be used for developing skills of individuals for future disruptions?

no

12) In the absence of the person in charge who will take the responsibility for that person.

We have a replacement but not full fledged.

13) How do you weigh risk management as a skill in hiring a new employee in managerial positions?

important

14) Do you consider to layoff people who can perform multiple roles in time of disruptions?

No it has not been considered because it is usually a last resort so that's why. Even in different disruptions the business is continued enough to not go for last resort.

15) What kind of employees who last get laid off in times of disruptions?

We cut perks such as fuel allowance car monetization. We consider this before going for downsizing.

16) How strong is your market position (brand loyalty)?

very strong.

17) If you offer a substitute product your customers will accept it?

It depends on the location.

18) Do you have a business continuity plan? If yes, how do you think it helps? If no then why not?

Yes, but we have a plan for 1-4 months not so much long-term planning. In case of disruptions, we also go for short term planning to mitigate. But up to 24 months is very difficult in our segment.

17) What is the degree of joint decision making? Especially from the employees who have learnt from past disruptions.

We have a layer and up to that layer we involve employees in decision making.

19) How is your leadership committed to avoid unnecessary waste?

Committed

20) What kind of critical assets(tangible) do you have and is there any contingency plan for them?

We have insurance coverage for that.

21) How do you communicate leadership with the rest of the organization?

We have a very flat hierarchy, coordination and interaction is very easily down the line not like a triangular structure.

22) Do you have an open culture for learning and joint decision making when it comes to respond to risk and anticipate it in advance?

Yes.

23) Do you have some resources to monitor the decision you have made in the past with their outcomes and learning from these decisions?

yes

24) Do you always have excess capacity to deal with abnormal requirements?

no

25) Do you have excess storage capacity and transportation?

no,

26) Do you have a system, whether its IT or trained staff which can give warnings of a possible disruption e.g due to low inventory levels?

To some extent yes,

27) Do you have a security system in place for the defense of your assets?

yes

28) Do you share mutual risk and assets with your partners?

yes

29) How is the level of information sharing between different actors in the supply chain and your firm?

4 good

30) Do you have anything in common with partners other than mutual customers or suppliers?

no

31) How do you describe your relationship with your suppliers and retailers?

Good. We go for partnerships to have cost efficiency.

32)If you have lot of options for choosing suppliers, what are the reasons behind going for the same supplier?

It depends on product parameters, expertise of supplier and lead time and cost it all depends on if you want to sacrifice quality or go for expensive product.

32) Do you have any product which you source from a single supplier in your supply chain? If yes how you deal with them in disruptions with these critical points?

We have some of these imported products and the only solution is to increase stock for this material or you will suffer a loss.

33) Do you have many actors in the supply chain, and they are closely located or far?

Yes, from close to far but mostly locally.

34) If you have a large number of actors how is the information flow between them and you?

4 good

35) in case of disruption how do you think resources from communities such as government, public, local economy can help you to overcome disruption and keeping your business ongoing?

Obviously, there is a role and area of improvement is always there. They are there to provide facilities, infrastructure and approvals and certifications you can produce by yourself but without them you cannot sell. In case of disruptions, you are in sort of emergency such as highway is damaged the government is there to rebuild it but it is for every business not only you. There cannot be additional support for you in this case. It is usually for everyone but they can do one thing, that is to improve the overall infrastructure because it is very time consuming and expensive.

36) How efficiently did the product travel through a supply chain?

Fast 4

37) Do you meet your objectives in a timely manner during the disruption?

No there are certain delays.

38) Do you meet your objectives in a timely manner post disruption?

no

39) Do you have supply chain wide procedures and plans for disruptions to enhance recovery?

Yes, but overall, a generic documentation is present it varies case to case. And a collaboration is present on top level. And their advisory goes down the line.

40) How does your supply chain take efforts to reduce lead time and respond to customer demands?

we don't have so much footprint in global level we have limited customer and volume, and their timeline are flexible and planning for them is different from national customer because their lead times are more. and the planning cycle is very refined.

41) How visible it is to see the product and processes in other parts of the supply chain? Is the information flow smooth and the right knowledge being transferred to the right people?

Visible

42) Do you know about the customer trends and pass it to other actors and are they visible to competitors also?

Yes, but they don't have company-oriented data it is confidential.

43) how self organised is the supply chain does it get effected by external forces?

Yes

44) how self organised is the supply chain does it have will to change its course easily?

yes

45) The co learning about the missed and actual disruptions is widely practiced?

yes

46) Do you have system wide backup and storage facilities in the supply chain?

Yes

47) Do you have replacements for your critical nodes?

yes

48) During the past disruption did you lose your core functionality? If you don't lose that how long, it took to absorb the setback from disruption?

We had one segment which was affected for a couple of weeks. Because we were in center, and it was based in sukkher in south. But we get support in the center because of a support of some road structure but it took us 3 weeks to recover all our problematic segments.

49) In your supply chain do you have diverse range of skills to absorb the shocks from disruption and recover it fast?

yes

personal insights:

it is always learning because you are not used to disruptions, because the last flood was in 2010 one of the biggest and severe then it comes last year in 2022. But if you have a

trend that there is going to be a monsoon season and the flooding is expected you can gauge or measure it. But like last year's rain if that happen now maybe it was not so severe because everybody was prepared for it and know it consequences but if it is coming after a very long time then people start to forget it and not well prepared for it. And now the mother nature comes strong every time, so we have sops for that to minimize impact as we have learned that floods are inevitable in monsoon periods.

