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Assessing Risk Management Strategies in Rice Production: A Case Study in Katipunan, Zamboanga del Norte

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Maria Juliet B. Sanlitan[1] MTHM
Yvone L. Sadoy[2] MA
Menardo B. Quiamjot Jr.[3]

[1]Acting Associate Dean, College of Business Administration, JRMSU-Katipunan Campus, Zamboanga del Norte, Philippines
[2]Faculty, College of Business Administration, JRMSU-Katipunan Campus, Zamboanga del Norte, Philippines
[3]Graduate, Bachelor of Science in Agribusiness Management, JRMSU Katipunan Campus, Zamboanga del Norte, Philippines

Abstract

Rice production and farmers' livelihoods are at risk because of several factors. This study was conducted to determine the risk management practices of the farmers encountered in rice production at the Municipality of Katipunan Zamboanga Del Norte. The study used a descriptive research design using a structured questionnaire as data gathering instrument. Random sampling method was used in selecting the one hundred twenty (120) respondents from the list of registered rice farmers outsourced from the office of the municipal agriculturist. The data gathered was statistically interpreted using frequency count and percentage. In this study, the researchers concluded that rice production is a complex system subject to various risks. In production risk, rice farmers were more exposed to the risk associated with the high cost of inputs in chemicals, high transportation cost is the most significant problem that the farmers are facing in marketing risk, lack of sources of capital in terms of the financial risk while insufficient manual labor in human risk. It is recommended that educational institutions, like Jose Rizal Memorial State University, and, in coordination with the Local Government Unit and other relevant government agencies, should conduct an extension program with a focus in providing opportunities for continued learning and develop new skills through the following risk management strategies: Integrated Pest Management (IPM), organic farming, and crop insurance. They should also be trained on the usage of different modern risk management techniques like insurance, integrated farming, and cooperative marketing.

Keywords: risk management strategies, rice production, production risk, marketing risk, financial risk, human risk, Katipunan, Zamboanga del Norte

INTRODUCTION

Rice is the staple food in the whole world. More than half of the people in the world, which is about 3.5 billion people, rely on it (FAO, 2004). Recently, changes in rice production has been observed. For instance, rice production in East Java Province in 2021 is estimated to be equivalent to 5.69 million tons of rice, or a decrease of 20.45 thousand tons 0.36 percent (Dilidharmayanti, 2022). In the Philippines, rice production has been continually changing over time mainly due to the dynamic challenges and needs of the Filipinos. Rice is widely grown in Luzon, Western Visayas, Southern Mindanao, and Central Mindanao. For the past two decades, rice production has increased from 12 million metric tons in 1999 to 19 million metric tons in 2008 (FAO, 2020). The annual-mean of total rice harvested area is approximately 4.7 million hectares and average yield is approximately 3.95 tons per harvested hectare in the Philippines.

Risk is an inevitable feature of agriculture in both developed and developing countries (Kabir, Cramb, Alauddin & Gaydon, 2019) and it has various sources. Seasonal weather variability and outbreaks of pests and diseases are the key sources of production or yield risk. Farmers are

also exposed to market or price risk due to volatility of farm input and output prices (Kabir et al., 2019). Farmers have developed various strategies and have different capacities to manage everyday risk. Risk management strategies fall into three broad categories: production, marketing, and management (Kabir et al., 2019). Production strategies include selecting products with low-risk potential, choosing short duration crops, implementing conservation measures, adopting risk-reducing technology, and adjusting the enterprise mix, especially through diversification (Rizwan et al., 2020).

The Municipality of Katipunan is one of the rice producing towns in Zamboanga del Norte. Most of the barangays in the Municipality are involved in the production of rice. There are over 1,269.45 hectares of land devoted to the production of rice. This includes irrigated, rainfed, and upland areas. Based on the record of the Department of Agriculture in Katipunan, Barangay Malugas is one the largest area engaged in rice production followed by Barangay Sinuyak, Seres, San Vicente, and Basagan (DA-Katipunan, 2022). As of the present, no research has been conducted in the Municipality of Katipunan, Zamboanga del Norte that specifically examines the risks affecting the rice production activities of local farmers. This lack of data presents a critical gap in understanding the challenges faced by rice farmers in the area, as well as the strategies they employ to manage these risks. Thus, this study focuses on determining the risk management practices of rice farmers in selected barangays of Katipunan.

Significance of the Study. The results of this study hold significance for various sectors and stakeholders involved in rice production and agricultural development in Katipunan. Primarily, the study provides the researchers with a deeper understanding of the risk management strategies employed by rice farmers in the selected barangays. Through this investigation, the researchers gained insight into how farmers adapt to challenges and uncertainties in rice production, particularly those brought about by environmental, economic, and social factors. The findings serve as a valuable academic contribution that can enhance the existing body of knowledge in agricultural research and serve as a foundation for further studies focusing on risk reduction and sustainability in farming.

