



Risk Mitigation Strategy and Rice Price Stability through Strengthening Supply Chains in Tojo Una-Una Regency

Rosida Adam¹; Fatlina Zainuddin^{*2}; Umar Syarifuddin³; Erwan Literary⁴
^{1,2,3,4} Tadulako University, Palu-Indonesia

*Corresponding Author

Rosida_adam@yahoo.co.id, Fatlina.Z@gmail.com, ErwansastrawanFEB@gmail.com,
umarsyarif@untad.ac.id

Abstract

This research aims to 1) Identifying the rice supply chain in Tojo Una-Una Regency; 2) Identifying risks seen from the perception of each rice supply chain actor in Tojo Una-Una Regency; 3) Evaluating the highest priority risks of each rice supply chain actor in Tojo Una-Una Regency; 4) Developing risk mitigation strategies for each rice supply chain actor in Tojo Una-Una Regency; 5) To find out the variation in margins at each level of the rice supply chain in Tojo Una-Una Regency. This type of research is qualitative descriptive located in Tojo Una-Una Regency. The number of informants is 31 people spread across 12 sub-districts in Tojo Una-Una Regency. From the results of the study, it was found that the rice supply chain in Tojo Una-Una Regency consists of several models/paths depending on the region and source of rice supply. For the supply of rice from within Tojo Una-Una Regency, it was donated by three sub-districts, namely Tojo, West Tojo and Ampana Tete Districts. Meanwhile, the supply of rice from outside Tojo Una-Una Regency comes from Parigi Moutong Regency, Banggai Regency, and South Sulawesi Province. In the rice supply chain, every actor from farmers to end consumers has a priority risk which is then based on these risks, mitigation strategies are developed to minimize their impact.

Keywords: Risk mitigation; supply chain; Rice.

1. Introduction

Rice is one of the important commodities in Indonesia because it is the main staple food for 255 million Indonesians with a growth rate of 1.31% per year. According to data from the National Food Agency (Bapanas), the per capita rice consumption of the Indonesian people in 2023 will reach 81.23 kilograms/capita/year. The total demand for rice for national household consumption in 2023 will reach 22.64 million tons. Household consumption increased by 0.93% compared to 2022 and became the highest record in the last five years. This is ironic, because the increase in rice consumption is not accompanied by an increase in the amount of production, where in 2023 Indonesia will produce as much as 34 million metric tons or a decrease of 1.2% compared to 2022. Meanwhile, rice consumption in Indonesia increased by 1.1% in 2023, reaching 35.7 million metric tons. This shows that there is a milled rice supply deficit of around 1.7 million metric tons, which is larger than the deficit in previous years (Katadata.co id, 2024). The decline in rice production is inseparable from the decline in national rice production as seen in the following graph:

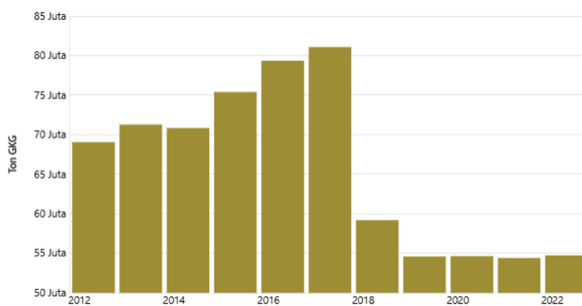


Figure 1: Total National Rice Production for the Period 2012-2022

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From the graph above, there has been a significant decrease in production from 2012 where the national rice production volume was able to reach 69.05 million tons of milled dry grain (GKG). The amount then increased to reach 81.07 million tons of GKG in 2017. However, starting in 2018, rice production will decrease until 2022 (BPS, 2024).

The provision of rice in sufficient quantities and affordable prices is the main goal of national agricultural development. Considering that the community's need for rice is increasing, innovation is needed to increase the effectiveness of rice flow through better performance between business people. In this case, the role of supply chain management is important to maintain the availability of rice in the community. However, it often experiences obstacles and risks that are often faced by existing supply chain systems (Zsidisin and Henke 2019).

Supply Chain Management is an approach by integrating various organizations that organize the procurement or distribution of goods, namely, *suppliers, manufacturers, warehouses and stores* efficiently so that the goods are produced and distributed in the right quantity, the right location, the right time in order to minimize costs and achieve customer satisfaction. The challenge in designing this supply chain is to design and maintain the service level of the entire system.

Food supply chain is a complex network of interconnected processes and actors that play a critical role in ensuring food security and stability. The rice supply chain is an integral part of the distribution system for necessities that support people's daily lives. However, supply chains for these commodities often face various challenges and risks that can disrupt smooth distribution and cause market instability (Oriekhoe, Addy et al. 2024). Therefore, it is important to develop effective risk mitigation strategies to address these issues and ensure stable and affordable supply availability (Um and Han 2021). The rice supply chain includes various stages ranging from production, processing, distribution, to final consumption. Each of these stages has its own vulnerability to risk. Failure to manage these risks can result in supply shortages, price spikes, and negative impacts on the economy and society. Possible sources of risk are also problems in the supply chain system both internally and externally, such as climatic conditions, production process conditions, price fluctuations, technology use, lack of information, quality standardization (Rachmat *et al.* 2006, Budijanto and Sitanggang 2011), infrastructure factors and transportation facilities (Farid and Subekti, 2012) and so on.

Central Sulawesi Province consists of thirteen districts and one city with a population of 2,985,734 people (BPS Central Sulawesi Province, 2020). Central Sulawesi Province is included in the priority category in handling food insecurity nationally. The large population data also has an impact on the amount of food consumption, especially rice, which is the staple food of the people of Central Sulawesi Province. Based on districts/cities, the amount of rice production and consumption is as follows:

Table 1. Rice Availability in Central Sulawesi in 2022

No.	Regency/City	Rice production GKG (ton)	Rice (tons)	Consumption of rice by the population/capita (kg)	Consumption	Surplus /(deficit)
1	Proud of the Islands	1,315	621	118	14.640	-14.020
2	Pride	151,750	88.618	118	44.146	44.471
3	Proud of the Sea	-	-	118	8.583	-8.583
4	Marowali	39,507	23.071	118	19.708	3.363
5	North Morowali	28,143	16,435	118	14.719	1.716
6	Well	83,220	48,598	118	29.840	18.758
7	Donggala	56,721	33.123	118	36.611	-3.487
8	ToyTrailer	57,474	33,563	118	27.437	6.126
9	Buol	17,181	10,033	118	17.700	-7.667
10	Squirrelly Squirrelly	249,993	145,989	118	53.620	92.369
11	Tojo Stuttgart	5,441	3.177	118	19.964	-16.787
12	Hammer	826	482	118	45.480	-44.998
13	Sigi	80,204	46,837	118	31.389	15.448

Data Source : Central Sulawesi Provincial Food Office in 2022

Based on the table above, it shows that among 13 districts/cities in Central Sulawesi, there are 5 districts and 1 city that experience a deficit in rice availability, namely Banggai Islands Regency, Banggai Laut Regency, Donggala Regency, Buol, Tojo Una-Una, and Palu City. Among the six districts, Tojo Una-Una Regency experienced the second largest deficit of 16,787 tons because the amount of consumption and the amount of production did not experience balance. This is one of the indicators that Tojo Una-Una Regency is included in the food insecure category, especially basic food, namely rice.

