The vulnerability of rice distribution in West Java Province, Indonesia: An intelligent analysis

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Abstract. Climate change affects the food security of a region. One indicator of food security is food accessibility. The accessibility factor that requires attention is food distribution. Rice is the main food commodity in Indonesia. Meanwhile, distribution, prices, and supply raise common problems for rice commodities in West Java. This study aims to analyze the vulnerability of rice distribution in West Java using Intelligent Analysis. The method employed in the research is the Intelligence Analysis that covers threats and vulnerability. Further, we also conducted expert interviews. The results showed that threat analysis is at a high level, as well as the vulnerability analysis. Several viable options to anticipate the vulnerability are by streamlining relations with business operators and building a system that is integrated online upon government parties who have an interest in threats that can address food vulnerability both on a national scale and in West Java Province.

1. Introduction
Climate change is acknowledged to disrupt food markets, generate risks to the food supply, and interfere with the overall food system [1][2]. The food system is a set of dynamic interactions between humans, environments and biogeophysical that induce food production, food processing, food distribution, as well as preparation and consumption. They cover several key components: (i) food availability (related to production, distribution, market); (ii) food access (related to affordability, allocation, and preference); and (iii) food utilization (related to nutritional value, social value, and food safety. Furthermore, the food system is also part of food security [3]. Global climate change impacts are complex and involving temporally, geographically, and socioeconomic variables. The impacts include a decrease in agricultural yields and earnings, reliability of delivery, food quality and safety, and food price stability [4]. Therefore, it is a potential hazard to food security. Apart from climate change, food security has already been an emerging issue worldwide, especially in its relation to world food price volatility, food fuel conversion, and the incomparable increase of the world's food demand with the population [5]. Based on the Global Food Safety Initiative in 2019, Indonesia is ranked 62nd, far behind Singapore (1st), Malaysia (28th), Thailand (52nd), Vietnam (54th) regarding affordability, availability, quality, and safety [6].

Several synergies on food security, especially under adaptation and mitigation of climate change are viable options that require careful management[4]. Tirado et al. [7] also conclude that to implement strategies on food security in addressing climate change risks, an integrated and transformative approach at all levels and aspects is required [1]. Food security is an important matter and one of the priorities in national development [8]. Rice availability is a top priority for the food security aspect. The five provinces with the highest production of rice (dry milled unhulled rice) in 2019 were East Java, West
Java, Central Java, South Sulawesi, and South Sumatra [9]. West Java Province is one of the provinces with the second-largest rice production rate in Indonesia. However, there are still problems with rice distribution.

Several researchers highlighted the supply chain collaboration and found that good flow and information disclosure between members of the supply chain is the key to its success [10][11][12] since it can help improve the relationship between members of the supply chain through the integration of information system and decision-making system, thus leading to improved performance in eliminating inefficiencies in the supply chain. Previous researches have conducted studies on supply chains[13][14], self-sufficiency food [15], local and agricultural food [16]. Many of those studies have similarities in the rice supply chain, distribution channels, supply chain targets, supply chain management, supply chain relationship structure, business chain processes, supply chain resources, and supply chain performance. Our study will be different from the previous studies because we focus on the analysis of rice commodity distribution using the intelligence analysis technique developed by Hank Prunkcun [17].

### 2. Method

This research employed a qualitative method. The data are collected from primary data and secondary data, including the results of interviews with related agencies and parties, official data processing, data on related legal cases that had been processed by the Indonesian National Police, and other government institutions. Threats and vulnerability analysis were carried out by giving value or weight for each component of the source of threats and vulnerabilities. The elements of vulnerability include attractiveness, ease of attack, and consequences. Meanwhile, the threat component consists of intention and ability [17]. The determination of the scale of threats and vulnerabilities has been decided subjectively, which is based on the facts obtained so that it can produce appropriate conclusions. The calculation of the scale of threats and vulnerabilities is based on the following table:

**Table 1. Threats and vulnerability coefficient scale.**

| Threat    | Coefficient | Vulnerability | Coefficient |
|-----------|-------------|---------------|-------------|
| Neglectable | 4-6         | Neglectable   | 1-3         |
| Low       | 7-10        | Low           | 4-6         |
| Middle    | 11-15       | Middle        | 7-9         |
| High      | 16-18       | High          | 10-12       |
| Serious   | 19-20       | Serious       | 13-15       |

