TEST Engineering & Management

January - February 2020
ISSN: 0193 - 4120 Page No. 3768 - 3779

The Analysis of Business Vulnerability in Rice Supply Chain in the Flood Prone Areas

M. Farid Wajdi[1], Muzakar Isa[2], Liana Mangifera[3]
Faculty of Economic and Bussiness, Universitas Muhammadiyah Surakarta (UMS), Surakarta, Indonesia
Correspondent author: muzakar.isa@ums.ac.id

Article Info
Volume 82
Page Number: 3768 - 3779
Publication Issue:
January-February 2020

Article History
Article Received: *18 May 2019*
Revised: *14 July 2019*
Accepted: *22 December 2019*
Publication: *20 January 2020*

Abstract:
This study aims to analyze the vulnerability of the region toward flooding, describe the rice supply chain, analyze the vulnerability of businesses in the rice supply chain in flood-prone areas in Klaten Regency to support regional and national food security.The population of this study is SMEs who are in the rice supply chain in flood-prone areas in Klaten Regency. Purposive sampling technique was used here to get those who have experienced flooding three times. This study used primary data, namely data on regional vulnerability and business vulnerability for SMEs. To collect the data, the researchers applied direct interviews with SME actors supported by questionnaires and FGDs for deepening the aspects of vulnerability to flooding. The analytical tool used is descriptive and index. SMEs in the rice supply chain in Klaten Regency included farmers and rice fellers, mill, wholesalers, retailers and consumers. Wholesalers are the most vulnerable members of the supply chain, followed by retail traders and farmers, and mill. In addition, labor vulnerability is the highest type of vulnerability, followed by consumer vulnerability, capital vulnerability and supplier vulnerability. This finding implies that to improve companies' resilience, so companies need to more attention to how they can prioritize to reduce companies vulnerabiliies. SMEs in the rice supply chain are an important element for maintaining food security.

Keywords: *Business vulnerability, supply chain, floods.*

I. INTRODUCTION

Small and medium-sized businesses (UKM) are business units that have an important role in the Indonesian economy, both as labor absorbers and as a major contributor to regional income (Isa and Mangifera, 2019). Indonesia is the most flood-prone country in the world, where SMEs are the most vulnerable business units when there is a threat of flooding, so they have a high level of risk of damage and loss (Thun et al. 2011; Isa et al. 2019). Many SMEs are spread in various business sectors, including agriculture, manufacturing, trade and services, one of which is rice planting and rice production and distribution (Pangestuti, and Setiadi. 2019).

Rice is a commodity that plays an important role in the economy and food security and is a major basis in the revitalization of agriculture in the future (Pangestuti, and Setiadi. 2019). SMEs in the rice supply chain have an important role in maintaining food security, especially in the production and distribution of rice (Tiwu et al. 2019). The rice supply chain is dominated by SMEs consisting of farmers and rice fellers, selem (ricemil), large traders, small traders, restaurants and consumers (Thapa et al. 2018; Tiwu et al. 2019). In flood conditions, compared to large companies, SMEs are more vulnerable (Thun et al., 2011). SMEs are vulnerable because they lack of resources to adapt the changing conditions in the rapidly changing business environment. Thun et al., (2011) and Arend and Wisner, (2005) explain that SMEs have fewer customers and lower sales volumes, higher capital and transaction costs, reactive nature in corporate strategy, and the existence of limited resources. In

January - February 2020
ISSN: 0193 - 4120 Page No. 3768 - 3779

addition, they usually operate under weaker cash flow conditions (Thun et al., 2011).

On the other hand, Wagner and Neshat (2012) explain the lower complexity of the business situation, making SMEs more resilient than large companies. SMEs have proven that they can get through a period of economic crisis due to natural disasters with certain advantages compared to large scale businesses. SMEs have many advantages such as it is easier to change business strategies and explore new sales channels or new markets, it is easier to reduce the organization's operational costs, entrepreneurs are closer to customers than heads of large companies, and they have more access to government support and assistance. SMEs also have a lot of knowledge about local markets (Arend and Wisner, 2005) and flexible organizational structures (Vaaland and Heide, 2007).

Business vulnerability is a business condition that does not have the ability to avoid, and face risks from the external environment such as disasters, policy changes, and technological developments (Yang et al., 2018; Isa et al. 2019). Business vulnerability to flooding is a negative factor that reduces and destroys the competitiveness of SMEs in the rice supply chain. SMEs that lack a lot of resources, abilities, competencies to manage and control the risk of damage and loss are very vulnerable when there is a threat of natural disasters. Business vulnerability is an important aspect to be analysed because it largely determines the competitiveness of SMEs in the rice supply chain in order to achieve food security. Klaten Regency's food security index in 2018 is very low, compared to the surrounding regions. One of the low levels of food security is due to the threat of flooding in Klaten Regency.