Interview 2:

Company: Species and many types of daily consumed foody products (Pakistan)

Person: Supply chain manager

Core products: species, ready made desserts, rice, and salt.

1)How do you source your raw material and inputs?

It depends on the nature of the product like some products are not readily available in Pakistan, so they have to be imported like some spices in India, but for rice we have own manufacturing facilities and our own farms. For dessert and other products, we have some suppliers but for some critical raw sources we are dependent on imports like from Afghanistan specially for nuts and other stuff.

2) What are your distribution channels?

In the past we mostly relied on distributors to sell our products, which are still widely used as well. But now for international sales we are going for online stores and direct sales to foreign customers but in some countries, we are also partners with local businesses. For

food service industry in Pakistan, we deliver directly to them such as restaurants and catering services.

3) How quickly you can choose between different suppliers when you face a disruption?

Again, it depends on the product type, but we have a large supplier base, so we change quickly, and our supplier bases are both locally and internationally.

4) Do you have substitutes of your core products to offer?

No we don't.

5) Do you have alternative distribution channels?

Yes

6) Do you have contract terms with your partners that you can delay the production in case of disruptions?

No, we usually don't have contract terms, but we always maintain some stock so that our production isn't stuck in disruptions.

7) How easily you can change the mode of delivery?

It is very difficult when it comes to international deliveries but locally, we can change it because of many third-party options.

8) How easily you can change the timing of deliveries?

Again, it depends on the international or local market. Same answer as above.

9) In case of cash shortage how fast you can access liquid assets?

Since we are a company with 70 years of experience and market name it's easy for us to access them.

10) What is the mode of transactions e.g on credit terms?

Mostly its on credit terms with both markets but it is also transforming into advance payments and cash on deliveries with small distributors.

11) Do you have a collective database of strategies which could be used for developing skills of individuals for future disruptions?

No, we don't have such database, but we learn and share experiences which is a critical hiring criterion also.

12) In the absence of the person in charge who will take the responsibility for that person.

We have replacements for most of the staff, but some high positions need time to be replaced.

13) How do you weigh risk management as a skill in hiring a new employee in managerial positions?

It is very important.

14) Do you consider to layoff people who can perform multiple roles in time of disruptions?

No, we try to avoid lay off as much as possible.

15) What kind of employees who last get laid off in times of disruptions?

Mostly people who work in daily wage labor.

16) How strong is your market position (brand loyalty)?

We have competition but because we have been in the market for a long time, it is strong.

17) If you offer a substitute product your customers will accept it?

It depends on the product we if we provide same taste they would.

18) Do you have a business continuity plan? If yes, how do you think it helps? If no then why not?

Yes, it helps to go through disruptions like the current economic crisis.

17) What is the degree of joint decision making? Especially from the employees who have learnt from past disruptions.

It is very high we involve every voice to make our processes better.

19) How is your leadership committed to avoid unnecessary waste?

We strongly try to avoid as much waste as we can.

20) What kind of critical assets(tangible) do you have and is there any contingency plan for them?

It is hard to disclose them, our machines and plants are very critical, and we have a risk management plan for them.

21) How do you communicate leadership with rest of organization?

With the help of experience and stories shared through every team. We also follow a chain of command to communicate critical matters.

22) Do you have open culture for learning and joint decision making when it comes to respond to risk and anticipate it in advance?

Yes.

23) Do you have some resources to monitor the decision you have made in the past with their outcomes and learning from these decisions?

Yes currently we are taking help from business analysis softwares to dig deep into past data and to keep us updated with modern technology to help us learn.

24) Do you always have excess capacity to deal with abnormal requirements?

Yes.

25) Do you have excess storage capacity and transportation?

Yes, for both markets.

26) Do you have a system, whether its IT or trained staff which can give warnings of a possible disruption e.g due to low inventory levels?

Yes, we are currently updating it.

27) Do you have a security system in place for the defense of your assets?

We have a safety drive running right now to enhance safety practices.

28) Do you share mutual risk and assests with your partners?

No, we don't for most of our products and for shipments we have incoterm but for production it is complete our responsibility.

29) How is the level of information sharing between different actors in the supply chain and your firm?

Strong. We use all channels of communication.

30) Do you have anything common with partners other than mutual customers or suppliers?

Not more then customers or suppliers.

31) How do you describe your relationship with your suppliers and retailers?

We believe a strong relationship with our suppliers and distributors can help us to grow so that's why we are trying to improve it more.

32)If you have lot of options for choosing suppliers, what are the reasons behind going for the same supplier?

The trust on quality of the product because it affects the taste of the consumer.

32) Do you have any product which you source from a single supplier in your supply chain if yes how you deal with them in disruptions with these critical points?

Yes we have many products we try to make a partnership with that supplier or if possible start producing it by ourself.

33) Do you have large number of actors in supply chain and they are closely located or far?

Yes we have our business in almost all of the continents but our supply lines are closely located mostly in Asian countries.

34) If you have large number of actors how is the information flow between them and you?

The information takes place with the help of technology so everything is coordinated and go smoothly.

35) in case of disruption how do you think resources from communities such as government, public, local economy can help you to overcome disruption and keeping your business ongoing?

Government role is very important if you see india current situation they have ban export of rice to protect them from shortage of rice. Moreover natural disruptions cannot be managed alone and all can contribute to revive it.

36) How efficient the product travelled through a supply chain?

Fast

37) Do you meet your objectives in a timely manner during the disruption?