Tojo Una-Una Regency is one of the regencies located in Central Sulawesi Province. The area of Tojo Una-Una Regency consists of a land area and an archipelago area with a land area of 5,721.51 km² or 572,151 Ha and a sea area of 3,566.21 km². With a population of 169.48 and a population growth rate of 1.96 (Tojo Una-Una in Numbers, 2023) (insert BPS Tojo Una-Una, 2023). The rice fields are only around 1,744 ha including 643 ha of unplanted rice fields of which most of the area is an archipelago with a total of 12 sub-districts, 6 sub-districts are in the archipelago and 6 others are in the mainland area. Rice production in Tojo Una-Una Regency itself comes from three sub-districts, namely Ampana Tete District, Tojo District, and West Tojo District with a total production of 12,988 tons and converted into rice to 6,754 tons (Agriculture and Food Security Service, 2020)

The regional structure consisting of land and islands provides tougher challenges in the management of the supply chain of various community needs, especially rice. The existence of inter-island transportation is one of the efforts to distribute various commodities including rice and gas which will ultimately support increasing public access/affordability to related agricultural commodities and in an effort to stabilize prices.

By measuring risks in the supply chain, both rice and gas, it is hoped that it can minimize, reduce, or even eliminate the causes and occurrences of risks in the supply chain. The results of this risk measurement can also be used to increase or stabilize both rice production and rice prices. The recommendations of this research are as follows: (a) Identifying Risks: Identifying various risks that affect the rice supply chain; (b) Analyzing the Impact of Risks; (c) Develop effective Mitigation Strategies.

2. Literature Review

2.1 Supply Chain

Ballou (2004) states that the supply chain includes all activities (transportation, inventory control, etc.) that take time along the network to convert raw materials into finished goods as well as information that is passed on to the end customer and has added value for the customer. Supply chain is a way to generate value so as to achieve a competitive advantage, i.e. value for customers and suppliers within the company, and value for the company's stakeholders. *The supply chain* includes three parts (Lina, 2008), namely *Upstream Supply Chain*, *Internal Supply Chain* and *Downstream Supply Chain*

According to Bhatnagar & Sohal (2005) there are basic groups that play a role in creating a Supply Chain, each of which has different functions, which are as follows:

- 1) *Producers - Producers* are the organizations that make products. Includes companies that produce raw materials and companies that produce finished goods.
- 2) *Distributors* – Distributors are companies that take large quantities of inventory from manufacturers and deliver a combination of related product lines to consumers.
- 3) *Retailers – Retailers* are companies that keep small amounts of inventory for the general public. Retailers also usually use a combination of price, certain products, services and satisfaction as the main tool to attract consumers.
- 4) *Customers* - Consumers are the group that buys and uses products.

2.2. Supply Chain Management

According to the institution *The Council of Supply Chain Management Professional* (CSCMP) defines supply chain management as: "The planning and management of all activities related to resources and procurement, conversion and all logistics management activities. *The Singapore-based Logistic & Supply Chain Management Society*, meanwhile, defines supply chain management as: "The result of the coordination of related techniques to plan and execute all stages in a global network to procure raw materials from suppliers, transform them into finished goods, and deliver products and services to customers".

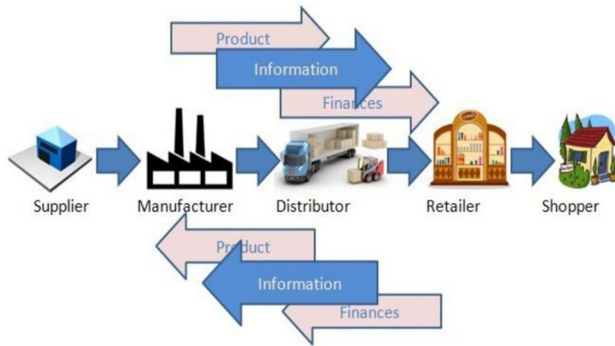


Figure 2: Typical Supply Chain

Source: www.Aims.educations

2.3 Rice Supply Chain

The supply chain in rice commodities generally consists of five to six supply chain members. Based on the results of Sharma *et al.* (2013) The rice supply chain in India consists of six chain members including rice farmers, intermediary traders or collectors, rice processors (*Rice Processing Unit*), distributors, retailers, and end consumers. The results of the study Wong *et al.* (2010) in Malaysia, a comprehensive rice supply chain starts from the farmer level with the use of quality seeds, quality control processing processes, and integrated distribution between supply chain members.

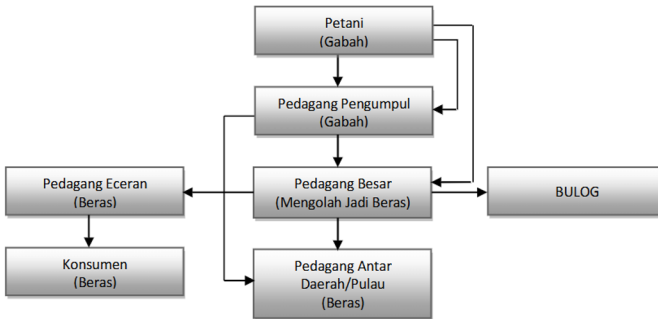


Figure 3: Rice Supply Chain

2.4. Risk Management

Risk Management is an effort to know, analyze, and control risks in every company activity with the aim of obtaining higher effectiveness and efficiency. Therefore, it is necessary to first understand concepts that are able to provide meaning and broad scope in order to understand the risk management process. The image below explains how to manage risk well.