Business vulnerability in the rice supply chain is an important factor in the evolution of its performance. There are four types of business vulnerability for SMEs; financial vulnerability, labor, suppliers, and customers (Thapa et al. 2018). Financial vulnerability has 3 main aspects, namely mobility, ownership, and business size as the main determinants of corporate vulnerability. Companies with higher capital mobility, a higher proportion of capital, and a larger size are not too vulnerable to disasters. In the employment dimension, ease of employee replacement and worker flexibility are the two main determinants of company vulnerability. Companies that have greater availability of labor and flexible working hours have lower levels of vulnerability. The dimensions of vulnerability of business suppliers are determined by dependency on infrastructure and suppliers. For the customer dimension, consumer reach and variation are the two main determinants of this vulnerability. Companies with larger and more stable market coverage and have a variety of services / products have a low level of vulnerability.

To manage the threat of natural disasters successfully, a strategy redesign must be carried out. Strategy redesign is defined as a strategic and tactical plan, which leads to operational actions aimed at reducing business vulnerability in the rice supply chain by making changes to the core elements of the supply chain scenario (Vlajic et al., 2012). This study aims to analyze the vulnerability of the region to flooding, describe the rice supply chain, analyse the vulnerability of businesses in the rice supply chain in flood-prone areas in Klaten Regency to support regional and national food security.

II. LITERATURE REVIEW

Business is an entity involved in commercial activities including resources to create products, both goods and services. Figure 1 illustrates the process by which businesses use capital and labor to convert rice from suppliers to rice that is sent to customers (Thapa et al. 2018). Capital consists of fixed assets, inventory and cash, while labor is the

January - February 2020
ISSN: 0193 - 4120 Page No. 3768 - 3779

contribution of people who work with their knowledge and skills.

These resources are organized into value chains that include material purchases, operations, sales, services, finance, research and development (products and processes), supervision, general administration. By selling rice or rice to consumers, businesses generate revenue which is then returned to suppliers to make payments that maintain business continuity in a dynamic balance of input and output flows. Conversely, disruption in any part of the flow has the potential to jeopardize business viability.

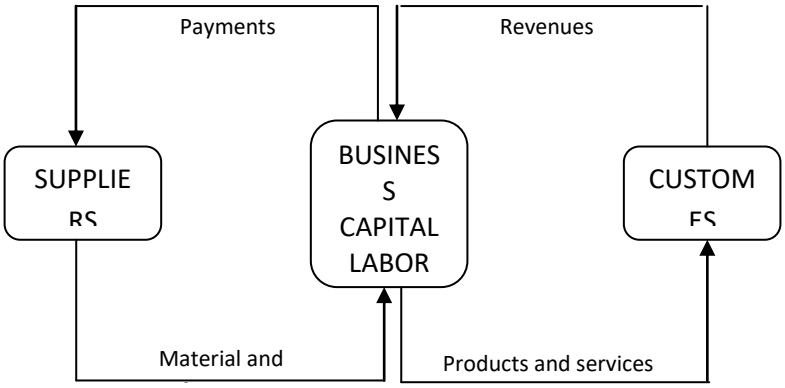

Fig. 1. Conceptual Model of Business Operations

Farmers, households and other businesses play important roles as suppliers and customers for rice business operations. The government is a supplier of road networks and some facilities (for example clean water, electricity, and fuel) and is also a consumer of several business products and services. Furthermore, the government can influence business development through policies such as taxes, loans, and land use (Blakely and Bradshaw 2002). Households contribute to business operations as suppliers of employees and as consumers for most products and services. Finally, inter-business relationships are also important. Other companies continue to supply parts of infrastructure that are not provided by the government and also distribute or consume products and services.

The flood disaster affects the business operations of every business in the rice supply chain in Klaten, Central Java Province, Indonesia. There are 4 types of business vulnerabilities; capital, labor, supplier, and customer vulnerabilities.

a. Capital Vulnerability

Capital is classified into three categories according to the level of liquidity: fixed assets (eg buildings, equipment, furniture, and vehicles), inventory (for example raw materials, semi-finished products, and finished products), and cash (for example cash, and accounts receivable). Assets remain very vulnerable because they have low mobility and can suffer physical damage directly from flooding. For this reason, businesses with large amounts of fixed assets are more vulnerable than those with small amounts of fixed assets (Tierney 1997). Likewise, businesses with large inventories are particularly vulnerable because these materials have low mobility and can suffer direct physical damage. Cash and receivables are not so vulnerable to flooding because they are intangible assets processed electronically, so information about them can be stored in various locations.