For the Local Government Unit (LGU), the study offers valuable information on the different challenges and hazards faced by farmers in the process of cultivating and producing rice. By understanding these difficulties, the LGU can design and implement more responsive agricultural programs and policies that address the specific needs of farmers in the community. The results can also serve as a reference in formulating risk management frameworks, disaster preparedness plans, and capacity-building initiatives that aim to strengthen the resilience of the local agricultural sector.

The findings are also highly beneficial to the rice farmers themselves. Through this study, they are able to identify and reflect on their existing risk management practices, recognize effective strategies, and adopt improved approaches in addressing the threats that affect their productivity and livelihood. The knowledge generated from the research can help farmers make better-informed decisions that lead to increased efficiency, reduced vulnerability, and more sustainable rice production practices.

For Jose Rizal Memorial State University, including faculty and students, the study serves as a benchmark and a valuable source of data for future academic and extension activities. The results may inspire the development of university-led outreach programs designed to enhance farmers' knowledge and skills in agricultural risk management. Furthermore, the study strengthens the university's role as a partner in community development by linking academic research with practical applications that directly benefit local farmers.

Finally, the study is significant to future researchers as it provides a reliable reference and theoretical basis for further exploration of

risk management in rice production. The findings may guide future investigations in identifying new areas of inquiry, improving methodologies, and expanding the understanding of how farmers can better cope with risks in agricultural systems. In this way, the study contributes not only to the academic community but also to the ongoing pursuit of sustainable agricultural development in the region.

Objectives. This study was conducted to determine the possible risks and problems that the farmers encountered in rice production and the strategies they adopt to manage these risks. Specifically, it sought to answer the following:

1. To determine the sources of risk encountered by the farmers in terms of:
   1.1 Production Risk;
   1.2 Marketing Risk;
   1.3 Financial Risk; and,
   1.4 Human Risk?

2. To determine the risk management strategies adopted by the rice farmers in terms of:
   2.1 Production Risk Management Strategy;
   2.2 Financial Risk Management Strategy;
   2.3 Marketing Risk Management Strategy; and,
   2.4 Human Risk Management Strategy?

3. What possible interventions or recommendations may be proposed to effectively manage and reduce the identified risks in rice production?

LITERATURE REVIEW

Risk Sources in Rice Production. Risk is the probability of an event resulting in a loss when the event occurs during a certain period (Badariah et al., 2012). The presence of risk in agriculture has a significant influence on farmers' production and investment decisions, so a good risk management concept is needed. Risk can be said as a result (or deviation from the realization of a disaster) that may occur unexpectedly. Even though an activity has been planned properly, it still contains uncertainty that later it will not go completely according to the plan. In other words, risk must be managed appropriately so that the company's effectiveness is not compromised. The fact that farmers live in different climatic and institutional conditions implies different perceptions of risk. This situation is caused by: 1) different probabilities of certain risk factors 2) different mentality and awareness of farmers and or 3) a mixture of both (Borges & Machado, 2012). Understanding the right risk perception can be seen as a prerequisite for choosing an efficient risk management strategy, because farmers who are not aware of the risks, they face will not be able to manage them effectively (Sulewski & Kłoczko-Gajewska, 2014).

Risk sources comprise of all the factors and variabilities that produce a risk. There are four main roots of agricultural risk namely, production, marketing, financial and human risk (Huirne et al., 2000). Smallholders typically prefer low-cost, incremental changes (IPM, low-cost water conservation), whereas larger/commercial producers can adopt capital-intensive measures (mechanization, formal insurance). Thus, an intervention's cost and lumpy investments strongly influence adoption patterns (Feder et al., 1985; Schulz & Börner, 2022).

Production and Technical Risk. Agricultural productivity in both crops and livestock is largely influenced by biological processes that are sensitive to weather conditions, pests, and diseases. Insufficient rainfall or prolonged drought can result in reduced yields, while extreme weather events such as hailstorms or heavy rains can cause severe damage to crops. Similarly, pest infestations and disease outbreaks may lead to significant production losses. Farmers face these uncertainties each season, as they cannot predict rainfall patterns, weather disturbances, or pest occurrences when deciding to plant or raise livestock. Despite these risks, they must still invest resources such as labor, seeds, fertilizers, and equipment, without assurance of recovery.

Equipment failures, like a tractor breakdown during harvest, can also disrupt production and lower yields (Salihu et al., 2021).

Evidence shows that combining hands-on extension approaches, such as Farmer Field Schools (FFS), with technical practices like Integrated Pest Management (IPM), improved varieties, and water management, alongside institutional supports including cooperatives, market linkages, and access to credit or insurance, delivers larger and more durable benefits than stand-alone measures (van den Berg & Jiggins, 2007; Pretty & Bharucha, 2015). Integrated approaches have been found to reduce pesticide dependence, improve farmer knowledge, and increase the likelihood of sustained practice change (van den Berg & Jiggins, 2007; Davis et al., 2012).

