ASSESSMENT OF FRUIT SUPPLY CHAIN RISK

DIVYANSHU GIRI (21SLAM1010011)

School of Business

Galgotias University, Greater Noida, INDIA

ABSTRACT

The main aim of this research is to study gain a better understanding of the fruit supply chain and the individuals that work inside it, from farmers to distributors to retailers. Agricultural landscape in India relies heavily on fruit supply chains to ensure a consistent flow of nutritious produce from farmers to consumers. However, challenges such as post-harvest losses, inadequate infrastructure, and market fragmentation persist, impacting both economic prosperity and environmental sustainability. This paper advocates for the development of a comprehensive assessment model for fruit supply chains to address these challenges effectively. By examining production processes, transportation logistics, market dynamics, and stakeholder engagement, the proposed model aims to identify inefficiencies and improvement opportunities. Collaboration among diverse stakeholders is emphasized to ensure the model's adaptability and relevance across different production systems and regions. Furthermore, insights from the global fruit market underscore the importance of addressing emerging trends such as changing consumer preferences and technological innovations. By leveraging digital technologies and promoting sustainable practices, the fruit industry can navigate challenges and capitalize on opportunities for growth and resilience in the years to come.

KEYWORDS

Fruit supply chains risk, Rik assessment, Failure Mode and Effect Analysis.

INTRODUCTION

An integral part of India's dynamic agricultural landscape are optimal fruit supply networks. The intricate network of connections established by these supply chains, which connect farmers with consumers, ensures a consistent flow of nutritious, recently harvested food. Problems such as post-harvest losses, inadequate infrastructure, and fragmented markets persist despite fruits' substantial contribution to India's agricultural output. The development of an all-encompassing assessment model for fruit supply chains has to be a strategic goal in light of these challenges. This model gives a framework for studying the supply chain, which includes production processes, transportation logistics, market dynamics, and stakeholder engagement. Better judgements and targeted actions are the result of the model's ability to identify inefficiencies, bottlenecks, and improvement opportunities via a thorough study of these components. A robust assessment approach is necessary due to the fruit supply chains' substantial social, economic, and environmental implications. Wasted resources, continued food poverty, and financial losses for farmers are all consequences of post-harvest losses. Issues such as inefficient supply chains

exacerbate farmers' lack of access to markets, which in turn makes it difficult for farmers to achieve economic independence and exacerbates rural poverty. The environment is at risk due to soil degradation, water scarcity, and species extinction caused by inefficient farming practices and inadequate infrastructure. The objectives of developing a comprehensive assessment model need joint and multidisciplinary work. Collaborating and sharing information is essential among experts and stakeholders from many disciplines, including legislators, academics, corporate executives, and farmer organisations. By combining their knowledge and experiences, stakeholders may create a model that is adaptable to different production systems and locations, considers the environment at large, and is ready for implementation. Making India's agricultural sector more robust, sustainable, and inclusive may be achieved, in the end, by establishing an assessment framework for fruit supply chains. Through the dissemination of valuable insights and data-driven recommendations for focused interventions and policy adjustments, the model enables decision-makers to improve supply chain performance and reveal socio-economic advantages. Research on fruit supply networks is urgently needed within the complex web of India's agricultural environment. In order to understand the intricate workings and inefficiencies of these crucial channels for agricultural goods, research of this kind is essential. In order to understand post-harvest losses, market fragmentation, and infrastructure deficiencies, the research aims to explore the complexities of production, distribution, and market access. To improve supply chain efficiency and craft tailored solutions, a deep knowledge of farmers' lives is required. We need to look at fruit supply chains closely to see the whole picture of the social, economic, and environmental impacts. Reform efforts may be highlighted by the study if the monetary effect of post-harvest losses and market inefficiencies could be quantified. The study aims to promote inclusive growth and equitable distribution of benefits by examining socioeconomic aspects, such as gender dynamics in the supply chain and the empowerment of smallholder farmers. Researching the environmental impact of fruit supply chains might help provide insight on conservation efforts, climate resilience, and sustainable resource management.