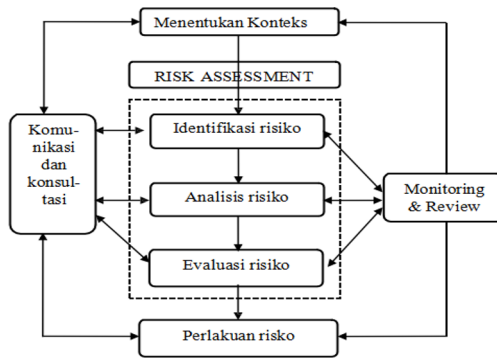


Figure 4 : Risk Management Process

2.4.1 Setting the Context

The process of determining external and internal constraints or parameters to be used in managing risks, determining the scope and determining the risk criteria to be set in the risk management policy.

2.4.2 Risk Assessment

A systematic application of risk management policies, procedures and practices of communication, consultation, setting context and identification, analysis, evaluation and treatment, monitoring and risk assessment.

- a. *Risk Identification* - The process of finding, recognizing, delineating, and describing risks
- b. *Risk Analysis* - The process of understanding the nature of the risk and to determine the level of risk (providing the basis for risk evaluation and decisions regarding risk treatment/mitigation, also includes risk estimation.

$$\text{Risk} = \text{Function (impact and possibility)}$$

Or

$$\text{Risk} = \text{impact} \times \text{likelihood} (R = D \times K)$$

- c. *Risk Evaluation* - The process of comparing the results of a *risk analysis* with the *risk criteria* to determine whether the risk or the magnitude of the risk is acceptable or tolerated (risk evaluation helps in making decisions for risk treatment).

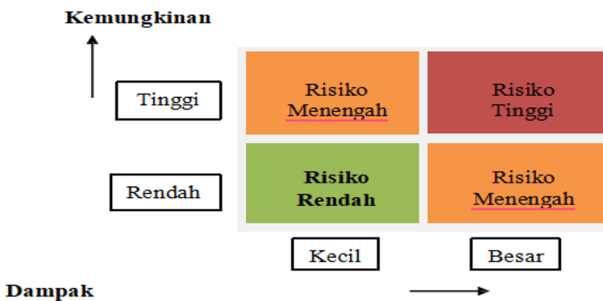


Figure 5 : Quantitative Risk Rating Display

2.4.3 Appetite Risk

Appetite risk is the desired risk after undergoing a mitigation process. Usually this appetite risk is determined by the company's top managers or jointly in terms of decision-making from an event with other related functions in the company.

2.4.4 Risk Mitigation

Mitigation is risk treatment that aims to reduce risk, the form can be in the form of reducing the likelihood of risk occurring; reduction of losses resulting when such risks occur, and verified.

3. Research Methods

This type of research is qualitative descriptive research and uses both primary and secondary data. The research is located in Tojo Una Una Regency, Central Sulawesi Province. Data collection techniques are carried out through surveys and interviews as well as questionnaires. The number of informants in this study is 31 people, namely the agriculture office as the agency that controls the state of food, rice farmers, rice mill owners, distributors and retail traders and end consumers. The data analysis used was descriptive analysis and *Fuzzy AHP (Analytical Hierarchy Process)* analysis. Descriptive analysis is used to describe each actor in the rice supply chain. This method is also used to identify the sources of risk according to the perception of each actor in the rice supply chain. The identification of risks according to the perception of each supply chain actor is seen from the results of respondents' answers to the *Likert scale questionnaire*.

4. Research and Discussion Results

4.1 Rice Supply Chain Entities

The results described based on the theory that has been discussed are based on the interview process with informants from whom information was obtained related to the rice supply chain from the initial process, namely farmers, purchase and production and distribution to the final consumers of rice in Tojo Una-Una Regency as follows:

1. Farmer Level

Farmers are members of the chain that starts the rice supply chain. These farmers play an important role in the rice supply chain because the quality and quantity of rice supply are very determined by them. Rice farmers in rice-producing areas work together with milling parties who in addition to acting as farmer partners, also as collectors. However, not all of the grain that has been harvested is sold to the mill. Some farmers sell directly to end consumers and some of their crops are stored for daily family consumption. Farmers have planned for the quantity/capacity of grain production, namely the harvest for the next few months so that every demand by the mill always continues and is always available.

2. Rice Milling Rate

Activities in rice milling are value-added activities through drying, milling, and packaging. In this stage, most of the farmers as the initial suppliers cooperate with mills to produce grain into rice. Some of the rice production is sold directly, some are sold to the milled pick.

In most of the rice purchase process at the farmer level, farmers collaborate with milling parties in the form of capital loan assistance for land cultivation costs, saprodi usage costs and labor costs. After harvesting, farmers will return the capital loan assistance to the milling party in the form of grain produced and the selling price is adjusted to the market price. After collaborating with the mill, farmers carry out grain delivery activities according to the agreed amount.

Based on the agreement, the grain/rice that is the result of the farmer when it has reached the time for the harvest process, then the mill that makes an agreement with the farmer who carries out the harvest process. Where from the harvesting process on the land to the rice becomes rice that is ready for consumption. To pay off the payment from the results of the agreement between the farmer and the mill owner who is the party who provides capital in the land production process. The milling party added 2% of the harvest according to the agreement.

Based on the results of the interview, it was stated that the supply needs to meet the food shortage in Tojo Una-Una Regency were supplied by the majority from three places, Parigi Moutong Regency, Banggai Regency and South Sulawesi Province. The supply of rice fulfillment is also usually fulfilled from Poso Regency, precisely in the Tentena area. However, the supply from the Tentena area is not as much or as regular as the rice supply from the other three supplier areas, as seen in the following figure.

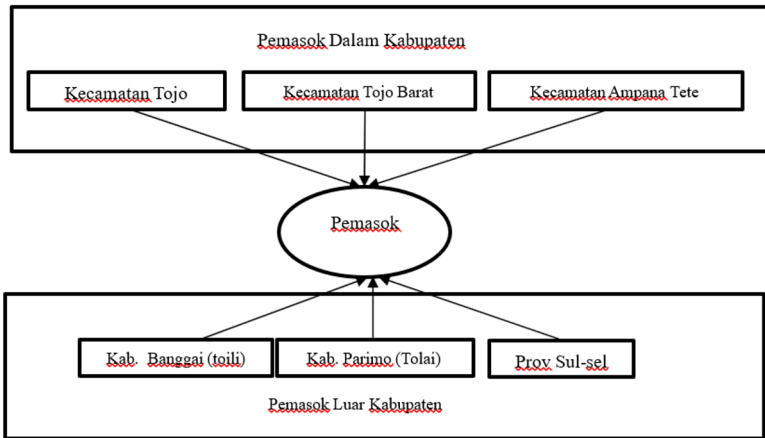


Figure 6: Tojo Una-Una Regency Food Fulfillment Suppliers

3. Rice Trader Level

Rice traders can be grouped into two, namely traders/large agents (*wholesalers*) and retail traders (*retailers*). In wholesalers, there are generally still value-added activities through *grading* and packaging. Some wholesalers/agents do packaging with certain trademarks, such as Rojo Lele, Pandan Wangi and so on. Some of these branded rice are marketed to supermarkets and some to traditional retailers.