Mostly yes

38) Do you meet your objectives in a timely manner post disruption?

Yes

39) Do you have supply chain wide procedures and plans for disruptions to enhance recovery ?

Yes

40) How does your supply chain take efforts to reduce lead time and respond to customer demands?

We usually try to use different routes to reduce our lead time and we have buffer stocks to continue production. Our supply planner looks for alternative source of procurement through risk management plans to alter as quickly as possible.

41) How visible it is to see the product and processes in other parts of supply chain? Is the information flow smooth and right knowledge is being transferred to right people?

The information flow is visible to all stakeholders and continuously monitored.

42) Do you know about the customer trends and pass it to other actors and are they visible to competitors also?

Yes

43) how self organised is the supply chain does it get effected by external forces?

Yes it does and gradually recovers with the help of all actors.

44) how self organised is the supply chain does it have will to change its course easily?

Yes

45) The co learning about the missed and actual disruptions is widely practiced?

Mostly

46) Do you have system wide backup and storage facilities in supply chain?

Yes

47) Do you have replacements for your critical nodes?

Yes

48) During the past disruption did you lose your core functionality? If you don't lose that how long it took to absorb the setback from disruption?

We recover immediately but we are still trying to recover from its long lasting impact.

49) In your supply chain do you have diverse range of skills to absorb the shocks from disruption and recover it fast?

yes

Interview 3:

Company: Logistics company to transfer food related products (Norway)

Person: Logistics coordinator

Core products: transportation of food

1) How do you source your raw material and inputs?

We buy them from diverse suppliers

2) What are your distribution channels?

Air, road and boat

3) How quickly you can choose between different suppliers when you face a disruption?

Very difficult

4) Do you have substitutes of your core products to offer?

yes

5) Do you have alternative distribution channels?

no

6) Do you have contract terms with your partners that you can delay the production in case of disruptions?

No

7) How easily you can change the mode of delivery?

Very easy

8) How easily you can change the timing of deliveries?

easy

9) In case of cash shortage how fast you can access liquid assets?

Not easy not difficult

10) What is the mode of transactions e.g on credit terms?

Contract based

11) Do you have a collective database of strategies which could be used for developing skills of individuals for future disruptions?

yes

12) In the absence of the person in charge who will take the responsibility for that person.

We have replacements.

13) How do you weigh risk management as a skill in hiring a new employee in managerial positions?

Not important

14) Do you consider to layoff people who can perform multiple roles in time of disruptions?

No.

15) What kind of employees who last get laid off in times of disruptions?

Not sure

16) How strong is your market position (brand loyalty)?

Very low

17) If you offer a substitute product your customers will accept it?

Yes

18) Do you have a business continuity plan? If yes, how do you think it helps? If no then why not?

Yes, it helps to go through bad situations.

17) What is the degree of joint decision making? Especially from the employees who have learnt from past disruptions.

Very strong

19) How is your leadership committed to avoid unnecessary waste?

not committed very much 3 on scale

20) What kind of critical assets(tangible) do you have and is there any contingency plan for them?

No

21) How do you communicate leadership with rest of organization?

No idea

22) Do you have open culture for learning and joint decision making when it comes to respond to risk and anticipate it in advance?

Yes.

23) Do you have some resources to monitor the decision you have made in the past with their outcomes and learning from these decisions?

yes

24) Do you always have excess capacity to deal with abnormal requirements?

no

25) Do you have excess storage capacity and transportation?

Yes,

26) Do you have a system, whether its IT or trained staff which can give warnings of a possible disruption e.g due to low inventory levels?

Yes,

27) Do you have a security system in place for the defense of your assets?

yes

28) Do you share mutual risk and assests with your partners?

no

29) How is the level of information sharing between different actors in the supply chain and your firm?

poor

30) Do you have anything common with partners other than mutual customers or suppliers?

no

31) How do you describe your relationship with your suppliers and retailers?

close

32)If you have lot of options for choosing suppliers, what are the reasons behind going for the same supplier?

Good reputation

32) Do you have any product which you source from a single supplier in your supply chain if yes how you deal with them in disruptions with these critical points?

no

33) Do you have large number of actors in supply chain and they are closely located or far?

no

34) If you have large number of actors how is the information flow between them and you?

strong

35) in case of disruption how do you think resources from communities such as government, public, local economy can help you to overcome disruption and keeping your business ongoing?

No help from communities

36) How efficient the product travelled through a supply chain?

Very fast

37) Do you meet your objectives in a timely manner during the disruption?

yes

38) Do you meet your objectives in a timely manner post disruption?

Yes

39) Do you have supply chain wide procedures and plans for disruptions to enhance recovery ?

Yes

40) How does your supply chain take efforts to reduce lead time and respond to customer demands?

No effort. We just need to reach the time window in time.

41) How visible it is to see the product and processes in other parts of supply chain? Is the information flow smooth and right knowledge is being transferred to right people?

It is very visible

42) Do you know about the customer trends and pass it to other actors and are they visible to competitors also?

Yes

43) how self organised is the supply chain does it get effected by external forces?

Yes

44) how self organised is the supply chain does it have will to change its course easily?

Yes

45) The co learning about the missed and actual disruptions is widely practiced?

Mostly

46) Do you have system wide backup and storage facilities in supply chain?

Yes

47) Do you have replacements for your critical nodes?

no

48) During the past disruption did you lose your core functionality? If you don't lose that how long it took to absorb the setback from disruption?