However, many evaluations report only short-term gains in knowledge or practice and lack multi-season follow-up to demonstrate the persistence of adoption, sustained yield gains, or long-term welfare improvements (Davis et al., 2012; Pretty & Bharucha, 2015). Furthermore, studies often employ varied success metrics, such as yield, income variance, adoption rate, or perceived risk, making synthesis difficult and complicating the assessment of which interventions most effectively deliver welfare gains under different objectives (Schulz & Börner, 2022).

In addition, technical interventions frequently overlook socio-institutional factors such as intra-household decision-making, gendered labor and access, trust in institutions, and local governance, all of which significantly influence the uptake and equity of benefits (Feder et al., 1985; Schulz & Börner, 2022). These limitations highlight the importance of designing risk management strategies that consider not only the technical aspects of production but also the social and institutional dynamics that shape farmer behavior and outcomes.

Moreover, variations across different agroecological contexts require tailored interventions. Flood-prone, drought-prone, and saline environments demand distinct technical mixes—for example, flood-tolerant varieties and improved drainage systems versus drought-resilient varieties and water harvesting techniques. Matching interventions to local agroecological and socioeconomic conditions is therefore essential to ensure their effectiveness and sustainability (Pretty & Bharucha, 2015).

Marketing Risk. According to Naim Kakar et al., (2025), price or market risk refers to the uncertainty surrounding the prices that manufacturers must pay for inputs or the prices they will receive for commodities. Price risk takes many different forms from commodity to commodity. armers typically have little control over market prices, which are influenced by various external factors. The supply of agricultural goods depends on collective production decisions, weather conditions, and other elements that affect yield, while demand is shaped by consumer preferences, income levels, overall economic performance, and the availability of substitute products. Furthermore, production costs fluctuate based on input expenses and yield levels. Although input prices tend to remain relatively stable, variations in yields and market prices make production costs a significant source of financial risk for farmers.

Price movements sometimes follow seasonal or cyclical patterns that can be predicted; however, changes in supply or demand may also occur unexpectedly, thereby influencing market prices. When farmers plant crops or allocate resources to livestock production, they do so without certainty about the prices their products will command. For instance, during periods of low rainfall, crop yields often decline, which subsequently drives and directs prices upward.

Financial Risk. According to Naim Kakar et al., (2025), financial risk arises when a farm firm takes out a loan and incurs repayment obligations. Increasing interest rates, the possibility of lenders calling loans, and limited credit availability are all components of financial risk.

Nto et al. (2017) noted that interest rate and non-accessibility of credit to rice producers are part of the major reasons of financial risk in the production of rice. Rice farmers usually loan cash from informal sources with a very high-interest rate. Formal credit establishments are extremely forced in funding rice production as a result of inherent risk and limitations.

Human Risk. Human risk refers to the risks to the farm business caused by illness or death and the personal situation of the farm family. Accidents, illness and death can disrupt farm performance. In many countries labour migration away from rural areas is a common occurrence. Migration can cause labour shortages for the farm. Political and social unrest can also limit labour availability. The spread of HIV/AIDS has had a serious impact on labour availability and productivity in some areas. When farmers plant their crop or commit resources to raise livestock, they cannot be certain whether they will have enough labour to manage the farm enterprises (Craven et al., 2008).

Risk Management. Decision-making is a central aspect of farm management, as farmers must plan and act despite uncertainty. At the start of each cropping season, they decide which crops to plant, the seeding density, and the amount of fertilizer to apply without knowing what yields or market prices will be months or even years later, especially for perennial crops and livestock. Only in limited situations can farmers predict outcomes with certainty, such as when borrowing from banks where interest rates are fixed. Most farming decisions, however, involve unpredictable results influenced by changing conditions, other people's actions, and uncontrollable future events. To make sound decisions, farmers must access reliable information on input and output prices, expected yields, and technical requirements.

Theoretical Framework. This study was anchored on the Enterprise Risk Management (ERM) theory. Enterprise risk management (ERM) is a new paradigm for managing risk from an inclusive perspective. It is widely embraced by boards of directors to address conflicts in the "principal-agency theory" and "information asymmetry" (Jankensgård, 2019). ERM implementation enhances sound decision-making through the complete flow of risk information and the minimization of information asymmetries (Bohnert et al., 2018). Unlike traditional risk management that may operate in silos, ERM promotes a holistic view of risk, encouraging unified surveillance and response across all units. This approach allows for consistent monitoring and mitigation of both internal and external risks, while also promoting a shared risk culture throughout the organization.

ERM has been widely adopted across various industries, including aviation, construction, public health, energy, finance, and increasingly, agriculture, due to its ability to streamline risk identification, enhance communication, and guide strategic decision-making. The framework also fosters accountability by assigning ownership and responsibility for assessing and managing risk, regardless of employee turnover or changing industry standards. In this way, ERM supports long-term sustainability and resilience in both public and private sector operations.