4.2 Rice Supply Chain Management Model

The flow of the rice food supply chain in Tojo Una-Una Regency obtained from the results of the interview started from farmers as the initial chain of the supply chain management process and then entered the milling process and then continued in the distribution process from the three regions that supply rice in Tojo Una-Una Regency, continuing to the community who sell rice at retail until it reaches consumers. Where this route is a public route that is not based on a certain season. The distribution lines of rice trade in Tojo Una-Una Regency can be seen in the following figure:

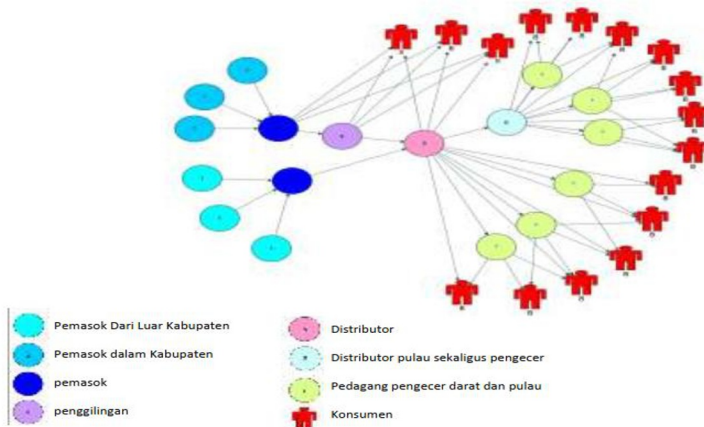


Figure 7. Rice Food Supply Chain Management Model in Tojo Una-Una Regency

For more details, the diversity of rice supply chain lines in Tojo Una-Una Regency is given in the following Table:

Table. 2 Rice food supply chain line models in Tojo Una-Una Regency

Uraian Jalur	Jalur/Model Distribusi								
	1	2	3	4	5	6	7	8	9
Daerah Penghasil Beras									
Petani Produsen									
Petani di ampana tete	↓	↓	↓	↓	↓	↓	↓		
Petani di kec. Tojo dan Tojo Barat	↓	↓	↓	↓	↓	↓	↓	↓	
penggilingan									
distributor		↓							
Distributor sekaligus Pengeccer			↓	↓	↓			↓	
Distributor darat sekaligus pengeccer	↓							↓	
Distributor sekaligus pengeccer di kepulauan walea besar		↓	↓			↓	↓	↓	
Distributor darat yang mengirim beras melalui tol laut		↓	↓	↓	↓			↓	
Distributor kepulauan sekaligus pengeccer	↓							↓	
Pedagang Pengeccer		↓	↓		↓		↓	↓	
Pengeccer	↓					↓		↓	
Petani menjual beras ke konsumen	↓	↓	↓	↓	↓	↓	↓		↓
Konsumen akhir									

(Source: Almubarak, 2023)

4.3 Rice Supply Chain Risks

4.3.1. Risks at the Farmer Level

The following are the average results of the assessment given by farmer respondents on the risk criteria and sub-criteria faced. This assessment shows the criteria and subcriteria that are considered risky based on the perception of respondents at the farmer level as seen in the following table:

Table 3. Total Value of Criteria and Subcriteria According to Farmers

Yes	Criterion	Subcriteria	Flat-flat	Valuation
1	Supply	Supply diversity	3.00	Less important
		Supply uncertainty	4.67	Very important
2	Transportation	Infrastructure damage	3.33	Less important
		Uncertainty of transportation time	2.00	Not important
		Insecurity on the road	3.33	Less important
		Long haul distances	3.33	Less important
3	Price	Inflation	4.33	Important
		Price fluctuations	4.33	Important
		Information distortion	3.00	Less important

4	Quality	Low quality	4,67	Very important
		Quality variation	3.00	Less important
5	Milieu	Natural disasters	3.67	Less important
		Government policy	3.67	Less important
		Climate	5.00	Very important
		Political, social conditions and culture	4.67	Very important
		Pests/ diseases	5.00	Very important
6	Production	Competitor products	4.00	Important
		Production capacity	3.00	Less important
		Inefficient production process	3.67	Less important
		Production target is not Reached	4.67	Very important
		Use of technology	3.33	Less important

Based on the results of the first phase questionnaire, the criteria and subcriteria selected are included in the assessment hierarchy based on the total score as seen in the following table.

Table 4. Selected Criteria and Sub-Criteria According to Farmers

Yes	Criterion	Subcriteria	Valuation
1	Supply	Supply uncertainty	Very important
2	Price	Inflation	Important
		Price fluctuations	Important
3	Quality	Low quality	Very important
4	Milieu	Government policy	Very important
		Climate	Very important
		Pests/ diseases	Very important
5	Production	Competitor products	Important
		Production target not met	Very important

Source: Primary Data Processed, 2024

The table above shows the risks based on the perception of the farmer respondents. In supply risk, supply uncertainty is one of the risks. This is because supplies such as fertilizers are sometimes not available when farmers are in need for rice cultivation. At supply risk, inflation and price fluctuations are risks. This is because if there is a big harvest, it will cause prices to fall. In addition, often farmers who grow rice do not use a planting schedule that pays attention to the needs and availability of rice in the market, so that rice prices fluctuate. In quality risk, low quality is a risk caused by unfavorable weather, pests/diseases that attack rice during cultivation so that the quality of the crop becomes low. Environmental risks are government policies, climate, pests/diseases, and competitor products. This is due to the government still not implementing a policy on rice entering the village so that the price falls and makes farmers lose money. The uncertain climate, especially during the rainy season, makes the harvest have a low quality compared to the dry season. At the time of rice cultivation, farmers are very disturbed by the presence of pests and diseases that attack rice. This makes farmers lose a lot of money, even for capital does not return. At production risk, the production target is not achieved due to an uncertain climate and the presence of pests/diseases that attack rice.