It takes weeks

50) In your supply chain do you have diverse range of skills to absorb the shocks from disruption and recover it fast?

yes

Interview 4:

Company: a conglomerate for food related products (Pakistan)

Person: manager procurement

Core products: desserts, jams, pickles, frozen meals, ketchup, recipe masala, rice, basic spices, and snacks.

1) How do you source your raw material and inputs?

We buy them from diverse suppliers. Mostly from India and Pakistan but now we are moving to China and Afghanistan also.

2) What are your distribution channels?

Online stores, distributors, partnerships

3) How quickly you can choose between different suppliers when you face a disruption?

quickly

4) Do you have substitutes of your core products to offer?

no

5) Do you have alternative distribution channels?

yes

6) Do you have contract terms with your partners that you can delay the production in case of disruptions?

No

7) How easily you can change the mode of delivery?

easily

8) How easily you can change the timing of deliveries?

In between easy and difficult

9) In case of cash shortage how fast you can access liquid assets?

difficult

10) What is the mode of transactions e.g on credit terms?

Contract based credit terms and inco terms

11) Do you have a collective database of strategies which could be used for developing skills of individuals for future disruptions?

yes

12) In the absence of the person in charge who will take the responsibility for that person.

We have replacements.

13) How do you weigh risk management as a skill in hiring a new employee in managerial positions?

important

14) Do you consider to layoff people who can perform multiple roles in time of disruptions?

yes

15) What kind of employees who last get laid off in times of disruptions?

General Labor

16) How strong is your market position (brand loyalty)?

very good

17) If you offer a substitute product your customers will accept it?

Yes

18) Do you have a business continuity plan? If yes, how do you think it helps? If no then why not?

Yes, it helps to go through difficult times.

17) What is the degree of joint decision making? Especially from the employees who have learnt from past disruptions.

strong

19) How is your leadership committed to avoid unnecessary waste?

Committed

20) What kind of critical assets(tangible) do you have and is there any contingency plan for them?

Plants and warehouses. Yes we have

21) How do you communicate leadership with rest of organization?

Through multi modes of communication

22) Do you have open culture for learning and joint decision making when it comes to respond to risk and anticipate it in advance?

Yes.

23) Do you have some resources to monitor the decision you have made in the past with their outcomes and learning from these decisions?

yes

24) Do you always have excess capacity to deal with abnormal requirements?

yes

25) Do you have excess storage capacity and transportation?

Yes,

26) Do you have a system, whether its IT or trained staff which can give warnings of a possible disruption e.g due to low inventory levels?

Yes,

27) Do you have a security system in place for the defense of your assets?

yes

28) Do you share mutual risk and assests with your partners?

no

29) How is the level of information sharing between different actors in the supply chain and your firm?

good

30) Do you have anything common with partners other than mutual customers or suppliers?

no

31) How do you describe your relationship with your suppliers and retailers?

partners

32)If you have lot of options for choosing suppliers, what are the reasons behind going for the same supplier?

Quality of product

32) Do you have any product which you source from a single supplier in your supply chain if yes how you deal with them in disruptions with these critical points?

no

33) Do you have large number of actors in supply chain and they are closely located or far?

Yes, from close to far

34) If you have large number of actors how is the information flow between them and you?

good

35) in case of disruption how do you think resources from communities such as government, public, local economy can help you to overcome disruption and keeping your business ongoing?

No help In term of business

36) How efficient the product travelled through a supply chain?

Very fast

37) Do you meet your objectives in a timely manner during the disruption?

yes

38) Do you meet your objectives in a timely manner post disruption?

Yes

39) Do you have supply chain wide procedures and plans for disruptions to enhance recovery ?

Yes

40) How does your supply chain take efforts to reduce lead time and respond to customer demands?

We try to use all modes to respond as quickly as possible

41) How visible it is to see the product and processes in other parts of supply chain? Is the information flow smooth and right knowledge is being transferred to right people?

Visible

42) Do you know about the customer trends and pass it to other actors and are they visible to competitors also?

Yes

43) how self organised is the supply chain does it get effected by external forces?

Yes

44) how self organised is the supply chain does it have will to change its course easily?

no

45) The co learning about the missed and actual disruptions is widely practiced?

yes

46) Do you have system wide backup and storage facilities in supply chain?

Yes

47) Do you have replacements for your critical nodes?

no

48) During the past disruption did you lose your core functionality? If you don't lose that how long it took to absorb the setback from disruption?

It takes months to recover

49) In your supply chain do you have diverse range of skills to absorb the shocks from disruption and recover it fast?

yes

Interview 5:

Company: conglomerate of food manufacturing companies in Norway

Person: procurement category manager

Core products: vegetable oil, frozen pizza, can foods, fmcg products

1) How do you source your raw material and inputs?

it depends on the category because we have different products. Sometimes its Europe Asia or south America. Now it's a global sourcing but with a focus on Europe.

2) What are your distribution channels?

It's the traditional structure with retailers and distributors. Another channel is business to business. We have online too but its too small.

3) How quickly you can choose between different suppliers when you face a disruption?

Very quickly. But again, it really depends on the product type. For some products you need testing in the factory but for some you don't need. If talking about my category its fairly smoothly. If logistics are in place and testing is done.

4) Do you have substitutes for your core products to offer?

Yes in vegetable oils there are. For example if we don't have sunflowers we take its substitute such as repsona. But for short period of time.

5) Do you have alternative distribution channels?

No because they are retail channels in Norway and scanidvia its difficult to change them specially for fmcg products.

6) Do you have contract terms with your partners that you can delay the production in case of disruptions?

