Resilience Measurement of SMEs Batik Sampang in Dealing with Natural Disasters

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Abstract. Sampang Regency is one of regions in East Java affected by flood every year. This causes disruption to the economic system of the community, especially for SMEs. Batik is a potential creative industry whose production processes are influenced by weather and climate. The quality of colouring and drying of batik depends on the brightness of the sun and the humidity around the production area. Therefore, this study aims to measure the level of resilience of Batik SMEs so that it can provide information to SMEs managers in planning flood disaster mitigation and extreme weather in batik production and marketing process. The dimensions of resilience of SMEs were identified from literature studies which were then grouped based on eight social-technical aspects. Data were collected using a semi-structure questionnaire. The questionnaire was validated by three disaster experts in SMEs. Respondents in this study were ten batik SMEs in Sampang Regency. Resilience levels were measured by adopting risk assessment measurements with multiplication between the probability and capacity of SMEs in the dealing with natural disasters. The measurement of resilience was used to formulate mitigation efforts that are expected to aid SMEs and the Government in dealing with natural disasters.

Introduction

Indonesia is one of the countries potentially affected by the disaster. The geographical position of Indonesia is located at the confluence of four tectonic plates, the Australian, Asian Plate, Plate of the Pacific Ocean and the Indian Ocean plate. Disasters that are common in Indonesia include earthquakes, tsunamis, volcanic eruptions, floods, landslides, hurricanes, extreme weather, tidal waves and droughts. Disasters that hit each region vary. Every rainy season, Indonesia is never free from floods. One area that is hit annually by floods is Sampang district, Madura [1].

Floods occur in every rainy season in Sampang Regency. Topographically, Sampang Regency is a hilly stretch, slope with an average of 2–25% and altitude between 0-300 m dpl. Such topography strongly supports the occurrence of soil erosion processes which cause siltation of the river so that the continuous capacity of the river for rainwater will cause flooding. Flood disasters not only disrupt colouring process in Batik production, but also small businesses or SMEs. Data of the Central Statistics Agency [2] show that until 2015, the number of SMEs in Indonesia reached 3,668,873 business units. The SMEs have contributed 57-60% to Gross Domestic Product (PBD) and employment of 97% of the total national workforce. So far, SMEs have survived from the disasters. However, the actual level of resilience has never been studied. Therefore, this research was conducted to measure the level of resilience so that it could be used to determine mitigation efforts by the SMEs and the Government.

This study aims to measure the level of resilience of The SMEs by focusing on social and technical perspectives. These two aspects are the main perspectives in industrial management. Six perspectives on socio-technical systems [3] added two other perspectives, namely safety and...
environment [4] will be applied in this study. This research was conducted on The Batik SMEs in Sampang because Sampang is a region that every time the rainy season is affected by floods which if the floods of activities in Batik SMEs are disrupted such as the delays in the supply of raw materials and the production process, especially in the colouring and drying process. When the rainy season the intensity of sunlight will decrease even if it does not exist, then the resulting batik colour will be bad because the drying process is not optimal. Therefore, solar heat has a major influence on the productivity of The Batik SMEs.

Review of Literature

Resilience Measurement

Resilience is defined as the ability to prevent, survive, recover from and learn from the effects of extreme weather. Corporate resilience is defined by [5] as a company's adaptive capacity and its ability to overcome, adapt and recover from disruption. Several studies propose the concept of resilience and its measurement in physical infrastructure facilities. Resilience of important physical infrastructure could be assessed during and after natural disasters (earthquakes, floods and droughts), which disrupt the performance of these facilities. Organizations must also manage their resilience (for example: resilience to natural disasters) to improve competitiveness and be able to reduce risks due to natural disasters [4]. Table 1 presents several definitions of disaster resilience identified from literatures.