4.3.2 Grinder-level risks

The following are the average results of the assessments given by respondents for the grinder. In the process of receiving grain, grinding grain, up to the stage of selling rice, there are often risks experienced by millers. Here is a table showing the criteria and subcriteria that are considered risky based on respondents' perceptions at the grinder level.

Table 5. Total Value of Criteria and Subcriteria According to Grinder

Yes	Criterion	Subcriteria	Flat-flat	Valuation
1	Supply	Supply diversity	4.33	Important
		Uncertainty of supply availability	4.33	Important
2	Transportation	Infrastructure damage	4.00	Important
		Uncertainty of transportation time	4.00	Important
3	Price	Insecurity on the road	3.67	Less important
		Long haul distances	3.67	Less important
		Inflation	3.67	Less important
		Price fluctuations	4.33	Important
4	Quality	Information distortion	4.67	Important
		Low quality	5.00	Very important
5	Milieu	Quality variation	4.67	Important
		Natural disasters	3.67	Less important
		Climate	4.33	Important
6	Production	Political, social and cultural conditions	2.33	Not important
		Pests/ diseases	3.00	Less important
		Competitor products	3.33	Less important
		Production capacity	4.33	Important
		Inefficient production process	3.67	Less important
		Production target not met	3.67	Less Important
		Use of technology	4.67	Very important

Source: Primary Data Processed, 2024

Based on the results of the first phase questionnaire, the criteria and subcriteria selected to enter the assessment hierarchy based on the total score are as seen in the following table.

Table 6. Selected Criteria and Sub-Criteria According to the Grinder

Yes	Criterion	Subcriteria	Valuation
1	Supply	Supply diversity	Important
		Supply uncertainty	Very important
2	Transportation	Uncertainty of transportation time	Important
3	Price	Price fluctuations	Important
		Information distortion	Important
4	Quality	Low quality	Very important
		Quality variation	Important
5	Milieu	Climate	Important
6	Production	Production capacity	Important
		Production target not met	Important
		Use of technology	Very important

Source: Primary Data Processed, 2024

The Table above shows the risks that occur at the grinder level. On supply risk, supply diversity and supply uncertainty are risks that are considered important by grinder respondents. This is due to the seasonal nature of rice so that grain is not available all year round. Rice milling business activities run during the harvest season and a few months after. In transportation risk, the uncertainty of transportation time is one of the risks caused by the long or near distance of picking up grain from the location by the grinder and the delivery of grain to the grinder. At price risk, price fluctuations and information distortion become risks. This is because during the harvest season and the high or low quality of rice makes rice prices unstable and like to change. In terms of environmental risk, climate is a risk caused by the rainy season when the quality of grain decreases due to the drying period of grain. At the risk of production, production capacity, production targets are not achieved, the use of technology becomes a risk. This is due to damage to the machinery used so that there is a lot of rice and therefore, production yields decrease.

4.3.3 Risks at the Distributor/Retail Trader Level

The following are the average results of the assessment given by respondents for distributors/retailers. The respondents at the distributor/retail trader level are those who are domiciled in Tojo Una-Una Regency, both in the form of shops and stalls. In the process of supplying rice to delivering rice to consumers, there are often risks experienced by distributors/retail traders. The following are tables showing the risks that are considered risky based on respondents' perceptions at the retail trader level.

Table 7. Total Value of Criteria and Sub-Criteria According to Retail Traders

Yes	Criterion	Subcriteria	Flat-flat	Valuation
1	Supply	Supply diversity	3.67	Less important
		Supply uncertainty	4.33	Important
2	Transportation	Infrastructure damage	4.00	Important
		Uncertainty of transportation time	4.00	Important
3	Price	Insecurity on the road	3.33	Less important
		Long haul distances	4.00	Very important
		Inflation	4.33	Important
		Price fluctuations	4.00	Important
4	Quality	Information distortion	3.00	Less Important
		Low quality	4.33	Important
5	Environment	Quality variation	4.00	Important
		Pests/ diseases	2.00	Not Important
		Competitor products	4.00	Important

Source: Primary Data Processed, 2024

Based on the results of the first phase questionnaire, the criteria and subcriteria selected are included in the assessment hierarchy based on the total score as seen in the following table.

Table 8. Selected Criteria and Sub-Criteria According to Retail Traders

Yes	Criterion	Subcriteria	Valuation
1	Supply	Supply uncertainty	Important
2	Transportation	Price fluctuations	Very important
		Uncertainty of transportation time	Important
3	Price	Long haul distances	Very important
		Price fluctuations	Very important
4	Quality	Low quality	Important
		Quality variation	Important
5	Environment	Competitor products	Important

Source: Primary Data Processed, 2024

The table above shows the risks that occur based on perceptions at the distributor/retailer level. In supply risk, supply uncertainty is a risk caused by the unavailability of the needed rice supply. The unavailability of rice supply is due to very low crop yields for some time, making supply unavailable in the supply chain. At transportation risk, the uncertainty of transportation time and long distances are a considerable risk. This is because most of the rice needs are supplied from outside Tojo Una-Una Regency, namely from Parigi Moutong Regency, Banggai Regency, and South Sulawesi Province. Some of the rice is transported to distributors/retailers on the mainland using trucks, and some are directly transported to the islands by ship or ferry either from Toboli or Pagimana. At price risk, price fluctuations and information distortion become risks. This is due to low crop yields making prices expensive due to the demand for rice increasing and when the harvest is big, prices decrease. In addition, price differences also occur between retail on the mainland and the islands due to the considerable distance and the availability of transportation used to distribute rice to the islands. In quality risk, quality variation and low quality are risks. This is because if the quality is low, consumers will refuse to buy rice. Quality variations are also a risk caused by consumer demand in consuming rice depending on which it has been consumed frequently. In terms of environmental risk, the level of competition is a risk faced by traders because the source of rice mostly comes from Tojo Una-Una Regency.

4.3.4 Risks at the Consumer Level

The following are the average results of the assessments given by respondents for consumers. The respondents at the consumer level are the people in Tojo Una-Una Regency both on the mainland and in the islands. In the process of buying rice until the change of rice into rice by consumers, there are often risks experienced by consumers. The following are tables showing the risks that are considered risky based on respondents' perceptions at the consumer level.