Figure 1
Enterprise Risk Management Framework (Nocco & Stulz, 2008)

Guided by the ERM framework (Figure 1), this study sought to explore the risks encountered by rice farmers and the strategies they employ

to manage them. Specifically, it aimed to determine the sources of risk encountered by the farmers in terms of production, marketing, financial, and human risks. Production risks may include unpredictable weather, pests, diseases, or equipment breakdowns. Marketing risks involve challenges such as fluctuating prices, limited market access, or low demand. Financial risks pertain to unstable income, lack of credit, and rising input costs. Human risks encompass labor shortages, health problems, or the unavailability of skilled workers.

In addition, the study aimed to determine the risk management strategies adopted by rice farmers in response to these risks. These include production risk management strategies such as crop diversification, use of quality seeds, and adoption of appropriate technologies; financial risk strategies such as saving schemes, joining cooperatives, or accessing microfinance services; marketing risk strategies including product diversification, direct selling, and market price monitoring; and human risk strategies like labor-sharing practices, investing in training, and ensuring workers' health and safety. By aligning the study's objectives with the principles of ERM, the research provides a comprehensive understanding of how rice farmers in selected barangays of Katipunan, Zamboanga del Norte, manage the complex and interrelated risks they face in their farming activities.

Conceptual Framework. Figure 2 shows the schematic diagram of the study. The first box represents the sources of risk encountered by the rice farmers.

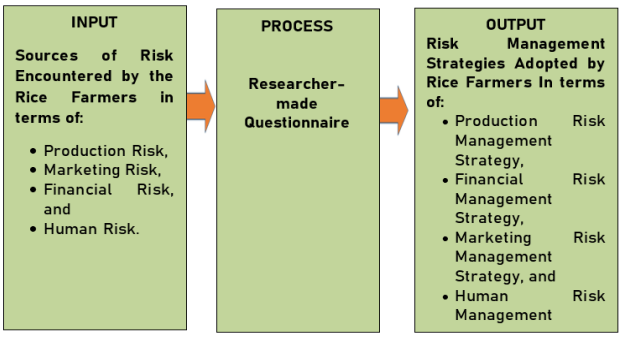

Figure 2
Research Paradigm

The arrow that pointed to the second box represents the researcher-made questionnaire needed to complete the study. The third box represents the risk management strategies adopted by the rice farmers.

METHODOLOGY

This study used the descriptive method of research to determine the sources of risk and risk management strategies employed by the rice farmers. A researcher-made questionnaire served as the primary data-gathering instrument. Its content and structure were validated by experts, including two university agriculture faculty members as well as the LGU Rice Coordinator. Frequency distribution and percentage were utilized in profiling the respondents and to determine the sources of risk encountered by the farmers. Mean was used to determine the risk management strategies adopted by farmers. Frequency distribution and percentage were also used to determine the sources of risk identified by the rice farmers, and the risk management strategies employed to address those risks.

Using purposive sampling, there were one hundred twenty (120) registered rice farmers in Katipunan, Zamboanga del Norte who served as respondents of the study. Majority of them were male, 67 % aged between 36 and 75 years and had mostly completed elementary education. Most were tenants, cultivating land areas between 1 to 1.4 hectares. The majority operated rainfed farms and had been engaged in rice farming for 30 to 45 years.

RESULTS AND DISCUSSION

The sources of risk encountered by the farmers is shown in Table 1. Sources of risk are those means through which farmers are exposed to certain unforeseen negative circumstances hindering or inhibiting their level of rice production in the study area. A comprehensive list of production risk sources was made and farmers were asked to think and answer appropriately about the sources of risks they encounter.

Production risk is a significant challenge faced by farmers, which refers to the uncertainty associated with crop yields, weather conditions, pests, and other factors that can impact the overall output of a farm. To manage these risks, farmers need to adopt a range of strategies, to help mitigate some of the risks they have encountered to their farms.

The findings also indicate that the rice farmers in the study area were more exposed to the risk associated with the high cost of inputs in chemicals (96%), the high cost of human resources for transplanting (93%), and insect and pest infestations, especially mollusk infestations (92%).

Table 1
Production risk encountered by farmers

Description	YES		NO		TOTAL	
	Frequency	(%)	Frequency	(%)	Frequency	(%)
1. Insect and Pest Infestation						
Weeds	106	88	14	12	120	100
Insects	97	81	23	19	120	100
Rodents	92	77	27	23	120	100
Mollusks	110	92	10	8	120	100
Disease	87	73	32	27	120	100
Birds	99	83	21	17	120	100
2. Natural calamities (flood, drought, strong winds) caused by adverse weather conditions	106	88	14	12	120	100
3. Climate variability (undefined rainy and dry season)	92	77	28	23	120	100
4. Unavailability of registered, certified or good seeds in rice	50	42	70	58	120	100
5. Lack of knowledge and proper training in proper rice production technology	80	67	40	33	120	100
6. Unavailability of production technicians for consultations	77	64	43	36	120	100
7. Climate Change	98	82	22	18	120	100
8. Water Source	85	71	35	29	120	100
9. Lack of farm machinery	99	83	21	17	120	100
10. High cost of human resources for:						
Land preparation	97	81	23	19	120	100
Pulling of seedlings	102	85	18	15	120	100
Transplanting	112	93	98	82	120	100
Weeding	98	82	22	18	120	100
Chemical Spraying	91	76	29	24	120	100
Harvesting	106	88	14	12	120	100
Drying	104	87	16	13	120	100
11.Not synchronized planting of rice farms in the area	83	69	37	31	120	100
12.Adjacent farmers' observance of proper rice production technology not practiced	80	67	40	33	120	100
13. Unclean and weedy area surrounding the farms	108	90	12	10	120	100
14. High cost of inputs						
Fertilizer	113	94	7	6	120	100
Chemicals	115	96	5	4	120	100
Seeds	103	86	17	14	120	100