The size of the business, measured by the number of employees, correlates with the business's ability to cope with flooding (Alesch et al. 2001). Small businesses have faced more obstacles in recovering from the effects of floods than large ones, but many factors can explain this finding. In addition, large businesses are more likely to be able to pay insurance or emergency funds for disaster recovery. Big business also has significant financial and political influence in their communities, which gives them high priority in government recovery policies and also substantial influence to rebuild their facilities first. Large

January - February 2020
ISSN: 0193 - 4120 Page No. 3768 - 3779

companies have a better position in the supply, purchase and transfer of workers to deal with emergencies. Finally, large businesses tend to have far stronger input and output ties that facilitate disaster recovery.

b. Labor Vulnerability

Flooding can disrupt labor in flood-stricken areas. Employee casualties (death, injury and illness) hamper business operations because employees cannot work. The level of disruption to the business depends on the ease of replacing employees. The large pool of workers and the dependence on unskilled workers make it easier to replace employees who have been displaced by disasters. Likewise, victims in employees' families can reduce their working hours or require extended leave. In addition, damage to employee residences can cause victims to move permanently or move to temporary housing for long periods of time (Bolin and Stanford 1998). Victim employees can become so busy restoring their household routines that their working hours must be reduced or completely limited for some time period.

c. Supplier vulnerability

Disasters can close suppliers that can force businesses to adjust for material shortages for at least a short time even if there is no physical damage. Suppose a neighboring grocery store depends on a regional distribution center for its supplies. If the distribution center is severely damaged and forced to close, the grocery store must find a new business partner or also suspend operations. This "domino" effect on production operations results in an economic multiplier in which indirect losses come out of direct losses. As such, businesses suffer direct losses when their capital assets are physically damaged and indirect losses when they are functionally connected to other businesses that have experienced direct or indirect losses.

d. Customer vulnerability

When there is a flood, businesses can also lose customers due to fatalities. In addition, demographic changes in flood-stricken areas can destroy established customer bases (Smith and McCarty, 1996; Smith and McCarty, 2006). A long period of time to get back new customers can be fatal for some companies, especially the small ones (Alesch et al. 2001). Furthermore, flooding can cause consumer's preferences to change and thus affect market demand for some products and services. For businesses that only provide products and services, flooding can cause direct sales to decline.

III. RESEARCH METHODS

The population of this study is SMEs who are in the rice supply chain located in flood-prone areas in Klaten Regency, Central Java Province, Indonesia. The population is unknown because there is no data about that in Klaten Regency. This study used a purposive sampling technique to get business actors who have experienced flooding three times. This study used a survey method directly to SMEs in flood-prone areas in Klaten Regency. The primary data used were the area of vulnerability and the level of vulnerability of the company.

To collect the data the researchers interviewed SMEs, gave several questionnaires and conducted FGDs to investigate the aspects of flood vulnerability. The analytical tools used in this study were index, index of vulnerability in the region and index of the company. In detail, the analysis of architecture is as follows.

1. Regional vulnerability index for flooding. The formation of regional vulnerability indexes is done through a compilation of all values of vulnerability aspects consisting of exposure,

TEST Engineering & Management

January - February 2020
ISSN: 0193 - 4120 Page No. 3768 - 3779

sensivity, and adaptive capacity variables. Weighting of each variable due to consideration of the effect of each aspect in shaping the aspect of vulnerability. The greater the influence of these aspects, the higher the weight given. Weighting is obtained through FGD with stakeholders related to flood risk reduction at the study site. Furthermore, the determination of the vulnerability index value is determined by the multiplication between the total scores of all indicators and the weighting of the variables of exposure, sensivity, and adaptive capacity Weis et al. (2016). The vulnerability index value of the area for flooding is determined by the following formula (Isa et al. 2018):

$$IKW = \sum_{i=1}^{3} (W_1 x X_1) + (W_2 x X_2) + (W_3 x X_3)$$

Note:
IKW = Regional Vulnerability Index for Floods
W1 = Exposure Weight
X1 = Exposure Score
W2 = Weight Sensitivity
X2 = Sensitivity Score
W3 = Adaptive Capacity Weight
X3 = Adaptive Capacity Score

2. Company vulnerability index for floods. The formation of the regional vulnerability index is done through a compilation of all aspects of the vulnerability aspects consisting of variables of supplier, labor, capital, and consumer vulnerabilities. Weighting of each variable is due to consideration of the effect of each aspect in shaping the aspect of vulnerability. The greater the influence of these aspects, the higher the weight given. Weighting is obtained through FGD with stakeholders related to flood risk reduction at the study site. Furthermore, the determination of the vulnerability index value is determined by the multiplication between the total score of all indicators and the variable weights of supplier vulnerability, labor vulnerability, capital vulnerability, and consumer vulnerability (Weis et al. 2016). The company vulnerability index value for flooding is determined by the following formula (Isa et al. 2018):

$$IKU = \sum_{i=1}^{4} (W_1 x X_1) + (W_2 x X_2) + (W_3 x X_3) + (W_4 x X_4)$$

Note:
IKU = Flood Vulnerability Index
W1 = Supplier Vulnerability Weight
X1 = Supplier Vulnerability Score
W2 = Weight of Manpower Vulnerability
X2 = Labor Crude Score
W3 = Capital Vulnerability Weight
X3 = Capital Vulnerability Score
W4 = Weight of Customer Vulnerability
X4 = Customer Vulnerability Score