Table 9. Total Value of Criteria and Subcriteria According to Consumers

Yes	Criterion	Subcriteria	Flat-flat	Valuation
1	Supply	Supply diversity	3.67	Less important
		Supply uncertainty	3.33	Less Important
3	Price	Inflation	4.67	Important
		Price fluctuations	4.00	Important
		Information distortion	3.00	Less important
4	Quality	Low quality	3.33	Less Important
		Quality variation	4.33	Important

Source: Primary Data Processed, 2024

Based on the results of the first phase questionnaire, the criteria and subcriteria selected are included in the assessment hierarchy based on the total score as seen in the following table.

Table 10. Selected Criteria and Sub-Criteria According to Consumers

Yes	Criterion	Subcriteria	Valuation
1	Supply	Supply uncertainty	Important
2	Price	Price fluctuations	Important
		Inflation	Important
3	Quality	Quality variation	Important

Source: Primary Data Processed, 2024

The Table above shows the risks at the consumer level based on the perception of consumer respondents. At supply risk, supply uncertainty becomes a risk, caused by the unavailability of rice in stores that are often the place where consumers buy rice. At price risk, price fluctuations and inflation are risks caused by very low crop yields by farmers for some time, which makes rice prices rise. However, when there is an import of rice, the price drops again. In quality risk, quality variation becomes a risk. This is due to the fact that at the time of grinding, the condition of the machine is not good. Quality variation is also a risk due to consumer pleasure in a variety that produces good quality. In addition, the economic ability of consumers to buy good and low quality.

4.4 Risk Mitigation Strategies for Each Rice Supply Chain Entities

4.4.1 Risk Mitigation at the Farmer Level

Based on the results of the weighting of risk factors using *fuzzy* AHP, it was obtained that the weight of the highest risk factors at the farmer level was environmental risk, followed by quality risk, price risk, supply risk, production and transportation risk as shown in the figure below:

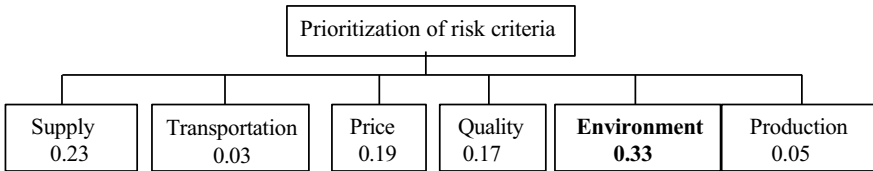


Figure 8. Structure of Risk Weighting Criteria at the Farmer Level

Based on the figure above, the criteria that have the highest risk priority are environmental risks. Environmental risk has subcriteria, namely natural disaster risk, government policy, climate, social, political, and cultural conditions, pest/disease risk, and competitor product risk with weighting as shown in the following figure:

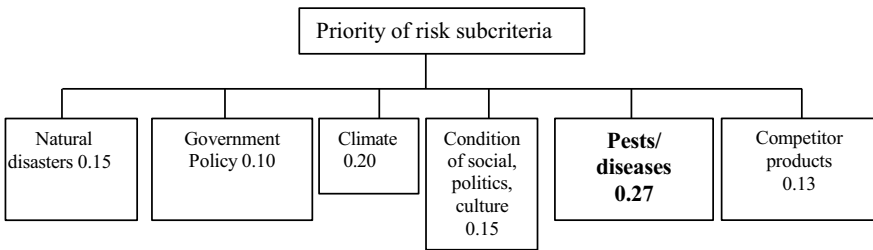


Figure 9. Risk Priority Weighting Structure at the Farmer Level

The figure above shows that pests/diseases are the highest risk to farmers' activities with a weight of 0.27. Other risks are the risk of natural disasters which has a weight of 0.15, the risk of government policies has a weight of 0.10, the climate risk has a weight of 0.20, the risk of political, social, and cultural conditions has a weight of 0.15, the risk of competitor products has a weight of 0.13. The risk of pests/diseases that has the highest risk to farmers' activities, which is meant is the number of pests in the form of rats and other diseases/pests that make farmers suffer huge losses.

Efforts that can be made to prevent pest risk are as follows:

1. Implementing the legowo row planting system is to regulate the planting distance in rows that are wider apart. It is intended to improve air circulation, sunlight, and reduce humidity thereby reducing the risk of plant pests and diseases.
2. Providing education and counseling to increase farmers' awareness about pest and disease control
3. Implement Integrated Pest Control (HPT) by combining various methods such as culture, biology, and chemistry
4. Carry out land cleaning or environmental sanitation, cleaning grass or bushes that rats use to nest, and maintaining the quality of irrigation water (avoid standing water that can trigger the development of diseases).

The risk that has the second largest weight is climate risk with a weight score of 0.27. Rice crop farming, as a typical plant species of tropical regions, is very vulnerable to climate change which results in weather pattern instability, as well as changes in environmental conditions such as the availability of water supply and air temperature. Irregular and extreme changes in rainfall patterns are one of the most striking impacts of climate change on rice farming. This has a great impact on the productivity of agricultural land and affects the yield and quality of rice plants (Nurhidayat, Difa et al. 2024). The mitigation efforts that can be carried out include:

1. In terms of farmer human resources, mitigation that can be done is to increase access to education and training for farmers in order to improve their knowledge and skills in engineering more efficiently as well as their adaptive capacity to climate change, so that farmers are more prepared and responsive to climate change.
2. Provide opportunities for farmers to access a wide range of knowledge, technologies and innovations relevant to climate change through partnerships with agricultural research and development institutions. This collaboration allows farmers to adopt more efficient, adaptive and sustainable agricultural practices, thereby reducing the impact of climate change on the agricultural sector and increasing farmers' resilience in dealing with it.
3. Encourage the development of adequate infrastructure, such as roads, irrigation, and post-harvest facilities. Good infrastructure allows farmers to be better prepared to face climate challenges such as drought or flooding. For example, efficient and reliable irrigation can help farmers better manage water in uncertain climate change conditions.
4. To ensure sustainable and adaptive agriculture, it is necessary to make efforts in the implementation of supportive policies and regulations. This policy must consider environmental, social, and economic aspects in agricultural practices. For example, the implementation of sustainable natural resource management policies, the protection and preservation of ecosystems, the use of environmentally friendly agricultural technology, and the development of agricultural methods that are adaptive to climate change (Sujarwo 2023)

4.4.2 Risk Mitigation at the Grinder Level

The results of risk identification at the grinder level using *fuzzy* AHP, the priority of risks faced by grinders in the rice supply chain is obtained, namely price risk being the highest priority and then followed by quality risk, production risk, supply risk, transportation risk, and environmental risk. The weighting of the risk at the grinder level can be seen in the following figure.