We are not keen on that because in disruptions everyone is waiting for things in factories or in shops on time. And if the suppliers are not meeting delivery targets then they are performing bad. So on retailer side we don't go for the delays. And on supplier side we focus on to get as much as possible on the material side and not us telling the customers that the product might be delayed.

7) How easily you can change the mode of delivery?

Very easy as long as the product quality and capability are maintained. It can be rail, containers.

8) How easily you can change the timing of deliveries?

We had direct communication with the supplier and coordinated with the factory. And sometimes in disruption we must adapt accordingly to the production plan. Sometimes we must have delays. And to key is that you have direct communication with the supplier and there is no discrepancy in that.

9) In case of cash shortage how fast you can access liquid assets?

Very easy.

10) What is the mode of transactions e.g on credit terms?

Credit terms. We never pay upfront.

Do you have a collective database of strategies which could be used for developing skills of individuals for future disruptions?

Yes, because in covid times throughout the period the procurement community has been a team and so on. Knowledge sharing and practices are presented to the organization. And they are shared and saved to use for future disruption.

11) In the absence of the person in charge who will take the responsibility for that person.

Yes. if its not planned then there is always someone who can be in contact with supplier until that person is back.

12) How do you weigh risk management as a skill in hiring a new employee in managerial positions?

Yes absolutely. It's very important also if they have the adaptability because in covid times a lot of things were new if you were working for 15 years you are facing this kind of thing for the first time in your career so adaptability was key element and now risk management.

13) Do you consider to layoff people who can perform multiple roles in time of disruptions?

No it was never on the agenda.

What kind of employees who last get laid off in times of disruptions?

It was the thing which was clear from the beginning from the management that no lay off and the factories were doing quite well at that time.

How strong is your market position (brand loyalty)?

The products are very common in the super markets and they are performing if you go to the market you see branded products with our brand name are so many.so its strong market position.

14) If you offer a substitute product your customers will accept it?

yes they will accept it if its is justified and explained to the customer why we are doing this in time of disruption.

15) Do you have a business continuity plan? If yes, how do you think it helps? If no then why not?

Yes we have a business success plan and during the disruptions we have weekly plans and updates in different part of organization regarding different issues that we saw in the market and it helps a lot on every side like sales or marketing how to communicate. And on production how to plan also in procurement how to act. That is super important and was in place.

17) What is the degree of joint decision making? Especially from the employees who have learnt from past disruptions.

It was quite high because during that period it was good to hear everybody and more brain more input for decision making. But in some cases, it helped in fast reaction time.

16) How is your leadership committed to avoid unnecessary waste?

Very committed.

17) What kind of critical assets(tangible) do you have and is there any contingency plan for them?

Yes we have a big organization with structures in different countries so they can cover up if something happen with production or some plant is shutdown.

18) How do you communicate leadership with the rest of the organization?

It is shared and in meetings giving information to everybody and also people presenting what they have been doing.

19) Do you have an open culture for learning and joint decision making when it comes to respond to risk and anticipate it in advance?

yes

20) Do you have some resources to monitor the decision you have made in the past with their outcomes and learning from these decisions?

Yes I will say so because we have a reporting system and in those decisions are reported. And can assess the impact on the procurement.

21) Do you always have excess capacity to deal with abnormal requirements?

Yes trying to meet the requirement as much as we can but it is also possible to go over the capacity like now we are constantly going with excess capacity. So possibility is there

22) Do you have excess storage capacity and transportation?

Transportation should not be a problem but storage capacity can be a bottleneck. But there is always alternative to warehousing.

23) Do you have a system, whether its IT or trained staff which can give warnings of a possible disruption e.g due to low inventory levels?

Yes we have SAP and other systems.

24) Do you have a security system in place for the defense of your assets?

Yes we have cyber security team in place.

25) Do you share mutual risk and assets with your partners?

As far as I recall we don't have a common ownership and if you are talking about suppliers as partners, we don't share assets with them.

26) How is the level of information sharing between different actors in the supply chain and your firm?

Very strong. If we talk about the digital orders and confirmation technologies it is available in market. We have access to different circulations. The supplier also share information through newsletters and bulletins. So in this era of modern technologies information is widely available and share I will say.

27) Do you have anything in common with partners other than mutual customers or suppliers?

Yes it depends if supplier develop a product he is allowed to sell this to other customers but if the product development is done by us and specific then they produce it only for us.

28) How do you describe your relationship with your suppliers and retailers?

With suppliers we work with long term relationships. And it is very useful and crucial in period of disruptions. At some point we were obliged to prioritize supplier and that's the key to sustain business in long term with partnerships in disruptions rather than transactional relationships.

32) If you have lot of options for choosing suppliers, what are the reasons behind going for the same supplier?

Reason could be many it could be the quality provided, in competitive prices, support to our product development team. It can be location as well because of lead times.

29) Do you have any product which you source from a single supplier in your supply chain? If yes how you deal with them in disruptions with these critical points?

This can be for specially tailored made products, so after crisis we are looking for alternatives for these situations in our action plan. In time of crisis you should be in tight dialogue with these bottlenecks about the possible delays and adapting your own production accordingly. So this can be tight tight situation where you look for alternatives who can make that tailor made product for you at the same time you are in dialogue with your single supplier constantly about production.

30) Do you have many actors in the supply chain, and they are closely located or far?

Yes, we have a global sourcing map with a focus on Europe but for some products in Europe we have raw material coming from east asia or Africa. The supply chain is global but supply base is concentrated in Europe.