The results indicate that farmers who rely on chemicals to grow their crops faced financial risks. Exposure to chemicals can cause short-term and long-term health problems for farmers. Pesticides, for example, can cause skin irritation, respiratory problems, and even cancer if used improperly or without protective gear. Herbicides and fertilizers can also cause health problems if inhaled or ingested. In terms of the high cost of human resources for transplanting since the availability of labor for manual transplanting can be unpredictable, particularly during peak planting seasons when many farmers require workers at the same time. This can lead to a shortage of available workers, which can delay the planting process and affect crop yields. It can also be seen that rice farmers also encountered problems in terms of insect and pest infestation, especially the mollusk, which can be a risk to farmers because they feed on crops and can cause significant damage to the plants. They are particularly attracted to young plants, which are more vulnerable to damage; they can reduce crop yields and sometimes even destroy entire crops. This can be especially problematic for farmers who rely on their crops for livelihood.

Some of them reported that 42% of the farmers were facing the unavailability of registered, certified, or good seeds in rice, which are very important because registered and certified seeds are usually produced using high-quality breeding techniques with a focus on disease resistance, yield potential, and other desirable traits. These seeds are rigorously tested and approved by regulatory bodies to ensure their quality and suitability for specific growing conditions.

Pretty and Bharucha (2015) emphasize that insect and pest infestations, including mollusks like the golden apple snail, are a major cause of crop loss in rice farming. They confirm that such pests are especially damaging during the early growth stages of rice and can destroy entire crops. The study supports your finding that 92% of farmers identified pest infestation as a major production risk. The article also highlights how chemical pesticide use—while widespread—leads to high financial costs and health hazards due to poor safety practices and lack of training.

Marketing risk is a significant concern for farmers, as it refers to the potential for losses that may arise due to changes in market conditions, such as changes in demand, prices, or supply chain disruptions. To analyze marketing risk, farmers need to consider a range of factors that could affect their ability to sell their products profitably. So that farmers can identify potential marketing risks and develop strategies to mitigate them.

Table 2 shows that the majority of the problem encountered by the farmers is the high transportation cost (90%) which means that high transportation costs can also make it harder for farmers to get the inputs they need for their farms. For example, if a farmer needs to purchase fertilizer or other supplies that are located far away from their farm, they may have to pay more to transport those supplies to their farm, which can increase their production costs. While 64% of the respondents have experienced poor farm-to-market roads, this means that if farm-to-market roads are in poor condition, farmers may have difficulty accessing markets to sell their crops or purchase necessary supplies. This can result in lost income or increased costs for transportation.

Table 2
Marketing risk encountered by farmers

Description	YES		NO		TOTAL	
	Frequency	(%)	Frequency	(%)	Frequency	(%)
1. Low price of harvested Palay	91	76	29	24	120	100
2. Difficulty in finding storage facility	103	86	17	14	120	100
3. Difficulty in finding buyers/middlemen	98	82	22	18	120	100
4. Poor farm to market road	77	64	43	36	120	100
5. High transportation cost	108	90	12	10	120	100
6. Unavailability of drying facilities	97	81	23	19	120	100

According to Dorosh et al., (2010), poor rural road connectivity contributes to high transaction and transportation costs, which in turn discourages farmers from expanding production or investing in better inputs. The study emphasizes the link between infrastructure and market participation, echoing your result that poor roads and high transport costs severely affect farming operations.

Table 3
Financial risk encountered by farmers

Description	YES		NO		TOTAL	
	Frequency	(%)	Frequency	(%)	Frequency	(%)
1. Unavailable credit facilities	102	85	18	15	120	100
2.High Interest rate	92	77	28	23	120	100
3.Low access to credit	85	71	34	29	120	100
4. Lack of sources of capital	110	92	10	8	120	100
5. Low income and return on investment	99	83	21	17	120	100

Farmers are often exposed to financial risks due to the inherent uncertainties involved in agricultural production. These risks can arise from a variety of factors, such as changes in weather patterns, fluctuating market prices, pests and diseases, and changes in government policies. To manage these risks, farmers need to have a good understanding of the various types of financial risks they may encounter and adopt appropriate risk management strategies. Overall, managing financial risks is an essential part of the agricultural business, and farmers should take proactive measures to mitigate these risks to ensure the long-term sustainability of their operations.