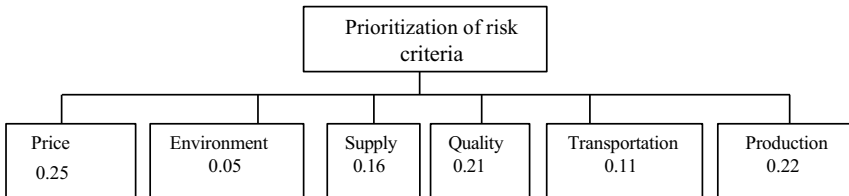


Figure. 10. Risk Priority Weighting Structure Risk Criteria at the Grinder Level

Based on the Figure above, it can be seen that the highest risk priority at the grinder level is price risk, which is 0.25. Supply risk has a weight of 0.16, transportation risk has a weight of 0.11, quality risk has a weight of 0.21, environmental risk has a weight of 0.05 and production risk has a weight of 0.22. The following is the weighting structure of the risk priority criteria at the grinder level. Price risk has subcriteria, namely inflation risk, price fluctuation risk, and information distortion risk. The risk structure of the subcriteria on environmental risk can be seen in the following figure.

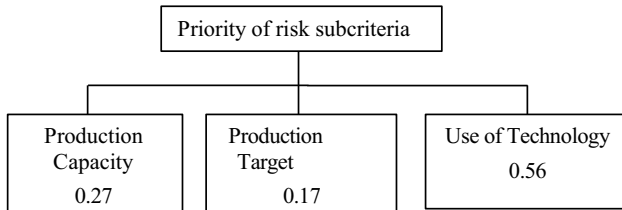


Figure 11. Priority Weighting Structure of Price Risk Subcriteria at the Grinder Level

The figure above shows that the use of technology is the highest risk to grinder activity by having a weight of 0.56. Another risk is the risk of production capacity having a weight of 0.27, and the risk of the production target not being achieved has a weight of 0.17. In addition,

production capacity is also a risk at the grinder level. The capacity in question is in addition to the capacity of the milling machine, also the drying and storage capacity of rice (Hafiz 2022). The larger the production capacity, the greater the amount of rice that can be milled at one time. This certainly affects the income and cost of milling (Murniati, Wijaya et al. 2018)

Mitigation efforts that can be carried out to minimize the risks that occur include:

1. Providing access to rice millers to get additional capital both through government assistance programs and access to other capital such as cooperatives and banks, so that rice millers can improve grinding machine technology and increase production capacity both drying locations, as well as warehouses where rice is stored (Yahman, Widada et al. 2020)
2. For the risk of supply uncertainty, which is caused by a long enough harvest season so that there is often a shortage of rice supplies outside the harvest season. It is recommended that the grinder build cooperation with farmers outside the region or other milling businesses. In addition, business actors can also purchase large quantities during the harvest season as supplies.

4.4.3. Risk at the Distributor/Retail Trader Level

The results of risk identification at the level of retail traders using *fuzzy* AHP, obtained the priority of risks faced by retail traders in the rice supply chain, namely price and quality risks being the highest priority and then followed by environmental risks, supply risks, and transportation risks. The assessment of risks at the distributor/retail trader level can be seen in the following figure.

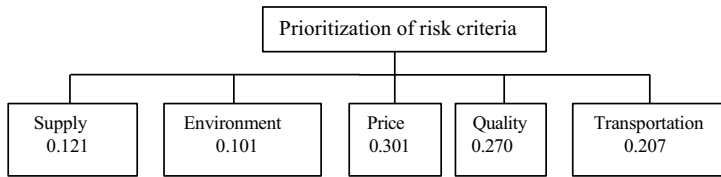


Figure 12. Risk Priority Weighting Structure Risk Criteria at the Retail Trader Level

Based on the figure above, it can be seen that the highest risk priority at the retail trader level is price and quality risk, which is 0.301 and 0.270. Supply risk has a weight of 0.121, transportation risk has a weight of 0.207, and environmental risk has a weight of 0.101. Therefore, the criteria that have the highest risk priority are price risk and quality risk. Price risk has subcriteria, namely inflation risk, price fluctuation risk, and information distortion risk. Quality risk has subcriteria, namely the risk of low quality and the risk of quality variation. The assessment of the level of importance between the subcriteria on price risk can be seen in the following figure.

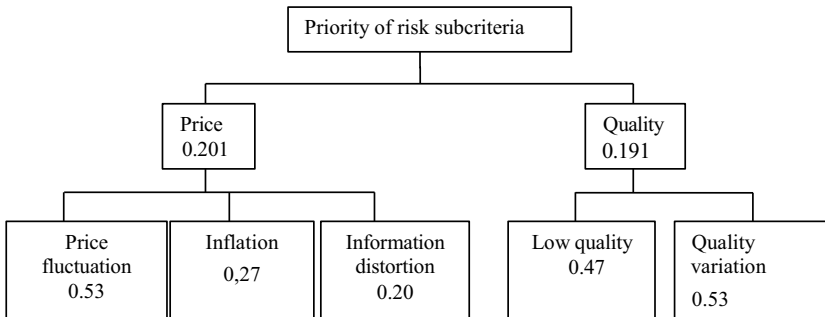


Figure 13. Priority Weighting Structure of Price and Quality Risk Subcriteria at the Distributor/Retail Trader Level

From the image above, it can be seen that price fluctuations are the highest price risk to retail trader activities with a weight of 0.53. Another risk is the risk of inflation which has a weight of 0.27, and the risk of information distortion has a weight of 0.20. Furthermore, in quality risk,

quality variation is the highest quality risk to retail traders' activities with a weight of 0.53. Another risk is the risk of low quality which has a weight of 0.47. This risk is caused by the price of rice being lowered because of low quality such as unpleasant rice. The price sold by retail traders ranges from Rp 13,000-Rp 16,000 per kg. In addition, the quality of rice is sometimes low and very varied, which makes consumers reject or choose the rice to buy. The large amount of grain found in rice is one of the factors that make consumers refuse to buy rice.

Mitigation efforts that can be carried out to minimize the risks that occur are to form cooperation between traders to control the price of rice in the market. In addition, prices that often fluctuate also require intervention from the government to stabilize rice prices.