**Table 2. Threat and vulnerability components.**

| Threat | Component Threat | Component vulnerability |
|--------|-----------------|-------------------------|
|        | Intention       | Attractiveness          |
|        | Expectation     | Ease of attack          |
|        | Knowledge       | Consequence             |
|        | Ability         | Resource                |

### 3. Results and discussion

The actors involved from upstream to downstream include several business actors, farmers, middlemen, Bulog (Indonesian Bureau of Logistics) Sub-Directorate, agents, wholesalers, retail traders, and households as final consumers. The distribution channels of rice in West Java, in general, are shown in Figure 1.
Based on figure 1, there are four distribution channels from upstream to downstream, namely:

- **Channel A**: Farmers – Middlemen – Milling – Retail – Supermarkets – Individual Consumers.
- **Channel B**: Farmers – Wholesaler – Mill – Wholesaler – Individual Consumer.
- **Channel C**: Farmers – Middlemen – Mill – Individual Customers.
- **Channel D**: Farmers – Middlemen – Mill – Wholesaler – Bulog Subdirectory – Bulog’s Suppliers – Retailers – End Consumers

In each trade system, we classified threats into two elements, namely the element of intention and the element of capability. The grouping of these elements is described in Table 3.

**Table 3. Distribution functions group based on intention and capacity in rice trading**

| Channel                  | Intention                                      | Capability                                                                 |
|--------------------------|------------------------------------------------|---------------------------------------------------------------------------|
| Farmers                  | - Grain sale                                   | - Only have small capital                                                 |
|                          | - Exchange agricultural products for cash      | - Unable to process unhulled rice into ready-to-consume rice              |
|                          |                                                 | - Do not know market information                                          |
| Brokers/ Collecting Traders | - Act as an aggregator by collecting rice from farmers | Provide market access to farmers                                         |
|                          |                                                 | - Provide loan to farmers                                                |
|                          |                                                 | - Perform an exchange function (sales and purchases)                     |
|                          |                                                 | - Physical function (transport)                                          |
|                          |                                                 | - Facility function (risk assumption and market information)             |
| Small mills              | - Collect rice, usually in small quantities and is a pure service business that only accepts unhulled rice from farmers without cooperation with middlemen or rice traders | - Perform an exchange function (sales and purchases)                     |
|                          |                                                 | - Has an RMU (Rice Milling Unit) machine, a small rice mill machine      |
|                          |                                                 | - Mills can store grain                                                 |
|                          |                                                 | - Has the capability to process unhulled rice into rice                   |
| Channel                  | Qualification                                                                 | Potential threats |
|-------------------------|-------------------------------------------------------------------------------|-------------------|
| Farmers                 | - Lack of access to market, market information, and insufficient capital.     | Low               |
|                         | - Have a high level of dependence on wholesalers                              |                   |
| Brokers/Collecting      | - Act as decision-makers on rice price to farmers                              | High              |
| Traders                 | - Have market access, market information                                       |                   |
|                         | - Have sufficient capital.                                                    |                   |
|                         | - Become lenders for farmers                                                   |                   |
|                         | - Have the ability to monopolize the stock of grain                            |                   |
| Small mills             | - Have equipment to produce in limited quantities.                             | Middle            |
|                         | - Do not have the production capacity to dominate the market                   |                   |
| Large Mills             | - Have a large production capacity                                             | High              |
|                         | - Have excellent market information                                           |                   |
|                         | - Have strong capital                                                         |                   |
|                         | - Have a bigger capacity to store and process rice                            |                   |
|                         | - Control the rice sales market                                               |                   |

The scale assessment of threats to each stakeholder was conducted after revealing the intentions and capabilities of each distribution channel. After completing the assessment of the intention and threat elements, the scale of threats to the rice trade system is shown in the following table 4.

**Table 4. Threat Scale on rice distribution.**
- Have the potential to carry out monopolistic action both in terms of price and rice stock because it has sufficient capital and a warehouse for storage.
- Have the opportunities that threaten unfair business competition for profit.

| Big Wholesalers | High |
|-----------------|------|
| - Have a strong influence and act as decision-makers on rice prices to retailers. |
| - Have a bigger capacity to store rice |

| Small wholesalers | Middle |
|-------------------|--------|
| - Have a strong influence and act as decision-makers on rice prices to retailers. |
| - The owned rice stock is relatively in small capacity |

| Retailers | Middle |
|-----------|--------|
| - Follow the price from the Wholesalers |
| - Do not have the ability to determine the price |

We can conclude that the threats to rice trading organizations are divided into three groups, namely low (farmers), medium (small mills, small wholesalers, and retailers), and high (middlemen, large mills/rice factories, and large wholesalers). In the rice market, from middlemen to mills, rice factories, and large collectors, the middlemen become the decision-makers on the price level. Middlemen also have a position to determine the price from farmers because they have a transportation function so that they are at risk of depreciation, and middlemen have equal resources to make sales in fast time (Market information function). In certain situations, middlemen become a solution as lenders for farmers. Farmers prefer to borrow funds from the middlemen due to easy payback.