LITERATURE REVIEW

Thomas M. (2011) Christopher looks at the fruit supply chain and how logistics management and optimisation work in it. He emphasises the requirement of efficient transportation, storage, and distribution in ensuring that fruits retain their quality and freshness throughout the supply chain. The need of real-time tracking and monitoring technologies to reduce delays and waste is highlighted by Christopher's notion. Christopher recommends a method that employs logistics management best practices and leverages technology to make fruit supply chains more effective and efficient overall.

Smith (2008) examines fruit supply networks from a social and environmental sustainability standpoint, focusing on production, distribution, and associated concerns. He argues that sustainable farming practices, including organic farming and fair trade initiatives, are necessary to improve social justice while reducing environmental impacts. To aid stakeholders in making more sustainable sourcing and distribution decisions, Smith's technique incorporates EIAs and social responsibility criteria into assessments of fruit supply chains.

Patel (2016) The importance of information technology (IT) in optimising fruit supply networks is the focus of Patel's study. Data analytics, blockchain technology, and RFID tagging are crucial IT solutions, according to him, for improving supply chain visibility, traceability, and transparency. As part of his

strategy, Patel highlights the need of open communication and cooperation between all stakeholders, from farmers to merchants. To improve decision- making, streamline procedures, and reduce dangers in fruit supply chains, Patel provides a framework for using IT capabilities.

Alonso (2018) The focus of Garcia's research is the fruit supply chain and the potential benefits and risks of cold chain management. When it comes to transporting and storing perishable fruits, he stresses the importance of temperature regulation. The focus of Garcia's design is on a robust cold chain infrastructure, which comprises refrigeration facilities and insulated packaging, to prevent rotting and retain product freshness. Maximising cold chain operations and investing in the correct technology may enhance fruit supply networks and decrease post-harvest losses, according to Garcia's plan.

Wang (2021) investigates the ways in which trade patterns and market dynamics have evolved as a result of globalisation and its effects on fruit supply chains. The author delves into the challenges posed by cultural preferences, tariffs, and international trade restrictions in relation to the sourcing and distribution of fruits across different places. Wang argues that businesses should prioritise adaptive supply chain strategies that account for geopolitical and commercial unpredictability. Wang outlines a strategy to diversify sourcing, use trade agreements, and establish strategic relationships in order to enhance global fruit supply chains and capitalise on new market opportunities.

Alonso (2020) Focuses on resilience planning in fruit supply chains as a means to lessen the impact of disruptions and hazards caused by events such as pandemics and natural disasters. In order to minimise disruptions and keep the business running smoothly, he emphasises the requirement of a flexible supply chain, thorough risk evaluation, and backup plans. Lopez has a method that uses scenario analysis and resilience metrics for supply chain decision-making. Lopez proposes a strategy for proactively detecting and managing risks in order to build fruit supply networks that can withstand climate change and other unanticipated occurrences.

Kim (2022) is investigating how innovation and technology have affected fruit supply networks. He investigates how businesses are using cutting-edge technology such as the IoT, AI, and robotics to improve efficiency, stretch their budgets further, and satisfy their consumers. In Kim's approach, digital transformation and continuous innovation are emphasised as necessary for success in the ever-changing fruit sector. Embracing disruptive technologies and promoting inventiveness is Kim's proposed paradigm for future-proofing fruit supply chains and capitalising on digital growth opportunities.

Table 1: Risk identified from the literature Review

S. No.	Identified Risks	Author
R1	Inefficient transportation, storage, and distribution leading to quality and freshness degradation	Matthew Thomas (2011)
R2	Unsustainable farming practices	Mr. Smith (2008)

R3	Poor supply chain visibility, traceability, and transparency	Rakesh Patel (2016)
R4	Risks associated with cold chain management	Alonso (2018)
R5	Disruptions caused by geopolitical factors	Wang (2021)
R6	Hazards from natural disasters	Elias (2020)
R7	Failure to adopt cutting-edge technology	Kim (2022)

