

IDENTIFICATION AND EVALUATION OF AGRICULTURAL SUPPLY CHAIN RISK

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ABSTRACT

This research is based on different risk involved in supply chain of agricultural. The literature review examines the challenges facing rural agricultural supply chains in various regions, particularly in Ghana, Ethiopia, and the Philippines. The primary focus is on the detrimental effects of inadequate transportation infrastructure, including poorly maintained roads and limited access to transportation networks. These challenges contribute to high transportation costs, post-harvest losses, and reduced agricultural output. Moreover, the prevalence of pests, diseases, and natural disasters further exacerbates the vulnerabilities of these supply chains. Despite the significance of agricultural production as a source of livelihood and economic activity in these regions, the constraints imposed by transportation limitations hinder market access, increase input prices, and impede overall economic growth. Strategies to address these challenges must prioritize investments in transportation infrastructure, market information systems, and resilience-building measures against environmental risks. FMEA method is applied to assess and prioritise the agricultural supply chain risks. It is use to analysis the level of risks.

Keywords: Supply chain risk, Risk assessment, FMEA, Agricultural supply chain.

1. INTRODUCTION

Supply chains in agriculture are essential to the world's food systems because they enable the distribution of food from farms to consumers. The availability of safe and nutritious food for communities across the globe is ensured by these supply chains, which are complex networks involving many stakeholders such as farmers, processors, distributors, retailers, and consumers. On the other hand, there are a lot of dangers that may disrupt operations, jeopardize food security, and damage the sustainability of agricultural production systems due to how linked agricultural supply networks are. Food production and distribution systems may be made more resilient and sustainable if stakeholders take the time to learn about the ins and outs of agricultural supply chains and the problems theyface. Equipment breakdowns, labour shortages, quality control problems, and interruptions in the supply

chain are all examples of internal hazards. In contrast, natural catastrophes, climate change, market volatility, regulatory shifts, and geopolitical unrest are examples of external risks. As a crucial thread in the extensive web of agricultural trade, road transport is an integral part of how the sector functions. Its pivotal role in linking agricultural producers to buyers, markets, and distribution networks makes its importance impossible to exaggerate. A key component of agricultural commodity marketing is the accessibility that road transport provides. Because of their remote locations, farms depend on well-developed road networks to transport their produce to nearby towns and cities. In addition to connecting farmers to local markets, roads also connect them to regional and worldwide trade routes, making it easier to transport agricultural goods across borders and opening up more market options. Delivering perishable items like fruits, vegetables, and dairy products on time is of the utmost importance in agricultural marketing. For these goods to reach their destinations quickly without losing any of their quality or freshness. An efficient supply chain, beginning with the farm and ending at the market, relies heavily on road transit. Overall cost-effectiveness and profitability are aided by road networks, which streamline transportation, minimize transit times, and reduce transportation costs. The agricultural supply chain risk study is lacking in the literature. Hence following research questions are framed:

RQ1: What are the agricultural supply chain risks in India?

RQ2: What is the suitable technique to assess and evaluate the agricultural supply chain risk?

2. LITERATURE REVIEW

Public transportation appears to be inadequate in rural areas, where the bulk of the world's poor reside. It is challenging to sell things at local markets due to a lack of access to high-quality supplies and high transportation costs caused by poor and inadequately maintained roads. (Kishor and Basanta, 2021; Adugna, 2009).

The presence of pests and illnesses linked to agricultural supply chain operations poses the greatest biological and environmental risk concerns in Ghana's agricultural supply chain. Concerns about biological and environmental dangers in Ghana's agricultural supply chain also include contamination that compromises food safety and degradation of processing and production methods. There is little to no risk to the agricultural supply chain from human contamination, diseases, or pollution due to inadequate sanitation. Yeboah et al. (2014) found that their capacity to handle risks resulting from contamination and degradation in production and processing was lacking.

Highways carry the majority of Ethiopia's interurban freight and passengers, as reported by Ibrahim (2011). Rural producers encounter additional challenges due to the road's low density and seasonal weather. Centralized social and economic resources, such as marketplaces and major thoroughfares, are located far from many people's homes and places of employment. Transportation costs are increased due to inadequate infrastructure, which ultimately leads to higher input prices and limits the capacity of small holder farmers to access consumers. The economy experiences a slowdown due to the negative effects on health, education, and productivity.