31) If you have a large number of actors how is the information flow between them and you?

good

32) in case of disruption how do you think resources from communities such as government, public, local economy can help you to overcome disruption and keeping your business ongoing?

Yes I will say so. Because in some countries in disruptions government can put ban on exports which are critical for production, and they can make disruptions worse. Also, government and institutions can help to overcome disruptions to maintain flow.

33) How efficiently did the product travel through a supply chain?

No you have to adapt like all of the sudden shipping industry was in crisis and lead times went upto 8 weeks from 4 weeks. So the key here is to adapt and have close communication with supplier to navigate disruptions.

34) Do you meet your objectives in a timely manner during the disruption?

Yes I will say we meet our objectives on time and as I said the key here was communication. And to maintain long term partnership with suppliers so that they can prioritize and tradeoff in these situations between we don't have enough product, or we are going to supply you because you are our long term partners in these situations.

35) Do you meet your objectives in a timely manner post disruption?

yes

36) Do you have supply chain wide procedures and plans for disruptions to enhance recovery?

Yes.

37) How does your supply chain take efforts to reduce lead time and respond to customer demands?

Here I I will say it is planning in connection with raw material coming in and planning according to the customers in order to manage expectations on the customer side. So will say communication on both sides of supply chain. Pushing your suppliers to be on time and communicating with your customers about the crisis and possible lead times to manage on time deliveries.

How visible it is to see the product and processes in other parts of the supply chain? Is the information flow smooth and the right knowledge being transferred to the right people?

yes

38) Do you know about the customer trends and pass it to other actors and are they visible to competitors also?

Yes

39) how self organised is the supply chain does it get effected by external forces?

Yes if the organization takes place internally.

40) how self organised is the supply chain does it have will to change its course easily?

Yes it has very agile mindset in that area

41) The co learning about the missed and actual disruptions is widely practiced?

yes

42) Do you have system wide backup and storage facilities in the supply chain?

Yes

43) Do you have replacements for your critical nodes?

Yes like in logistics if one node is affected then we have a backup to reroute it.

44) During the past disruption did you lose your core functionality? If you don't lose that how long, it took to absorb the setback from disruption?

This is more on the core production side. But on the procurement side we didn't lose our core functionality. so after the end of covid crisis when world start to re-open, we were relatively fast in bringing back our lead times from extended lead times.

45) In your supply chain do you have diverse range of skills to absorb the shocks from disruption and recover it fast?

Yes

Interview 6

Company: Bangladesh food manufacturing company

Person: AGM, supply chain

Core products: Spices, Snacks, Cookies, Bread, beverage, Jam, Grocery

46) How do you source your raw material and inputs?

We maintain a diverse supplier network, sourcing raw materials and inputs both locally and globally. Our major ingredients are primarily obtained from national-level suppliers, but for specific raw materials unavailable in India, we source them globally.

47) What are your distribution channels?

Our distribution channels are quite diverse. We use conventional methods like distributor wholesalers and retailers. In addition, we've embraced modern distribution channels such as direct sales to stores and e-commerce platforms. We cater to both international and local markets, although our international market share is relatively small.

48) How quickly you can choose between different suppliers when you face a disruption?

The agility in transitioning between suppliers during disruptions proves to be quite challenging. Our ability to choose between suppliers during disruptions depends on the nature of the product. If the product allows flexibility, we can quickly adapt and select suppliers. However, for products reliant on a limited supplier base, we maintain inventory to sustain disruptions.

49) Do you have substitutes for your core products to offer?

Yes

50) Do you have alternative distribution channels?

Yes, we have effectively diversified our distribution channels to adapt to the evolving market landscape. We not only rely on traditional distribution avenues but also engage with modern methods like eco-friendly distribution channel.

51) Do you have contract terms with your partners that you can delay the production in case of disruptions?

We have specific contract terms for certain product segments that enable us to delay production, especially when customers face financial setbacks.

52) How easily you can change the mode of delivery?

We can efficiently change the mode of delivery when needed, with a rating of 4 on a scale of 1 to 5.

53) How easily you can change the timing of deliveries?

Changing the timing of deliveries is somewhat challenging, with a rating of 3 on the same scale.

54) In case of cash shortage how fast you can access liquid assets?

Accessing liquid assets in case of a cash shortage is very easy, with a rating of 5 on the scale.

55) What is the mode of transactions e.g on credit terms?

Our transactions primarily involve advance payments or credit-based terms, and we typically don't deal with cash deliveries.

56) Do you have a collective database of strategies which could be used for developing skills of individuals for future disruptions?

No, we do not have a collective database of such strategies.

57) In the absence of the person in charge who will take the responsibility for that person.

We have a designated replacement, although not a full-fledged one.

58) How do you weigh risk management as a skill in hiring a new employee in managerial positions?

Risk management is considered an important skill when hiring new employees for managerial positions.

59) Do you consider to layoff people who can perform **multiple** roles in time of disruptions?