IV. RESULTS AND DISCUSSION

1. Regional Vulnerability

Klaten is one of the regencies in Central Java Province of Indonesia, located between 7˚32′19 ″ to 7˚41`8′33 South Latitude and 110˚26′14 ″ to 110˚47′51 ″ East Longitude. Administratively, Klaten Regency is divided into 26 sub-districts, 391 rural villages and 10 urban villages. The area of Klaten is divided into 3 plains, namely Merapi Slope Plain, Kapur Mountain Plain and Lowlands. Merapi Slope Plain stretches to the north covering a small portion north of the Districts of Kemalang, Karangnongko, Jatinom and Tulung. Kapur Mountain Plate stretches to the south covering a small portion to the south of Bayat and Cawas Districts. The longitudinal lowlands in the middle cover the entire district area in Klaten except for a small portion of the area which is the slopes of Mount Merapi and Mount Kapur. Regency is the most flood-prone area in Central Java Province in

TEST Engineering & Management

January - February 2020
ISSN: 0193 - 4120 Page No. 3768 - 3779

the category of non-coastal areas. Based on the Spatial Planning of the Klaten Regency in 2011-2031 it is explained that the prone areas to flooding natural disasters in the District of Klaten are the Districts of Bayat, Cawas, Ceper ,gantiwarno, Juwiring, Karangdowo, Pedan, Prambanan, Trucuk, Wedi and Wonosari.

Vulnerability is a major factor influencing the amount of flood risk, which consists of personal casualties, damage and losses (Isa, et al 2019, Isa et al, 2018). The large amount of risk will negatively affect the economy in the short term, although in the long run it can also have a positive effect (Isa, 2016). Flood risk reduction will be effective if done through reducing the level of vulnerability of the region and business units. Regional vulnerability to flooding can be explained through the vulnerability index (Isa et al. 2018). The value of the area vulnerability index for flooding in Klaten Regency is explained as Table 1 below.

Table 1
Regional Vulnerability Index of Klaten Regency Flood

Description	Eksposure		Sensitivity		Adaptive Capability		Vulnerability Index
	Score	Bobot	Score	Bobot	Score	Bobot	
Vulnerability Index	0.39	0.35	0.68	0.30	0.42	0.35	0.49

Source: Primary data processed (2019)

The figures in the table above describe the vulnerability index of Klaten District for flooding. Klaten District vulnerability index for floods was 0.49, which means that Klaten Regency is in the medium vulnerability category. Vulnerability levels are grouped into 3 classifications, namely low (<33%), moderate (0.34-0.66) and high (> 0.67). An index number of 0.49 is a multiplication of scores and weights of exposure, sensitivity and adaptive ability variables. Exposure score of 0.39, sensitivity of 0.68, and ability of adaptation of 0.42 were obtained from answers to questions in the questionnaire filled out by respondents. Exposure weight figures of 0.35, sensitivity of 0.30, and adaptability of 0.35 were obtained from the results of the FGDs along with the key person regarding the weighting of 3 regional vulnerability variables for flooding.

From the table above it can be seen that the sensitivity variable is the highest forming aspect of vulnerability followed by aspects of adaptive ability and exposure. These results are different from similar studies conducted in coastal areas which explain that exposure as the most vulnerable variable to the threat of flooding and resulting in a high risk of flooding (Isa et al. 2015).

Adger (2006), and Luers (2005) mention sensitivity is an aspect of vulnerability that explains the level of individual conditions in society, and their environment for the existence of flooding in an area. This aspect illustrates the individual condition of the flood affected community. The index value for indicators of community income and frequency of treatment is in the category of high vulnerability to flooding areas, and the index value for access to clean water and sanitation is in the category of vulnerability of areas for moderate flooding. These results indicate the economic and public health aspects are the highest aspects causing the sensitivity variable as the most vulnerable variable against the threat of flooding so that the resulting risk is high.

Adaptive capacity is the second most vulnerable variable to the threat of flooding in Klaten Regency. Allen (2005), and Isa et al (2015) state that adaptive capacity is an aspect of vulnerability that explains the ability of a system, region and community to carry out flood risk reduction. Evacuation route or route aspects are in the area of high vulnerability to flooding. With this, aspects of the evacuation route must be improved to reduce the risk of flooding.

January - February 2020
ISSN: 0193 - 4120 Page No. 3768 - 3779

Furthermore the aspects such as (1) river conditions, embankments, floodgates, (2) the existence of flood-prone maps, (3) level of community education, (4) distance of houses to health services, (5) number of NGOs, (6) number of camps, (7) insurance ownership, and (8) the number of early warning is in the category of vulnerability of the current region. The indicators (1) evacuation location for flood victims, (2) access to flood information, (3) emergency services, (4) socialization and (5) training are in the category of low vulnerability areas.