Table 3 shows the following financial risk encountered by the farmers. Of all the reasons, the most important risk encountered by the respondents was lack of sources of capital (92%) while 71% of the respondents have experienced low access to credit. Agriculture is a capital-intensive business. Farmers require capital to purchase land, equipment, seeds, fertilizers, and other inputs necessary to produce crops or raise livestock. Without sufficient capital, farmers may not be able to invest in the latest farming technologies or equipment, which can result in lower yields and reduced profitability.

On the other hand, low access to credit also limits the ability of farmers to expand their operations and invest in new technologies or equipment, which can lead to lower yields and decreased competitiveness in the market. Without access to credit, farmers may be forced to sell their produce at lower prices or delay investment in their farms, which can have long-term negative consequences.

Farmers who engage in rice production face a variety of human risks that can affect their livelihoods and well-being Overall, farmers engaged in rice production must be aware of these human risks and take steps to manage them to ensure the sustainability of their businesses and the health and safety of themselves and their workers.

Table 4 lists the following human risks that farmers may confront: The finding shows that the majority of the respondents have experienced insufficient manual labor (81%) and 4% of the respondents did not use proper protective attire during production operations (ex. spraying) which means if there is not enough manual labor, tasks may take longer to complete or may not be done as well, which can reduce productivity and increase costs. This can also lead to delays and other problems that can affect the overall success of a project or business.

Table 4
Human risk encountered by farmers

Description	YES		NO		TOTAL	
	Frequency	(%)	Frequency	(%)	Frequency	(%)
1. Insufficient manual labor	97	81	23	19	120	100
2. Health issues as a result of continuous spraying of chemicals	34	29	85	71	120	100
3. Not using proper protective attire during production operation (ex. Spraying)	5	4	115	96	120	100
4. Ageing labor resources	85	71	35	29	120	100

According to the respondents, it is not risky for them since most of them are wearing their proper attire during the operation. This is because not using proper protective attire during production operations can put farmers at risk of various hazards, such as exposure to chemicals, injuries from sharp objects, and heat or cold stress. For example, farmers who handle pesticides or other hazardous chemicals without protective clothing are at risk of skin irritation, respiratory problems, and other health issues. In addition, farmers who work with machinery or tools without protective clothing, such as gloves or steel-toed boots, are at risk of injuries such as cuts and fractures.

The ILO (2020) highlights that agriculture is one of the most hazardous occupations globally. It notes that failure to use appropriate personal protective equipment (PPE) such as gloves, masks, and boots exposes farmers to numerous risks, including chemical poisoning, injuries, and respiratory conditions. This supports your finding that while only 4% of your respondents reported not wearing PPE, the risk remains significant due to potential exposure to pesticides and other hazards. The ILO also emphasizes the importance of regular training and access to PPE to minimize health risks in the field.

Risk management strategies are those techniques employed by the farmers in order to mitigate the incidence of risks.

Table 5 shows the production risk management strategies that the farmers adopted. It was shown that majority of the respondents have strongly practiced the following strategies, which are farming that is located in an area that is not prone to damages from natural calamities (adjacent to rivers, flooding, rainfed or unirrigated farms, drought) (91%) and uses proper pesticides and chemicals to spray the crop in case of pest and disease occurrence (90%).

The results indicate that areas that are not prone to natural calamities offer better growing conditions for certain crops, such as those that require a specific type of soil or climate. This can result in higher yields and more profitable harvests. The result also stated that most of the farmers used and sprayed the crop with proper pesticides and chemicals in case of pest and disease occurrence, which was commonly used by the farmers to protect their crops from pests and diseases because these can cause significant damage and reduce crop yields. Pests and diseases can quickly spread and destroy crops, leading to significant financial losses for farmers. By using pesticides and chemicals, farmers can control pests and diseases, which can help increase crop yields and ensure the quality of their produce. This can also help reduce the need for manual labor.