The region's bountiful vegetable crops—carrots, potatoes, avocados, and cabbage—have brought it fame. These crops have numerous purposes, including food, goods, and a source of livelihood. The area has some of the worst road infrastructure difficulties in the country, even though it is well-known as a center for agricultural output, which provides income and subsistence for the people. The lack of marketable vegetable commodities is a direct result of the poor state of the roads, which in turn affects people's capacity to earn a livelihood and the amount of money they bring home. Specifically, according to Wonddemu (2015).

Problems with transporting commodities with a near-term expiration date have arisen due to a lack of suitable alternatives (Bisht, 2013). Claimed that insufficient transportation networks and a dearth of market data resulted in significant losses of horticultural products. Due to the poor road connectivity between the land and the roadhead, transporting goods locally is highly expensive (Bisht, 2013).

Mengesha et al. (2015) states that there are numerous limitations to the primary system in Ethiopia that is used for vegetable cultivation and sales. Among the many challenges it faces are ineffective marketing support systems, out-of-date and erroneous market data, and substantial losses after harvest. So, household economics, market conditions, and farmers' levels of involvement all have a role in determining the amount of plots of land that farmers are willing to focus on growing vegetables. Impacts on manufacturing, supply chain efficiency, and community revenue can be seen both directly and indirectly through road infrastructure. The article by Tunde and Adeniyi (2012) explained how poor road conditions reduce agricultural production. Future plans to improve road networks and sell agricultural products may be affected by the study's findings. Transportation costs, the efficiency of farm input delivery, and agricultural productivity and supply are all negatively impacted by inefficient road networks, according to the study.

Natural catastrophes and hazards pose the greatest threat to the Philippines' natural resource and environmental sectors. One of the main aims of development in this field is to make natural systems

more resilient and human societies more adaptive so that they can better handle natural disasters and hazards, especially those that are related to climate change (Israel and Briones 2012). In Table 1 we can see the main hazards in the food production supply chain.

Table 1: Supply chain risk identified in literature review

S. No.	Identified Risk	Author' name
1	Less agriculture output	Tunde and Adeniyi (2012)
2	Pests and diseases	Yeboah et al. (2014)
3	Post-harvest losses	Mengesha et al. (2015)
4	High transportation cost	Kishor and Basanta (2021), Ibrahim et al. (2011)
5	Natural Disasters	Israel and Briones (2012)
6	Inadequate roads infrastructures	Bisht (2013), Wondemu (2015)
7	Seasonal conditions	Ibrahim et al. (2011)

3. RESEARCH METHODOLOGY

It is possible to discover various failure modes and their causes and effects in a system by doing a failure mode and effects analysis (FMEA), which entails examining a large number of components, assemblies, and subsystems. A failure occurs when the device or its parts do not work as expected or could have caused harm. The organization's functions can be aligned with FMEA as an aim, decision, and set of criteria. A Risk Priority Number (RPN) is a way to categorize the risk associated with each possible result. To determine if teams should respond to a possible failure, the RPN is used as a foundation. One way to determine the RPN, or Risk Priority Number, is by:

$$\text{RPN} = \text{O} * \text{S} * \text{D} \quad (1)$$

where;

O: Probability of occurrence

S: Severity of event

D: Probability of detection

The linguistic scale to be used for subjective rating of risk by respondents from food industry are given in Table 2 & 3.

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

Linguistic Scale	Scale
Very Low (VL)	1-2
Low (L)	3-4
Medium (M)	5-6
High (H)	7-8
Very High (VH)	9-10

Table 3: Linguistic Rating Scale for Probability of detection of risk

Linguistic Scale	Scale
Very Low (VL)	9-10
Low (L)	7-8
Medium (M)	5-6
High (H)	3-4
Very High (VH)	1-2

4. DATA COLLECTION

Otipy company, an online platform that connects consumers with local farmers to purchase fresh produce and groceries directly. It aims to support farmers while providing consumers with convenient access to high-quality, fresh products. Customers can browse a wide range of fruits, vegetables, dairy products, and other groceries through the Otipy app or website, and have them delivered to their doorstep. The questionnaire was distributed among 4 employees of Otipy data collection process.