The assessment of the vulnerability scale was obtained after the researcher grouped the elements of vulnerability and identified the factors that influence them. The factors on the aspects of vulnerability in West Java Province are as follows:

**Table 5. Rice vulnerability in West Java.**

| Vulnerability | Affecting Factors | Condition in West Java |
|---------------|-------------------|------------------------|
| Attractiveness | - Raw material supply  
- The process in each institutional arrangement is not complex  
- Rice Consumption Rate  
- The ability of the Government (Bulog) to manage rice production in West Java | - Decrease of rice filed area, total rice production, and productivity  
- The processes of producing ready-to-consume rice using a milling machine are as follow: peel the skin of the unhulled rice - separate the unpeeled rice - remove the bran layer from the cracked rice - polish the rice until it is ready for consumption - pack the rice in size  
- The consumption of rice as a staple food in West Java is 1.59 kg/capita/week or 0.23 kg/capita/day  
- Bulog Subdivision only has 4 RMU |
| Impact | - The increase in the poverty rate due to weak economic capacity make it difficult to buy rice  
- Contributes to the inflation rate | - Rice provides the largest contribution to the poverty line in West Java Province, around 22.27 percent for urban areas and 28.59 percent for rural areas  
- West Java's inflation rate in 2018 reached 3.54 percent, and it was higher than the national inflation rate of 3.31 percent |
Vulnerable Attack - Ministry of Trade Regulation Number 57 of 2017 "Business actors in selling rice at retail to consumers have to follow the HET (highest retail price) provisions.".
- The quality of medium and premium rice is under SNI 6128: 2015
- Law No. 8 of 1999 "Business actors are prohibited from producing and/or trading in inappropriate goods and/or services
- The provisions set by the government are mandatory for business actors. However, the sanctions for violations are administrative, so they have a medium level of vulnerability.
- There is a fraud in mixing medium quality rice with premium quality. Thus, the quality percentage increases then rewarded under premium quality.
- Manufacturers can take advantage of consumers' ignorance. For example, when consumers are unable to distinguish the quality of premium and medium rice

Based on the vulnerability analysis, there is a high level of attractiveness in the middle class. It is affected by the availability of raw materials, the functions of the institutions which act as distribution agencies, the level of demand for rice, and the government's ability to manage rice as a target of threats. As for the ease of being attack, it shows a high level because the actors, the rules, and control are still weak, so there are gaps in the trading system to commit fraud. Further, the impact indicates a high level. Since rice is related to the livelihoods of many people, its price and availability have an effect on inflation and affect the increase in the poverty rate as well as become the people's economic space and affect the welfare of farmers, trade operators, and rice consumers.

4. Conclusions
The potential threats and vulnerability of rice distribution in West Java are in the high category. The findings suggest the requirement of government and stakeholders to take various steps to strengthen rice distribution, including:

- Effective relations with distribution actors and build an integrated online system for government parties who have an interest in threats that can affect food security both nationally and in West Java Province.
- Review the determination of the classification of premium and medium rice and determine the variety of medium and premium rice production.
- Build social protection with communities and organizations to help prevent threats to rice distribution.
- Encouraging the use of technology in each distribution institution that can reduce the number of parties involved to minimize price increases, and make it easier to control, both in terms of quantity and price.
- Prevent from an early age political and ideological interests that enter through rice policies that can harm farmers, traders, and the public as rice consumers.
- To increase supply chain development in the function of Gapoktan (Association of Farmer Groups), supply chain management, partner selections with several considerations such as better prices, parties who have become regular customers, and closer locations to cut off the rice distribution chain.

Further research should consider export and import activities within the rice distribution context. The reason is due to the fluctuating price that is affected by supply from other countries such as Southeast Asian countries, especially Thailand and Vietnam.

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