Table 5
Production risk management strategies adopted by farmers

Description	Strongly Practiced		Less Practiced		Not Practiced		TOTAL	
	Frequency	(%)	Frequency	(%)	Frequency	(%)	Frequency	(%)
1. Farm is located in area that is not prone to damages against natural calamities (adjacent to rivers-flooding, rainfed or unirrigated farm – drought)	108	90	7	6	5	4	120	100
2. Planted registered, certified, and goods seeds only	83	69	25	21	12	10	120	100
3. Planted rice seed varieties that I know are resistant to certain pests and diseases	12	10	106	88	2	2	120	100
4. Observed proper planting schedule in synchrony with the planting schedule in the area to minimize pest and disease infestation	92	77	12	10	16	13	120	100
5. Kept the rice area clean and free from weeds	97	89	23	19	0	0	120	100
6. Use and spray the crop with proper pesticides and chemicals in case of pest and disease occurrence	108	90	10	8	2	2	120	100
7. Practiced the recommended production technology in rice farming	75	63	34	28	11	9	120	100
8. Attended seminars and trainings organized by government agriculture agencies to upgrade knowledge on how to prevent and minimize pest, disease, and natural calamities damages in rice.	77	64	25	21	18	15	120	100
9. Consulted and seek advice with agriculture production technician in the municipality	12	10	102	85	6	5	120	100
10. Seek membership in farmers association and organization for exchange of information, knowledge, and production problems/issues	43	36	50	42	27	22	120	100
11. Used of mechanical harvesters (as against manual harvesting) to minimize post-harvest losses	27	23	77	64	16	13	120	100
12. Practiced Integrated Pest Management to minimize and reduce use of insecticides and pesticides	5	4	97	81	18	15	120	100
13. Covered my crop against damages by insuring in the Philippine Crop Insurance Corporation	6	5	12	10	102	85	120	100
14. Practiced proper production technology to minimize expenses)								
a) IPM	7	5	14	12	99	83	120	100
b) Organic farming	13	11	10	8	97	81	120	100

While fewer of them have strongly practiced consulting and sought advice with agriculture production technicians in the municipality (10%) and planting rice seed varieties that I knew were resistant to certain pests and diseases (10%). It means that they should consult with and seek advice from the agriculture production technician in their municipality. Consulting services can be expensive, and farmers may not be willing or able to afford them. On the other hand, seeking advice from agriculture production technicians in the municipality may be free or offered at a lower cost. It also indicates that, usually, for farmers, whatever seeds they have or receive from a government agency are all they will plant, without knowing that planting seed varieties that are resistant to common pests and diseases can help reduce the risk of crop damage and, in turn, increase the likelihood of a profitable harvest. Furthermore, planting resistant varieties of seeds can reduce the need for chemical pesticides and fungicides. While fewer of them have practiced integrated pest management to minimize and reduce use of insecticides and pesticides (4%) which means that many farmers may not be aware of the benefits of IPM or may not have access to information about how to implement it on their farms, farmers may not have received training or education in IPM practices, making it harder for them to adopt these methods. This finding is in line with the findings of Ben-Chendo et al., (2015) which stated that some of the respondents adopted the use of improved seeds and varieties of rice.

Financial risk management is a critical aspect of farming, as farmers are exposed to a range of risks. In conclusion, financial risk management is crucial for farmers to maintain the profitability and sustainability of their farms. By employing the strategies above, farmers can effectively manage financial risks ensuring long-term viability of their businesses.

Table 6
Financial risk management strategies adopted by farmers

Description	Strongly Practiced		Less Practiced		Not Practiced		TOTAL	
	Frequency	(%)	Frequency	(%)	Frequency	(%)	Frequency	(%)
1. I keep a record of previous risk costs to enable me forecast future financial risks	10	8	77	64	23	19	120	100
2. I engage in those transactions that I am familiar with and know that they are likely to yield higher returns	12	10	83	69	25	21	120	100
3. I try to avoid financial distress and the costs connected with it	17	14	23	19	80	67	120	100
4. I am aware of the various financial risks likely to arise in my business	21	17	85	71	14	12	120	100
5. I have contingent measures to take in case I am faced with a financial risk in my business	30	25	70	58	20	17	120	100

Table 6 highlights the methods that farmers use to manage their financial risk. It was shown that 25% of the respondents have contingent measures to take in case they face a financial risk in their business. This indicates that farmers may have limited resources to invest in contingency planning, such as insurance or savings accounts. They may prioritize other needs, such as purchasing equipment or paying for inputs, over building a financial safety net. While 8% of the respondents strongly practiced keeping a record of previous risk costs to enable them to foresee future financial risks

which is an important aspect of risk management, as it allows organizations to learn from past experiences and make better decisions regarding future financial risks. By analyzing past risk costs, organizations can identify patterns and trends, understand the causes of previous losses, and use this information to develop more effective risk management strategies.

According to the study of Cao et al. (2019), farm households often show declining participation in formal risk-management tools (e.g. insurance), despite volatility in returns. Risk-averse farmers treat insurance more as occasional investment (e.g. government-subsidized payouts) rather than structural contingency planning.

Marketing risk management is an essential aspect of farming that farmers need to consider to ensure the profitability and sustainability of their business. Farmers face various marketing risks that can affect their profitability and sustainability. However, by adopting the above strategies, they can effectively manage these risks and ensure the long-term success of their business.