4.4.4 Risk Mitigation at the Consumer Level

The results of risk identification at the consumer level using *fuzzy* AHP, obtained the priority of risks faced by consumers in the semi-organic rice supply chain, namely price risk being the highest priority and then followed by supply risk and quality risk. The assessment made will result in a priority weight that looks at the value of each risk. The weight of the assessment for risk at the consumer level is as shown in the following figure:

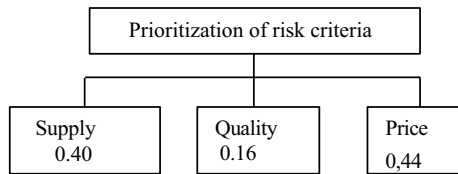


Figure 14. Priority Weighting Structure of Risk Criteria at the Consumer Level

Based on the Figure above, the highest risk priority at the consumer level is price risk, which is 0.44. Supply risk has a weight of 0.40 and quality risk has a weight of 0.16. Therefore, the criterion that has the highest risk priority is price risk. Price risk has subcriteria, namely inflation risk, price fluctuation risk, and information distortion risk. The assessment of the level of importance between the subcriteria on price risk can be seen in the following figure.

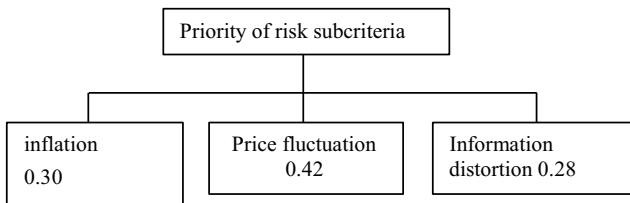


Figure 15.. Priority Weighting Structure of Price Risk Subcriteria at the Consumer Level

In the image above, it can be seen that price fluctuations are the highest price risk to retail traders' activities with a weight of 0.42. Another risk is the risk of inflation which has a weight of 0.30, and the risk of information distortion has a weight of 0.28. The following is the structure of weighting the risk priorities of the subcriteria at the consumer level. Once identified, price risk has several risk subcriteria, including inflation, price fluctuations, and information distortion. This is often experienced by consumers because of low quality or causes rice prices to fall, and when demand rises, rice prices rise.

Mitigation efforts that can be carried out to minimize risk are to maintain price stability for all parties or actors in the supply chain from downstream to upstream, including:

1. Increasing the role of BULOG in maintaining rice price stability (Harmawan 2024) . In this case, maintaining rice price stabilization, namely conducting market price operations if the price has begun to rise, Bulog sends rice to market traders so that the price in the market does

not exceed the price in the Ministry of Agriculture or by carrying out food stabilization movements, which aims to maintain consumer prices throughout the year (Arifin 2018).

2. Procure and distribute subsidized rice for low-income communities in accordance with Presidential Instruction No. 3 of 2012. One of them is by distributing SPHP rice evenly to the archipelago.

4.5. Rice Supply Chain Margin

One of the problems that is often faced in the rice supply chain is the high price margin between farmers and consumers. Price margin is the difference between the selling price and the purchase price at each level of the supply chain. Price margins are affected by various factors, such as production costs, transportation costs, storage costs, taxes, demand, supply, and market structure. The market structure describes the conditions of competition between supply chain players, such as the number and size of players, the level of product differentiation, barriers to entry and exit of the market, and the dependency between players. An unhealthy market structure can lead to inefficiency, inequality, and injustice in the rice supply chain. By applying a structure in discussing price margins in the rice supply chain, it is hoped that it can provide a clearer and deeper picture of the dynamics of rice supply chain management in the Tojo Una-Una Regency area. This is important to be done as a basis for formulating appropriate and effective policies to improve efficiency, balance, and fairness in the rice supply chain.

The rice price margin in Tojo Una-Una Regency varies depending on the location, type of rice and market location. Specifically in Ampana Tete District, Tojo District and West Tojo District, farmers sell milled dry grain (GKG) with a price range of Rp. 6,300-Rp. 7,400 per kg. After deducting production costs (seeds, fertilizers, and labor), farmers' margins typically range from 20% to 30% of the selling price. Rice millers buy GKG from farmers with a price range of Rp. 6,300-Rp. 7,400/kg. After going through the milling process, rice is sold at a price range of Rp. 11,000-Rp.13,000/kg. Margins at milling rates range from 15% to 25%, depending on efficiency and operational costs. Furthermore, the distributor buys the rice from the mill at an adjusted price, and sells to the retailer at a margin of about 10% to 20% depending on the volume and type of rice. At the retailer level, the price of rice can vary depending on the type and quality of the rice. The selling price at the retailer level ranges from Rp.14,000-Rp.15,500 with a margin ranging from 10%-20%.

The existence of a policy of determining the HET of milled dry grain (GKG) by the government is enough to stabilize rice prices at the retailer level. The price variation that occurs is not much different depending on the type and quality of rice. Especially for the Tojo Una-Una Regency area, there is a relatively small difference between the price of rice on the mainland and on the island. This difference is due to the distribution cost with a price difference range of Rp.500-Rp.1000/kg.

5. Conclusion

Based on the results of the research and discussion, the following conclusions can be drawn:

1. The rice supply chain in Tojo Una-Una Regency starts from the first, namely farmers who cultivate rice from land cultivation to harvesting. The second perpetrator is a grinder who functions in converting grain into rice. The third perpetrator is a distributor and retail trader who functions to sell rice to consumers. The fourth perpetrator is the end consumer.
2. Risks that occur based on the perception of supply chain actors: Risks at the farmer level are environmental risks, and production risks, Risks at the grinder level are supply risks, transportation risks, price risks, quality risks, environmental risks, and production risks. Risks at the retail trader level are supply risk, price risk, quality risk, and environmental risk. Risks at the consumer level are supply risk, price risk, and quality risk.
3. The evaluation of the highest risk priorities that occur in each supply chain actor uses fuzzy AHP, at the *supplier level* is supply risk and the supply risk sub-criterion is supply uncertainty risk. The risk at the farmer level is the environmental risk and the sub-criterion of environmental risk, namely the risk of pests/diseases. The risk at the slashing level is the environmental risk and the sub-criterion of environmental risk is the risk of competitor products. Risk at the grinder level is price risk and the sub-criterion of price risk is the risk of price fluctuations. The risk at the retail trader level is price risk and quality risk, the sub-criterion of price risk, namely the risk of price fluctuation and the sub-criterion of quality risk,

of price risk is the risk of price fluctuations.

4. The rice price margin in Tojo Una-Una Regency is different for each supply chain player, influenced by production costs, milling processes, distribution, and market structure, but in general it remains under control thanks to the relatively stable HET policy and distribution costs, so that the rice market in this region tends to be efficient and does not show significant disparities.

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