- No, laying off employees who can perform multiple roles is not typically considered, as it's usually a last resort.**
- 60) What kind of employees who last get laid off in times of disruptions?
In times of disruptions, we prioritize cost-cutting measures such as reducing perks like fuel allowances before considering layoffs.
- 61) How strong is your market position (brand loyalty)?
Our market position is very strong, with a high level of brand loyalty.
- 62) If you offer a substitute product your customers will accept it?
May be
- 63) Do you have a business continuity plan? If yes, how do you think it helps? If no then why not?
Yes, we have a business continuity plan, but it primarily focuses on short-term planning (1-4 months). Long-term planning for up to 24 months is challenging in our segment.
- 19) What is the degree of joint decision making? Especially from the employees who have learnt from past disruptions.
We involve employees up to a certain level in decision-making, especially those who have gained experience from past disruptions.
- 64) How is your leadership committed to avoid unnecessary waste?
Our leadership is highly committed to avoiding unnecessary waste in our operations.
- 65) What kind of critical assets(tangible) do you have and is there any contingency plan for them?
We have critical tangible assets, and we maintain insurance coverage to protect them.
- 66) How do you communicate leadership with the rest of the organization?
We have a flat hierarchy, ensuring smooth coordination and interaction throughout the organization. It's not structured as a triangular hierarchy.
- 67) Do you have an open culture for learning and joint decision making when it comes to respond to risk and anticipate it in advance?
Yes
- 68) Do you have some resources to monitor the decision you have made in the past with their outcomes and learning from these decisions?

Yes, we have resources in place to monitor past decisions' outcomes and learn from them.

69) Do you always have excess capacity to deal with abnormal requirements?

yes

70) Do you have excess storage capacity and transportation?

yes

71) Do you have a system, whether its IT or trained staff which can give warnings of a possible disruption e.g due to low inventory levels?

yes

72) Do you have a security system in place for the defense of your assets?

yes

73) Do you share mutual risk and assets with your partners?

No

74) How is the level of information sharing between different actors in the supply chain and your firm?

4

75) Do you have anything in common with partners other than mutual customers or suppliers?

We engage in risk-sharing and mutually share certain assets with our partners, fostering collaborative relationships.

76) How do you describe your relationship with your suppliers and retailers?

We primarily share mutual customers and suppliers with our partners. However, we do not have many other commonalities beyond these aspects.

32) If you have lot of options for choosing suppliers, what are the reasons behind going for the same supplier?

The choice of suppliers depends on various factors, including product parameters, supplier expertise, lead times, and costs. We weigh these factors when deciding whether to stay with the same supplier.

77) Do you have any product which you source from a single supplier in your supply chain? If yes how you deal with them in disruptions with these critical points?

No

78) Do you have many actors in the supply chain, and they are closely located or far?

We have various actors in our supply chain, ranging from closely located to some who are located far away. However, the majority are local.

79) If you have a large number of actors how is the information flow between them and you?

4

80) in case of disruption how do you think resources from communities such as government, public, local economy can help you to overcome disruption and keeping your business ongoing?

While there is a role for external resources like government support and local economic resources, it's important to note that these resources are usually available to all businesses facing disruptions. The government's role may involve infrastructure repair, which benefits all businesses, but there are no additional supports exclusive to our business.

81) How efficiently did the product travel through a supply chain?

4

82) Do you meet your objectives in a timely manner during the disruption?

We may not always meet our objectives in a timely manner post-disruption; the recovery process can also involve delays.

83) Do you meet your objectives in a timely manner post disruption?

Yes

84) Do you have supply chain wide procedures and plans for disruptions to enhance recovery?

No

85) How does your supply chain take efforts to reduce lead time and respond to customer demands?

We take measures to reduce lead time and respond to customer demands, although our operations primarily cater to a limited customer base with flexible timelines and refined planning.

86) How visible it is to see the product and processes in other parts of the supply chain? Is the information flow smooth and the right knowledge being transferred to the right people?

The visibility of product and processes across the supply chain is high, and information flows smoothly.

87) Do you know about the customer trends and pass it to other actors and are they visible to competitors also?

We do have insights into customer trends, but this data is treated confidentially and is not shared with competitors.

88) how self organised is the supply chain does it get effected by external forces?

4

89) how self organised is the supply chain does it have will to change its course easily?

3

90) The co learning about the missed and actual disruptions is widely practiced?

yes

91) Do you have system wide backup and storage facilities in the supply chain?

No

92) Do you have replacements for your critical nodes?

Yes

93) During the past disruption did you lose your core functionality? If you don't lose that how long, it took to absorb the setback from disruption?

Yes

94) In your supply chain do you have diverse range of skills to absorb the shocks from disruption and recover it fast?

Yes

Interview 7

Company: Bagladesh food manufacturing company

Person: GM supply chain

Core products: Sweet, Biscuits, Cookies, Bread, Curd, Yogurt, Cheese.

1. How do you source your raw material and inputs?

We have a well-established network of suppliers for sourcing our raw materials and inputs. The majority of our major ingredients are obtained from national-level suppliers. However, for specific raw materials that are not readily available in our local market, we have a select group of global suppliers.

2. What are your distribution channels?

Our distribution channels are quite diversified to cater to evolving customer preferences and market dynamics. We continue to utilize traditional distribution

methods such as distributor wholesalers and retailers. In addition, we've made significant inroads into modern distribution channels, including direct sales to stores and partnerships with e-commerce platforms. We serve both international and local markets, although our international market presence is relatively modest.

3. How quickly can you choose between different suppliers when you face a disruption?

The speed of choosing between different suppliers in times of disruption is primarily influenced by the nature of the specific product. If a product offers flexibility, we can swiftly adapt and select alternative suppliers. However, for products reliant on a limited supplier base, we maintain adequate inventory levels to weather disruptions effectively. **Even when a surplus of supplier options exists, the standing of our current suppliers, their reputation and reliability, remains a deciding factor in our choices.**

4. Do you have substitutes for your core products to offer?

Yes, we have a range of substitute products available for our core offerings. Our customers often make spontaneous purchasing decisions in our product category, and they are not overly brand-conscious. This buying behavior allows them to readily consider substitute products in case of unavailability.