RESEARCH METHODOLOY

Failure Mode and Effect Analysis (FMEA), which is a systematic method for identifying and prioritizing potential failures in a system, product, or process, and then evaluating their potential effects. Once potential failure modes are identified, the next step is to assess the potential effects or consequences of each failure mode. This includes considering how each failure could impact safety, performance, reliability, or other relevant factors. Each failure mode is assigned a severity rating based on the potential impact of the failure. This helps prioritize which failures should be addressed first. For each failure mode, the underlying causes and mechanisms are identified. Understanding the root causes helps in developing effective mitigation strategies. The likelihood or probability of each failure mode occurring is assessed and assigned an occurrence rating. This involves considering factors such as historical data, experience, and expert judgment. The ability to detect or prevent each failure mode before it occurs is evaluated and assigned a detection rating. This step helps identify weaknesses in detection methods and opportunities for improvement. RPN is calculated by multiplying severity, occurrence, and detection ratings. This helps prioritize which failure modes require immediate attention based on their overall risk. The Risk Priority Number (RPN) is calculated as:

$$RPN = O*S*D \qquad (1)$$

where; O: Probability of occurrence

S: Severity of event

D: Probability of detection

Table 2: Linguistic Rating Scale for Probability of occurrence (O)
and severity of impact (S) of risk

Linguistic Scale	Scale
Very Low	1
Low	2
Medium	3
High	4
Very High	5

Table 2: Linguistic Rating Scale for Probability of detection of risk

Linguistic Scale	Scale
Very Low	5
Low	4
Medium	3
High	2
Very High	1

DATA COLLECTION

For this research paper needs 24 retail shop of fruits has been taken for study of fruits supply chain. Due to the wide variety of fruits produced and traded across the world, the international fruit market is a dynamic and fascinating business. The industry provides both unprocessed and processed fruits to cater to a wide range of consumer preferences and dietary needs. Pineapples, bananas, and mangoes are just a few examples of the tropical fruits sold at the market. Apples, pears, and berries are some of the more temperate fruits available.

Table3 : Supply Chain Risk Rating by Respondent1

Identified Risk	Severity	Occurrence	Detection
R1	3	2	4
R2	1	3	2
R3	3	4	3
R4	3	3	4
R5	2	2	3
R6	3	4	3
R7	1	2	4

Table4 : Supply Chain Risk Rating by Respondent2

Identified Risk	Severity	Occurrence	Detection
R1	4	3	2
R2	3	2	3
R3	4	3	4
R4	4	3	3
R5	2	2	3
R6	4	3	3
R7	2	2	3

Table5 : Supply Chain Risk Rating by Respondent3

Identified Risk	Severity	Occurrence	Detection
R1	4	3	2
R2	4	3	3
R3	2	4	3
R4	4	3	3
R5	2	2	2
R6	4	4	3
R7	2	2	4

DATA ANALYSIS AND DISCUSSION

The data collect is analysed using FMEA method. The aggregate rating is obtained by taking mean rating of all the three respondents.

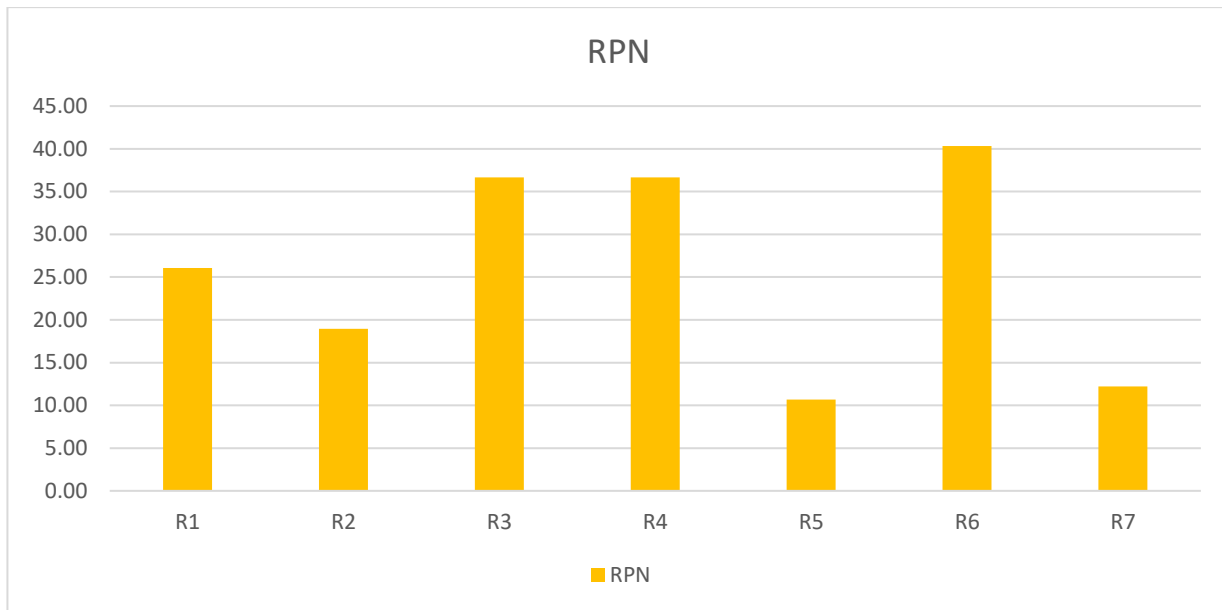| Identified Risk	Severity	Occurrence	Detection	RPN
R1	3.67	2.67	2.67	26.07
R2	2.67	2.67	2.67	18.96
R3	3.00	3.67	3.33	36.67
R4	3.67	3.00	3.33	36.67
R5	2.00	2.00	2.67	10.67
R6	3.67	3.67	3.00	40.33
R7	1.67	2.00	3.67	12.22