Exposure is the third factor that causes flood vulnerability in non-coastal area. Weis, et al. (2016) mentions that exposure is an aspect of vulnerability that explains the extent to which people are affected by floods in accordance with vulnerable communities, the location of homes and flood conditions. Index values for indicators of flood duration (length), flood inundation height and distance of house to flood source (river) are in the high vulnerability category, while the frequency of flooding, the number of elderly people and children under five are in the low vulnerability category. From this aspect, things that must be considered are the factors that cause the duration (length) of flooding, and the level of flood inundation. It is important to pay attention to drainage channels and catchment areas to reduce inundation height and duration of flooding. The existence of houses near the river must also be reduced, so the key is the enforcement of regional spatial planning and permits in the construction of new buildings or renovations.

High or low area vulnerability has an impact on business vulnerability in the rice supply chain. The level of regional vulnerability is one aspect of the company's external environment that impacts SME performance (Leopoulos et al., 2006; Brustbauer, 2016). Apart from being influenced by environmental aspects, SMEs are also affected by supply chain performance, which consists of suppliers, labor, capital and customers.

2. Rice Supply Chain

Every business in a geographical area has different consumers and suppliers; some have a spread market that covers a large area while others are supplied by and only serve local markets. Businesses in the impact area (Figure 2) may have suppliers inside or outside the disaster impact area. Likewise, the customer may actually be inside, partially inside, or completely outside the area of impact. Conversely, businesses that are outside the area of impact can be affected through supplier and customer interference. Indeed it is possible for businesses outside the area of impact to be more severely affected than businesses within the area of impact.

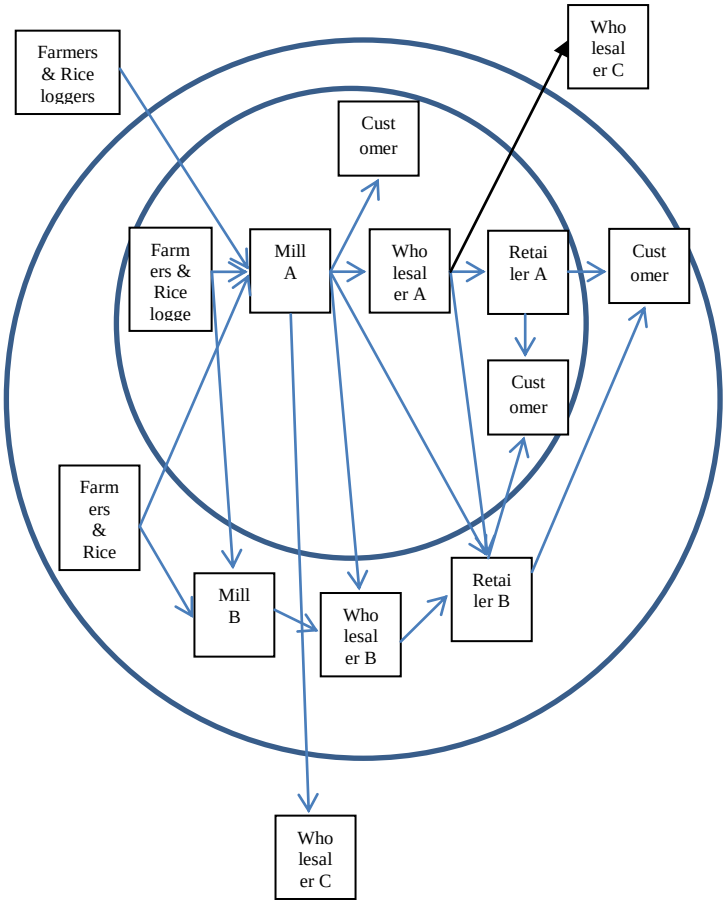

Fig. 2. Business Relationships in the Rice Supply Chain in Flood Prone Areas

January - February 2020
ISSN: 0193 - 4120 Page No. 3768 - 3779

The rice supply chain in Klaten Regency consists of (1) farmers and rice loggers, (2) mill, (3) big traders, (4) small traders and (5) consumers. This result is strengthened by the research by Pangestuti and Setiadi (2019) in Kudus Regency, Central Java, Indonesia and Bidarti et al (2019) in North Sumetara, Indonesia.

Supply chain actors involved in the rice and rice supply chain are farmers, rice fellers and mills, large traders and small traders (Silalahi, et al. 2019).

1. Farmers are the first supply chain actors. Farmers are actors who cultivate rice. Farmers play an important role in the rice supply chain because the quality and quantity of supply is very dependent on them. Most farmers cultivate their own land that is located close to where they live. This rice farmer sells rice to loggers and mills.
2. Rice loggers. They are a member of the supply chain that connects farmers with rice mills. These cutters play the role of collecting grain from farmers who will then be sold to rice mills. Grain that is purchased is usually directly picked up from the harvest location in the fields. Before harvesting time takes place, rice loggers usually come to the location of the rice field to harvest and then communicate to find out when the harvest and sale-purchase agreement. Yields in the form of harvested unhusked rice (GKP) are purchased and then directly sold to rice mills without any drying.
3. Rice mills are members of the supply chain that holds grain which will then be processed into rice. The rice produced by this rice mill comes from unhulled rice purchased from farmers and rice loggers. Grain purchased by rice mills must meet criteria or those that have good quality. The quality of grain seen from its physical form must be yellow in color and certainly has a lot of yield.
4. Rice traders. Rice traders can be grouped into two groups, namely wholesalers and retailers. For large traders, generally there are activities to add value through grading and packaging. Most of the big traders do packaging with certain trademarks, such as Rojo Lele, Pandan Wangi and so on. Some branded rice is marketed to the super market and partly to traditional retailers

Rice supply chain performance is influenced by the performance of each business unit in the rice supply chain (Thapa et al. 2018). With this, business vulnerability is a major factor that can influence the performance of the rice supply chain in flood-prone areas in Klaten Regency. The performance of SMEs in the rice supply chain will be effective if done through reducing the level of business vulnerability.