5. DATA ANALYSIS AND DISCUSSION

Analyzing the collected data is essential for drawing appropriate conclusions. Aggregate ratings are derived by taking mean value of four respondents as shown in Table 4.

Table 4: Aggregate Ratings

Risks	S	O	D	RPN
Less agriculture output	5	5.25	4.75	124.7
Pests and diseases	5.75	5.25	4.75	143.4
Post-harvest losses	5.75	3	4	69.0
High transportation cost	6.75	3.75	5	126.6
Natural Disasters	6.75	1.75	3.5	41.3
Inadequate roads infrastructures	5.25	4.25	7	156.2
Seasonal conditions	4.5	5.5	4	99.0

It can be thus concluded that Inadequate Road infrastructure has the highest RPN leading Pest and diseases the second highest and lowest RPN is Natural disaster. These risks could potentially lead to substantial losses in agriculture output and increase operational expenses. While other risks such as less agriculture output, post-harvest losses, natural disasters, and seasonal conditions are also important factors to consider, their RPN values suggest they may not pose as immediate or severe threats compared to inadequate roads infrastructure, pests and diseases, and high transportation costs. This might involve investing in infrastructure improvements, implementing effective pest and disease management strategies, and optimizing transportation logistics to minimize costs and maximize productivity in the agricultural sector. Funding for road infrastructure should be prioritised by law makers and government agencies to ensure that agricultural markets, especially in rural and isolated areas, are accessible. Reduced transportation costs, faster delivery times and easier access to markets can result from better transportation networks, roads and bridges.