| Table 1 Definitions of disaster resilience (Keating et al, 2014) | Author |
|-------------------------------------------------------------|--------|
| The ability of a system, community or community to be exposed to hazards to reject, absorb, accommodate and recover from the effects of hazards in a timely and efficient manner. | [6]    |
| The country’s capacity to survive, adapts, and recovers from national disasters and major economic crises so that their people can continue to live the life they value. | [7]    |
| The ability of states, communities, businesses and individual households to fight, absorb, recover from, and reorganize in response to natural hazard events, without endangering their progress and sustainable socio-economic development. | [8]    |
| The ability of a system, community or community to fight, absorb, overcome, and recover from the effects of hazards and to adapt to long-term changes in a timely and efficient manner without lasting damage to food security or welfare. | [9]    |
| The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of hazardous events in a timely and efficient manner, including through ensuring the preservation, recovery, or improvement of important basic structures and functions. | [10]   |
| The ability to prepare and plan, absorb, recover from, and more successfully adapt to adverse events. | [11]   |
| System or community resilience can be understood as the capacity to: a. anticipate, minimize and absorb potential stresses or destructive forces through adaptation or resistance  
  b. manage or maintain certain basic functions and structures during disasters  
  c. recover or bounce back after an event | [12]   |
| Resilience is the ability of the social system to respond to and recover from disasters and include inherent conditions that allow the system to absorb the impact and overcome an event, as well as post-event, adaptive processes that facilitate the ability of the social system to rearrange, change and learn in response threat. | [13]   |
Measurement is an activity which aims to identify the size of an object or symptom or activity based on predetermined parameters. Measurement of resilience is important to reduce the negative impact of a disaster that threatens the Indonesian economy. Resilience measurement will enable organizations to identify how strong the organizations are and what organizations can do to increase their resilience. Resilience measurement is carried out by measuring the level of risk of a system which will help determine steps to improve the level of resilience of the system (Utami, 2014). The Holistic Integrity Test (HIT) was proposed by Dobson (2016) with the aim of bringing quantitative analysis to resilience. HIT analyses a system's vulnerability to all possible conditions, including severe sudden events, which can disrupt the quality and health of the entire social-technical system. Consideration is given to the overall system characteristics to ensure possible problems that indicate weaknesses inherent in structural and non-structural parts of the system, which can then be investigated further to increase resilience and steps to reduce risk of loss.

**Risk Management**

Risk management is an approach carried out at risk level by understanding, identifying and evaluating the risk of a project. Then, what will be done to the impact and the possibility of transferring risk to other parties or reducing the risk that occurs are considered. Risk management is all activities related to risks, such as planning, assessment, handling, and monitoring risk (Kerzner, 2001). The aim of risk management is to recognize risks in a natural disaster and develop strategies to reduce or even avoid them (Wideman, 1992).

According to Utami (2018), measurement of resilience is conducted to determine the appropriate mitigation in accordance with the situation. The level of resilience to disaster of the SMEs is calculated by multiplying capacity and possibilities with the following equation:

\[ R_s = C_s \times P_s \]

Where:
- \( R_s \) = the Level of resilience of the SMEs
- \( C_s \) = Capacity of the SMEs
- \( P_s \) = Probability of capacity of the SMEs

Where value of probabilities are as follows:
- 1 = 0% - 20%
- 2 = 21% - 40%
- 3 = 41% - 60%
- 4 = 61% - 80%
- 5 = 81% - 100%

Then the level of resilience is determined based on the following values:
- 1 – 5 = Very low
- 6 – 10 = Low
- 11 – 15 = moderate
- 16 – 20 = High
- 21 – 25 = Very high

Mitigation is the first step carried out in response to natural disasters to reduce and minimize the impact of disasters. According to Law Number 24 (2007), mitigation is a series of efforts to reduce disaster risks, both in physical development as well as awareness and capacity building in facing disaster threats.
A Sociotechnical Approach

A sociotechnical approach is a method of considering equal weight of social and technical problems when a system is being designed. This approach recognizes that each organization or entity that is part of it consists of a set of interacting sub-systems. Thus, every organization has goals, vision and values, employs people with abilities, mindsets and attitudes, works in physical infrastructure, uses technology and tools, works with processes and practices, and shares certain cultural assumptions and norms. The sociotechnical framework identifies potential threats in a system so that the system can be made more resilient. The sociotechnical perspective can be extended to supply network systems by considering the interconnection and involvement of people or organizations (end users, managers, technology, human factor specialists, trade unions, suppliers, governments) in the system design process. In this study, the sociotechnical framework is applied to configure the measurement of resilience of the SMEs in dealing with natural disasters (Utami, 2014). The eight social and technical aspects are Goals or values, Technology, Procedure/method, Human Resources (People), Building or infrastructure, Culture, Safety, Environment

Methodology

This research was conducted on ten Batik SMEs in Sampang Regency, from February to June 2019. It used mixed-method. Data collected and analyzed in this research were the risks caused by natural disasters and strategies used to reduce the impact of these risks. Data were collected through observations of the SMEs shop floor, documentation from the SMEs and Dinas Koperasi dan UMKM, interviews with twelve respondents from the SMEs and decision makers from Dinas Koperasi dan UMKM Sampang Regency. This study used a combine answer questionnaire as a data collection instrument. This questionnaire was used to measure the level of resilience in the SMEs. The questionnaire was validated using the Delphi method and face validity.