3. Business Vulnerability

Business vulnerability is a business condition in which the owner does not have the ability to avoid and face risks from the external environment such as disasters, policy changes, and technological developments (Isa et al. 2015). Business vulnerability to flooding is one type of vulnerability faced by SMEs because in the short term it has a negative impact on business performance (Verbano and Venturini, 2013, Belas et al., 2014)).

Business vulnerability to flooding can be explained through the company's vulnerability index. This vulnerability index is determined by the multiplication between the total scores of all indicators and the weights of the supplier vulnerability variables, labor vulnerability, capital vulnerability and consumer vulnerability. The value of business vulnerability index for flood in Klaten Regency is explained as Table 2 below.

TEST Engineering & Management

January - February 2020
ISSN: 0193 - 4120 Page No. 3768 - 3779

Table 2
Business Vulnerability Index for the Klaten Regency Flood

Vulnerability Index	**Farmer**	**Mill**	**Wholesaler**	**Retailer**	**INDEX**
Supplier Vulnerability	0.38	0.44	0.56	0.30	**0.42**
Capital Vulnerability	0.52	0.47	0.51	0.51	**0.50**
Labor Vulnerability	**0.72**	0.53	**0.64**	0.52	**0.60**
Consumer Vulnerability	0.44	**0.60**	0.39	**0.73**	**0.54**
INDEX	**0.52**	**0.51**	**0.53**	**0.52**	**0.52**

Source: Primary Data Processed (2019)

The figures in the table above explain the business vulnerability index in Klaten District over flooding. The business vulnerability index in Klaten Regency over flooding was 0.52, which means that SMEs in Klaten Regency are in the category of moderate vulnerability. Vulnerability levels are grouped into 3 classifications, namely low (<33%), moderate (0.34-0.66) and high (> 0.67).

Based on the types of business actors in the rice supply chain of rice in Klaten Regency, the most vulnerable business actors were the category of wholesalers with a moderate level of vulnerability, amounting to 0.53. After the wholesalers, the next vulnerable business groups were retail traders (0.52) and farmers (0.52), and the last was mill (0.51). These four groups of business actors did not have high vulnerability gaps, meaning that their vulnerability levels are aligned, and they are in the moderate vulnerability category.

Farming is very vulnerable in the aspect of labor (Sasmita and Apriyanti, 2019), where aspects of labor are at a high level of vulnerability (0.72). Labor is the most important component in farming, where labor costs are the highest component in the production cost structure (Silvira et al, 2014). During floods, many workers focus on their individual needs and do not want to work as farm laborers. The highest vulnerability of labor was followed by capital appeal, consumers and suppliers.

Mill businesses are most vulnerable to the consumer aspect. Mill get rice from around and outside the region, as well as for consumers. For the mill, the majority of consumers are people around the business, and consumers do not focus on purchasing rice during floods. Consumer vulnerability had the highest score then followed by coolantanan workforce, capital, and suppliers.

Wholesalers are most vulnerable to labor aspects. They need a lot of labor. Many workers focus on their personal needs when there is a flood so that many wholesalers find it difficult to find labor. The vulnerability of labor was the highest, followed by the coolness of suppliers, capital and consumers.

Retailers are most vulnerable to the aspects of consumers where the aspects of consumers are at a high level of vulnerability (0.73). When there is a flood, rice purchases decline, this could be because consumers' main focus is on health rather than rice purchases. Consumer vulnerability was the highest cost, then followed by consumer pressure, capital and finally suppliers.

Based on the types of aspects of companies forming vulnerability in the rice supply chain of rice in Klaten District, the type of vulnerability that is most vulnerable is labor, which is equal to 0.60. The next types of vulnerability aspects are consumers (0.54), capital (o, 50) and suppliers (0.42). All types of vulnerability builders are in

January - February 2020
ISSN: 0193 - 4120 Page No. 3768 - 3779

the medium vulnerability category.

Labor is an important aspect in the performance of SMEs, especially SMEs that are in the rice and rice supply chain (Silvira et al, 2014). The large number of new large companies for textile products also impacts the interest of workers to work in the SME sector (Aprillya, et al., 2019).

V. CONCLUSION

This study aims to analyze the vulnerability of the region to flooding, describe the rice supply chain, analyse the vulnerability of businesses in the rice supply chain in flood-prone areas in Klaten Regency to support regional and national food security. In detail the conclusions of each research objective are described as follows.