5. Do you have alternative distribution channels?

Yes, we have effectively diversified our distribution channels including digital platforms and direct partnerships with retailers

6. Do you have contract terms with your partners that you can delay production in case of disruptions?

For specific product segments, we maintain contract terms that allow us to delay production in response to disruptions, particularly if our customers encounter financial difficulties. These terms provide a degree of flexibility to adjust to changing circumstances.

7. How easily can you change the mode of delivery?

We possess a high degree of flexibility in changing the mode of delivery, which rates at 4 on a scale from 1 to 5, making adjustments relatively swift and efficient.

8. How easily can you change the timing of deliveries?

Changing the timing of deliveries is moderately challenging, scoring a 3 on a scale of 1 to 5, indicating that while it is feasible,

9. In case of cash shortage how fast you can access liquid assets?

- Accessing liquid assets in times of cash shortage is somewhat challenging, with a rating of 3 on the scale.
10. What is the mode of transactions e.g on credit terms?
Our transactions involve credit terms and advance payments, and we typically don't deal with cash deliveries.
11. Do you have a collective database of strategies which could be used for developing skills of individuals for future disruptions?
Yes, we maintain a collective database of strategies aimed at developing the skills of individuals to better prepare for future disruptions.
12. In the absence of the person in charge who will take the responsibility for that person.
We have a designated replacement in place, ensuring a smooth transition of responsibilities in case of absence.
13. How do you weigh risk management as a skill in hiring a new employee in managerial positions?
Risk management is considered a vital skill when evaluating candidates for managerial positions.
14. Do you consider to layoff people who can perform multiple roles in time of disruptions?
The consideration of layoffs for employees with the ability to perform multiple roles is not a common practice, as it is typically a last resort.
15. What kind of employees who last get laid off in times of disruptions?
In times of disruptions, we prioritize cost-cutting measures.
16. How strong is your market position (brand loyalty)?
Our market position is strong, with a moderate level of brand loyalty.
17. If you offer a substitute product your customers will accept it?
Our customers are generally receptive to substitute products when needed.
18. Do you have a business continuity plan? If yes, how do you think it helps? If no then why not?
Yes, we have a business continuity plan that primarily focuses on short-term planning
19. How is your leadership committed to avoid unnecessary waste?
Our leadership is committed to avoid unnecessary waste in the operation process.

20. What kind of critical assets(tangible) do you have and is there any contingency plan for them?

We have critical tangible assets like insurance.

21. How do you communicate leadership with the rest of the organization?

Our organization is flat and we have top down approach to communicate.

22. Do you have an open culture for learning and joint decision making when it comes to respond to risk and anticipate it in advance?

Yes

23. Do you have some resources to monitor the decision you have made in the past with their outcomes and learning from these decisions?

Yes

24. Do you always have excess capacity to deal with abnormal requirements?

No

25. Do you have excess storage capacity and transportation?

No

26. Do you have a system, whether its IT or trained staff which can give warnings of a possible disruption e.g due to low inventory levels?

yes

27. Do you have a security system in place for the defense of your assets?

yes

28. Do you share mutual risk and assets with your partners?

No

29. How is the level of information sharing between different actors in the supply chain and your firm?

3

30. Do you have anything in common with partners other than mutual customers or suppliers?

Mutual risk sharing approach.

31. How do you describe your relationship with your suppliers and retailers?

We have a sound relationship with our suppliers and retailers.

32)If you have lot of options for choosing suppliers, what are the reasons behind going for the same supplier?

Its depends on the quality of the product, supplier expertise, lead times, and costs.

32. Do you have any product which you source from a single supplier in your supply chain? If yes how you deal with them in disruptions with these critical points?

No

33. Do you have many actors in the supply chain, and they are closely located or far?

The majority are local.

34. If you have a large number of actors how is the information flow between them and you?

3

35. in case of disruption how do you think resources from communities such as government, public, local economy can help you to overcome disruption and keeping your business ongoing?

The government may take initiative for infrastructural support during disruption. But community has little effort to support us.

36. How efficiently did the product travel through a supply chain?

3

37. Do you meet your objectives in a timely manner during the disruption?

Most of the times we try but sometimes it's not feasible to be on time during the disruption.

38. Do you meet your objectives in a timely manner post disruption?

Most of the times.

39. Do you have supply chain wide procedures and plans for disruptions to enhance recovery?

No

40. How does your supply chain take efforts to reduce lead time and respond to customer demands?

We make a plan to procure from the neighboring countries if possible to reduce lead time.

41. How visible it is to see the product and processes in other parts of the supply chain? Is the information flow smooth and the right knowledge being transferred to the right people?

Visible and smooth.

42. Do you know about the customer trends and pass it to other actors and are they visible to competitors also?

Yes we have insight about the customer trends.

43. how self organised is the supply chain does it get effected by external forces?

3

44. how self organised is the supply chain does it have will to change its course easily?

4

45. The co learning about the missed and actual disruptions is widely practiced?

yes

46. Do you have system wide backup and storage facilities in the supply chain?

No

47. Do you have replacements for your critical nodes?

Yes

48. During the past disruption did you lose your core functionality? If you don't lose that how long, it took to absorb the setback from disruption?

Yes

49. In your supply chain do you have diverse range of skills to absorb the shocks from disruption and recover it fast?

Yes