Figure 1: Fruit Supply Chain Risk RPN

Risk Mitigation Strategies

Transportation Troubles

Sometimes, when fruit is moved from the farm to the store, it's not handled very well, which can make it go bad faster. To fix this, we can use better trucks and warehouses that keep the fruit at the right temperature. Plus, we can plan smarter routes to get the fruit where it needs to go quicker.

Farm Worries

If farmers aren't careful, they might use methods that harm the environment or make it hard to keep growing fruit in the long run. So, we need to work with farmers to use techniques that are good for the environment and make sure they're doing things like using less water and not using too many chemicals.

Mystery in the Supply Chain

Sometimes, it's hard to know where exactly the fruit came from and how it got to you. By using technology like blockchain, we can track the journey of the fruit all the way from the farm to your plate. That means we can see if anything went wrong along the way.

Cold Chain Concerns

Keeping fruit cold is super important to keep it fresh. So, we need to have really strict rules about how cold the fruit needs to be at every step of the journey. And we should train people who handle the fruit to make sure they're doing it right.

Geopolitical Grumbles

When politics get messy, it can affect how fruit gets from one place to another. To avoid problems, we can get fruit from different places and have backup plans in case there's trouble in one area.

Nature's Wrath

Things like storms and other natural disasters can mess up the fruit supply chain. We can get ready for this by having plans in place to deal with emergencies, like finding other places to get fruit from if one area gets hit by a disaster.

Tech Troubles

If we don't keep up with the latest technology, we might miss out on ways to make the fruit supply chain work better. So, we need to be open to new ideas and use things like sensors and computers to help us keep track of the fruit and make smart decisions.

CONCLUSION

In conclusion, this research project offers a comprehensive understanding of various aspects influencing fruit supply chains. By synthesizing insights from studies on logistics management, sustainability, technology integration, market dynamics, resilience planning, and innovation, we have identified key strategies to enhance the efficiency, sustainability, and resilience of fruit supply networks.

Efficient logistics management and technology integration are essential for maintaining fruit quality and freshness throughout the supply chain. Sustainable farming practices contribute to social justice and environmental sustainability, while information technology solutions improve supply chain visibility and transparency. Cold chain management ensures product freshness, while adaptive supply chain strategies navigate global trade challenges.

Resilience planning is crucial for mitigating disruptions and ensuring business continuity in the face of unforeseen events. Embracing innovation and digital transformation are imperative for future-proofing supply chains and capitalizing on growth opportunities.

By implementing these strategies, stakeholders can build more agile, sustainable, and competitive fruit supply chains that meet consumer demands while minimizing risks and ensuring product quality and sustainability. Further research and practical implementation of these strategies are warranted to continuously improve fruit supply chain operations in an evolving global landscape.

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