Klaten Regency is in the medium vulnerability category. Sensitivity variable is the highest aspect of forming vulnerability followed by aspects of adaptive ability and exposure. High or low area vulnerability has an impact on business vulnerability in the rice supply chain. The level of regional vulnerability is one aspect of the company's external environment that impacts SME performance.

The rice supply chain in Klaten Regency consists of farmers and rice loggers, mill, wholesalers, retailers and consumers. Wholesalers are the most vulnerable members of the supply chain, followed by retail traders and farmers, and mill. In addition, labor vulnerability is the highest type of vulnerability, followed by consumer vulnerability, capital vulnerability and supplier vulnerability.

Business vulnerability for SMEs in the rice supply chain in Klaten Regency is in the category of moderate vulnerability. Based on the type of business actor, the most vulnerable business actors are the category of wholesalers, followed by retail traders and farmers, and mill. Based on the types of aspects that make up corporate vulnerability, the most vulnerable types of vulnerability are labor, followed by consumers, capital and suppliers. All types of vulnerability builders are in the medium vulnerability category.

SMEs in the rice supply chain are an important element for maintaining food security, particularly in the production and distribution of rice. UKM concerning about rice that is in the rice supply chain must be maintained for the sustainability of food security. Flooding as a threat from outside the company must be managed properly through reducing the level of vulnerability of the company so that the risk of flooding becomes lower or the resilience of the company increases.

Educational institutions, business actors, government, and society better known as ABGC must synergize and jointly reduce the level of vulnerability of SME businesses that are in the rice supply chain. The effort was made to maintain the sustainability of SMEs and maintain the level of food security in flood-prone areas.

VI. REFERENCE

[1]. Adger, W. N. (2006). Vulnerability: *Global Environmental change, 16: 268-281.*

[2]. Bidarti, A, Darwanto, D. H., Hartono, S., Jamhari. 2019. Supplier Structure and Performance Evaluation of Supplier Network Phase Rice Supply Chain Management in South Sumatra. AGRARIS: Journal of Agribusiness and Rural Develpoment Research, Vol. 5 No. 1 2019

[3]. Alesch, D. J., Holly, J. N., Mittler, E. & Nagy, R. (2001) Organizations at Risk: What happens when small businesses and not-for-profits encounter natural disasters. Small Organizations Natural Hazards Project, First Year Technical Report, University of Wisconsin-Green Bay. Fairfax, Public Entity Risk Institute.

January - February 2020
ISSN: 0193 - 4120 Page No. 3768 - 3779

[4]. Allen. (2005). *Climate Change Risk and Vulnerability*. Australian Greenhouse Office, Department of the Environment and Heritage, Canberra, Australia: 159.

[5]. Arend, R. J., & Wisner, J. D. (2005). Small business and supply chain management: is there a fit? Journal of Business Venturing, 20, 403-436, https://doi.org/10.1016/j.jbusvent.2003.11.003

[6]. Belas, J.; Machacek, J.; Bartos, P.; Hlawiczka, R.; Hudakova, 2014. M. Business Risks and the Level of Entrepreneurial Optimism among SME in the Czech and Slovak Republic. JOC, 6, 30–41.

[7]. Blakely, E. J., & Bradshaw, T. K. (2002). Planning Local Economic Development. Thousand Oaks, CA: Sage.

[8]. Bolin, R. and Stanford, L. (1998) The Northridge earthquake: Community-based approaches to unmet recovery needs. Disasters, 22, 21-38. doi:10.1111/1467-7717.00073

[9]. Brustbauer, J. 2016. Enterprise Risk Management in SMEs: Towards a structural model. International Small Business Journal. 34, 70–85.

[10]. Gao, L. Long-Term Contracting: The Role of Private Information in Dynamic Supply Risk Management. Prod. Operat. Manag. 2015, 24, 1570–1579.

[11]. Isa, M. 2016. Natural Disaster: Negative or Potisitive Impact to Economy Growth?, *The 3rd University Research Colloquium 2016, Kudus.*

[12]. Isa, M. and Mangifera, L. 2019. Continuous flood risk reduction on MSMEs: Implementation of MACTOR program. Economic Journal of Emerging Markets, 11(1) 2019, 113-121

[13]. Isa, M. Fauzi; Indah, A. Susilowati, I. 2019. Flood risk reduction in the northern coast of Central Java Province, Indonesia: An application of stakeholder's analysis. *Jàmbá: Journal of Disaster Risk Studies 11(1), a660. https://doi.org/10.4102/jamba.v11i1.660*

[14]. Isa, M., Sugiyanto, FX., Susilowati, I. 2018. Community resilience to floods in the coastal zone for disaster risk reduction, *Jàmbá: Journal of Disaster Risk Studies, Vol 10, No 1*

[15]. Isa, M., Sugiyanto, FX., Susilowati, I.. 2015. Adaptation and Mitigation Model for People to Restore Their Ecosystem from Flood in Semarang, Indonesia, *Jurnal Ekonomi Pembangunan, Vol. 16, No 2, Tahun 2015.*

[16]. Leopoulos, V.N.; Kirytopoulos, K.A.; Malandrakis, C. 2006. Risk Management for SMEs: Tools to use and how. Prod. Plann. Control, 17, 322–332.