Result and Discussion

The implementation of sociotechnical aspects began with the identification of resilience dimensions which were identified from literatures. Then, they were grouped according to the sociotechnical aspects. Table 2 provides the resilience dimensions.

| No. | Resilience Dimensions       | Definition                                                                 | Author   |
|-----|-----------------------------|---------------------------------------------------------------------------|----------|
| 1   | Technical                   | Ability to carry out activities during and after a disaster                | [14]     |
| 2   | Social                      | The ability of the SMEs to reduce the consequences of disasters as well as communication, support networks, inclusion, conflict, resolution | [14], [15] |
| 3   | Economy                     | The economic capacity of the SMEs to absorb economic losses due to disasters, such as income security, market access and employment, diversity and flexibility in livelihoods, financial services, land tenure | [14],[15] |
| 4   | Material Resources          | Availability of resources as a major supporter of the SMEs resilience      | [16]     |
| 5   | Preparedness and Planning   | Preparedness and disaster resilience planning                              | [16]     |
| 6   | Information management      | Resilience of the SMEs in the management and use of information             | [16]     |
| 7   | Guaranteed Path and Payment | The SMEs have many alternative courses                                     | [16]     |
| 8   | Government Process          | Governance that affects the resilience of The SMEs to disasters, both in the health sector and others | [16]     |
| 9  | Leadership Practice | The importance of leadership practices for the resilience of the SMEs in the face of disasters | [16] |
|----|---------------------|-------------------------------------------------------------------------------------------------|------|
| 10 | Organizational culture | The key to the resilience of the SMEs is to transfer knowledge | [15],[16] |
| 11 | Human Resources | The important role of human resources in the resilience of the SMEs to disasters | [15],[16] |
| 12 | Social Networking and Collaboration | The SMEs build and utilize networks to determine the extent to which they are resilient to disasters |      |
| 13 | Discussion | Make some relevant observations to maintain the resilience of the SMEs’ system. | [16] |
| 14 | Business | Business systems that include products and services, customers and interactions / relationships with them, the economic model underlying the business, and relationships with the environment (sales channels, markets, competitors, environment, and stakeholders) when a disaster occurs | [17] |
| 15 | Organisation | The SMEs in the company's internal arrangements, for example with processes, employee behaviour, corporate culture, management / leadership practices, and various structures and systems as well as the ability of organizations to take action to reduce the impact of disasters | [14],[17] |
| 16 | Information | Information quality, information management (collection, storage, distribution), and utilization of information. The information design domain is also related to company construction. Information architecture guides the way information (or better, data) must be used and handled. So, the principles might involve handling customer and supplier data, or how the operational system updates information systems. | [17] |
| 17 | Technology | Technology is very important to support businesses, organizations and information systems, as well as for the development of companies in the future. Technology, thus, is an important part of the company's construction. Therefore, for each technology, there is a related architecture, guiding the design. | [17] |
| 18 | Politic | leadership, participants, representation | [15] |
| 19 | Environment | land use, access to natural resources, sustainability | [15] |
| 20 | Physic | Structure, water supply, sanitation | [15] |
| 21 | Institutional | Management of resources, planning, responsiveness, accountability, rule of law | [15] |
| 22 | Disaster preparedness | Preparedness in the face of disasters, namely emergency plans, backup power systems, flood inspection measures and evacuation plans | [18] |
| 23 | reduction | The main procedure for disaster risk reduction | [18] |
Table 3 Resilience Measurement of the SMEs

As Figure 1 shows, the twelve Batik SMEs in Sampang have a level of resilience ranging from 2 to 4. Three SMEs at level 2, it indicates that the SMEs still have low capacity, resources, and planning in dealing with natural disasters. However, some of the SMEs have strategies in dealing with natural disaster, such as moving to a place far from the location of the flood, buying a machine to neutralize the effects of the flood.
heat so that the heat can be regulated, using alternative dyes to anticipate sudden cloudy condition, making a roofed drying place which is still exposed to wind flow, and monitoring the weather through weather forecast.

Conclusion

Catastrophic flooding due to the overflow of Kemuning River hitting Sampang every year causes a risk to the continuity of operations of SMEs. The results of this study indicate that the resilience level of SMEs to natural disasters ranges between 2 and 3, or low and medium. This information can be utilized by SMEs and local governments in planning mitigation to prevent the occurrence of higher risks to SMEs. Some independent mitigation activities carried out by SMEs can be developed and improved with the help of regional government assisted by universities in planning and implementation. Some risk mitigation strategies in dealing with natural disasters for the Batik SMEs in Sampang Regency are First, Avoiding risk by not carrying out production processes. Second, Transferring risk to third such as insurance institution for insurances of production tools, building, and human resources. Third, Exploiting risk is to reduce the likelihood of the risk occurring that will be generated more financial value, such as considering a backup system for electricity and water quality, backing up electronic data by storing data online and proposed to government to establish an interest-free or low-interest loan program for businesses to funding preparedness. Fourth, reducing risk is reducing the risk that might occur by monitoring the weather forecast through the Meteorological, Climatological, and Geophysical Agency. Joining or participating in an environmental group from the government and making a backup power system and flood inspection measures. Accept risk is the SMEs already have a high resilience so that they have a good coping effort when a disaster occurs, production activities can still be carried out as if there was no disaster.

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