Table 7
Marketing risk management strategies adopted by farmers

Description	Strongly Practiced		Less Practiced		Not Practiced		TOTAL	
	Frequency	(%)	Frequency	(%)	Frequency	(%)	Frequency	(%)
1. Storing of dried palay during low prices and selling during high prices	25	21	80	67	15	12	120	100
2. Milling and selling of palay as well-milled rice product to retailers and consumers	15	12	99	83	6	5	120	100
3. Membership in farmers association/cooperative to sell as a group by bulk at higher prices	7	6	108	90	5	4	120	100
4. Selling directly to grain-millers and wholesalers instead of commission agents	27	23	77	64	16	13	120	100
5. Planting early to harvest early and take advantage of pre-seasonal prices	74	62	27	23	19	15	120	100

Table 7 shows that 62% of the respondents have strongly practiced planting early to harvest early and take advantage of pre-seasonal prices, which means that planting early can also help farmers avoid potential weather-related issues that may arise later in the season, such as drought, excessive rainfall, or early frost. By planting early, farmers can often avoid these risks and ensure that their crops have sufficient time to mature and reach their full potential before these potential hazards arise. While 6 % of farmers strongly practice participating in a farmer association or cooperative, which they must implement, it will provide members with access to information on market trends, production techniques, and government policies. They can also provide resources such as credit, training, and equipment to help farmers improve their yields and quality.

According to the study of Urfels et al. (2021), a large dataset of 7,597 rice farmers finds that timely planting is critical for climate resilience, helping farmers avoid late-season drought or excessive rainfall. Early planting improves survival rates and yield potential, aligning with your result that 62% of respondents practice early planting to avoid weather-related risks and capture pre-season prices.

Farmers face a range of human risks, including economic, social, and health-related risks. These risks can have a significant impact on their livelihoods and can threaten the sustainability of their farming operations. Overall, the key to effective human risk management for farmers is to adopt a proactive approach and employ a combination of strategies that are tailored to their specific needs and circumstances.

Table 8 shows that the majority of the respondents (96%) strongly practiced using proper protective attire during farm operations. Using proper protective attire during farm operations is crucial for the safety, health, and comfort of farmers, as well as to comply with regulations and prevent accidents and injuries. While few of the respondents strongly practice taking proper care of human resources (SSS premium payment, Philhealth, etc.), which is only 10%, this means that farmers often operate on a small scale and have limited resources, making it difficult for them to prioritize human

resource management over other pressing needs such as crop maintenance and equipment repairs.

Table 8
Human risk management strategies adopted by farmers

Description	Strongly Practiced		Less Practiced		Not Practiced		TOTAL	
	Frequency	(%)	Frequency	(%)	Frequency	(%)	Frequency	(%)
1. Used Proper Protective Attire during farm operation	115	96	5	4	0	0	120	100
2. Attendance to trainings and seminars to upgrade knowledge and technical skills	80	67	36	30	4	3	120	100
3. Giving of appropriate salaries and wages	74	62	38	32	8	6	120	100
4. Taking proper care of human resources (SSS premium payment, Philhealth, etc)	12	10	85	71	23	19	120	100
5. Proper motivation to reduce labor turnover (ex. giving of incentives when harvest is high, etc)	13	11	91	76	16	13	120	100

Ekmekci and Yaman (2024) found out that about 66.5% reported using PPE, and 51.5% of occupational accidents were attributed to lack of PPE usage. Though PPE usage was lower than in your context, the study highlights the protective role of PPE in preventing injury—corroborating that consistent use (as seen in 96%) is essential and valuable for farmer safety and health.

Conclusion. Rice production is a complex agricultural system that is subject to various risks. The risks associated with rice production can be broadly classified into four categories: production risk, financial risk, marketing risk, and human risk. In production risk, the rice farmers selected barangays were more exposed to the risk associated with the high cost of inputs in chemicals, high transportation cost is the most significant problem that the farmers are facing in marketing risk, In terms of financial risk, the most important risk encountered by the respondents was on lack of sources of capital, while in terms of human risk, the majority of the respondents have experienced insufficient manual labor.

In risk management strategies, farmers have adopted various tactics that they have practiced in order to mitigate the incidence of risks, just like farming that is located in an area that is not prone to damages from natural calamities (adjacent to rivers, flooding, rainfed or unirrigated farms, drought), having contingent measures to take in case they face a financial risk in their business, planting early to harvest early and taking advantage of pre-seasonal prices, and using proper protective attire during farm operations.

Recommendations. It is recommended that educational institutions like Jose Rizal Memorial State University in coordination with the Local Government Unit and other relevant government agency should conduct an extension program with regards to providing opportunities to continue learning and develop new skills through the following risk management strategies like Integrated Pest Management (IPM), organic farming, and crop insurance. This is to level-up the awareness of the rice farmers towards the risk management strategies. They also should also be trained on the usage of different modern risk management techniques like insurance, integrated farming, and cooperative marketing. The extension and information campaign shall also include alternative livelihood training and seminars to the rice farmers and members of their household as a source of additional earnings to compensate for the decrease in income induced by the risk in the rice production. For future research, it is suggested to evaluate the effectiveness of specific risk management strategies such as IPM, crop insurance, and cooperative marketing in improving farmers' resilience and productivity. Further investigations may also explore the socioeconomic factors influencing the adoption of these strategies, as well as the long-term impacts of extension programs on farmers' knowledge, attitudes, and income stability.

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