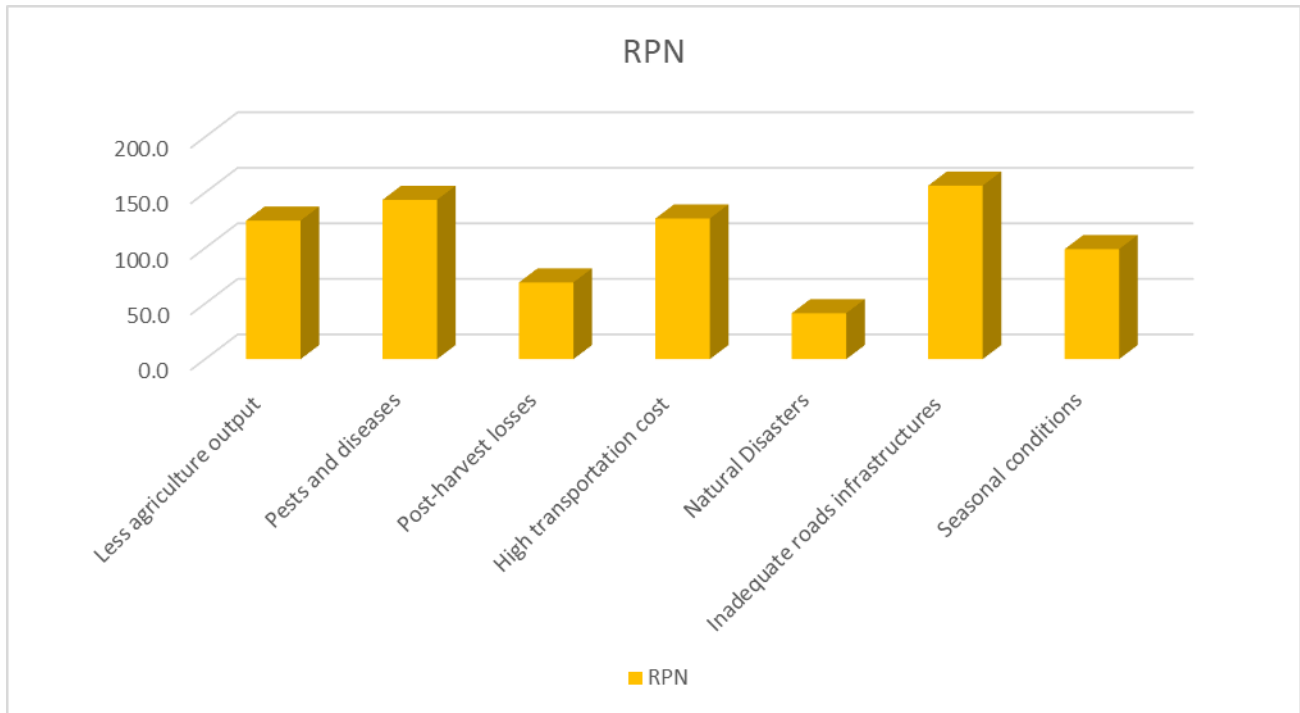


Figure 1: Agricultural Supply Chain Risk bar graph RPN

6. MITIGATION STRATEGIES

Inadequate Roads Infrastructure: Conduct a comprehensive assessment of existing road infrastructure to identify critical gaps and areas needing improvement. Develop and implement infrastructure development projects focused on enhancing road connectivity in rural agricultural areas. Collaborate with government agencies, private sector entities, and local communities to fund and execute infrastructure projects efficiently. Explore innovative solutions such as using technology for real-time monitoring of road conditions and maintenance needs.

Pests and Diseases: Establish integrated pest management (IPM) programs to monitor, prevent, and control pest and disease outbreaks effectively. Provide training and resources to farmers on best practices for pest and disease management, including the use of resistant crop varieties and environmentally friendly pest control methods.

High Transportation Costs: Analyze the transportation network and logistics chain to identify inefficiencies and cost-saving opportunities. Invest in infrastructure upgrades and transportation technologies to improve the efficiency and reliability of transportation routes for agricultural products. Negotiate favourable terms with transportation providers and explore alternative transportation modes to reduce costs.

Post-Harvest Losses: Enhance post-harvest infrastructure and facilities, such as cold storage, drying facilities, and packaging centres, to minimize losses and maintain product quality. Train farmers on proper post-harvest handling techniques, including harvesting, sorting, grading, and storage, to reduce spoilage and waste. Foster partnerships between farmers, processors, distributors, and retailers to streamline supply chains and improve coordination in post-harvest management.

7. CONCLUSION

Addressing the multifaceted challenges in agricultural supply chains in rural areas is crucial for ensuring food security, improving farmers' livelihoods, and promoting sustainable economic development. These challenges, including limited input access, high transportation costs, pest threats, and inadequate infrastructure, require a holistic approach involving investment in infrastructure, adoption of modern practices, effective pest management, and promotion of post-harvest techniques. By working together to tackle these issues, policymakers, stakeholders, and communities can unlock the full potential of rural agriculture, leading to positive impacts on both local and global scales.

REFERENCES

- Bisht, I. S. (2013). Biodiversity conservation, sustainable agriculture and climate change: A complex interrelationship. In *Knowledge systems of societies for adaptation and mitigation of impacts of climate change* (pp. 119-142). Berlin, Heidelberg: Springer Berlin Heidelberg.
- Ibrahim, M. M., Aboud, K. A., & Hussein, R. M. (2011). Genetic variability and path coefficient analysis in sweet basil for oil yield and its components under organic agriculture conditions. *Journal of American Science*, 7(6), 150-157.
- Israel, D. C., & Briones, R. M. (2012). *Impacts of natural disasters on agriculture, food security, and natural resources and environment in the Philippines* (No. 2012-36). PIDS discussion paper series.
- Goraga, Z. S., Mengesha, M., Miele, M., & de Lima, G. J. M. M. (2015). Swine production in Ethiopia: I. Socio-economic characteristics of producers and motivational drivers. *Global Journal of Agriculture and Agricultural Sciences*, 3(7), 279-287.
- Tunde, A. M., & Adeniyi, E. E. (2012). Impact of road transport on agricultural development: a Nigerian example. *Ethiopian Journal of Environmental Studies and Management*, 5(3), 232-238.
- Yeboah, N. E., Feng, Y., Daniel, O. S., & Joseph, N. B. (2014). Agricultural supply chain risk identification-a case finding from Ghana. *Journal of management and strategy*, 5(2), 31.