[17]. Luers, A.L. (2005). ‘‘The Surface of Vulnerability: An Analytic Framework for Examining Environmental Change’’,*Global Environmental Change 15: 214–223.*

[18]. Aprillya, M.R., Suryani, E., Dzulkarnain, A. 2019. System Dynamics Simulation Model to Increase Paddy Production for Food Security. Journal of Information Systems Engineering and Business Intelligence. Vol.5, No.1, April 2019

[19]. Silalahi, N.H., Yudha, R.O., Dwiyanti, E.I., Zulvianita, D., Feranti, S.N., and Yustiana, Y., 2019. Government policy statements related to rice problems in Indonesia: Review. 3BIO: Journal of Biological Science, Technology and Management Volume 1., Issue 1 (2019): 35 - 41

January - February 2020
ISSN: 0193 - 4120 Page No. 3768 - 3779

[20]. Pangestuti, M. D., Setiadi, M., A.. 2019. Analysis Supply Chain Distribution And Added Value Of Grain In Sub District Undaan Kudus Regency. Jurnal Ekonomi Pertanian dan Agribisnis (JEPA) Volume 3, Nomor 4 (2019): 671-680, ISSN: 2614-4670 (p), ISSN: 2598-8174 (e)

[21]. Silvira, H. H., dan L. Fauzia, 2014, Analisis Faktor-Faktor yang Mempengaruhi Produksi Padi Sawah, Jurnal Sosial Ekonomi Pertanian dan Agribisnis Universitas Sumatra Utara. 2 (4): 6-8.

[22]. Smith, S.K. and C. McCarty. 1996. "Demographic Effects of Natural Disasters: A Case Study of Hurricane Andrew." *Demography* 33:265–75.

[23]. Smith, S.K. and C. McCarty. 2006. "Florida's 2004 Hurricane Season: Demographic Response and Recovery." Paper presented at the annual meeting of the Southern Demographic Association, Durham, NC, November 2–4.

[24]. Thapa, T. L.; Bhattarai, C.; Khatri, B.; Bhusal, K.. 2018. Supply Chain Analysis of Rice Sub-Sector in Dang District, Nepal. International Journal of Applied Sciences and Biotechnology, Vol 6(4): 319-326 DOI: 10.3126/ijasbt.v6i4.22109

[25]. Thun, J.H., Drüke, M. and Hoenig, D. 2011, "Managing uncertainty – an empirical analysis of supply chain risk management in small and medium-sized enterprises", International Journal of Production Research, Vol. 49. No. 18, pp. 5511-5525.

[26]. Tierney, K. J. 1997. Business Impacts of the Northridge Earthquake. Journal of Contingencies and Crisis Management, 5(2), 87-97.

[27]. Tiwu, Wa Halida, Sepang, La Jante L., Rate, Paulina Van, 2019. Analysis of Ricesuplly Chain Distribution Channels in Bolaang Mongondow (Case Study in North Mopugad Village Dumoga Sub-District). Jurnal EMBA Vol.7 No.1, page 1031 – 1040

[28]. Vaaland, T. I., & Heide, M. 2007. Can the SME survive the supply chain challenges? Supply Chain Management: An International Journal, 12(1), 20-31.

[29]. Verbano, C. and Venturini, K. 2013. Managing Risks in SMEs: A Literature Review and Research Agenda. J. Technol. Manag. Innov. 2013, 8, 186–197.

[30]. Vlajic, J.V., Jack, G.A.J., van der Vorst, Haijema, R. A framework for designing robust food supply chains. International Journal of Production Economics 137, 2012. pp. 176–189.

[31]. Wagner, S., & Neshat, N. (2012). A comparison of supply chain vulnerability indices for different categories of firms. International Journal of Production Research, 50(11), 2877-2891

[32]. Weis, S.W., Agostini, V.N., Roth, L.M., Gilmer, B., Schill, S.R., Knowles, J.E., Blyther, R. (2016). Assessing Vulnerability: An Integrated Approach For Mapping Adaptive, Sensitivity, And Exposure. *Climate Change (2016) 136:615-629.*

[33]. Yang, S.; Ishtiaq, M.; Anwar, M. 2018. Enterprise Risk Management Practices and Firm Performance, the Mediating Role of Competitive Advantage and the Moderating Role of Financial Literacy. J. Risk Finan. Manag. 11, 35.

[34]. Sasmita, Y., and Apriyanti, M. 2019. Income Analysis of "Cahaya Ummul" Rice Milling Business (Case Study) In Lakatan Village Galang Subdistrict of Toli-toli. Journal of Agroland 26 (1) : 7 - 13 , 2019