

PARTICIPATORY MAPPING FOR DISASTERS IN TULUNGREJO VILLAGE, BUMIAJI SUB-DISTRICT, BATU CITY

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Abstract

The ecological situation in Batu has a significant potential disaster, one of the areas that have this is Tulungrejo village in the Bumiaji sub-district of Batu city. In general, there have been thirty-two disaster outbreaks in the Bumiaji sub-district; the area with the most disaster risk is Tulungrejo village. Therefore, as an awareness of emergency response situations, participatory mapping for disaster potential risk is essential to conduct by using the information of local people. This research applied the Participatory Geographic Information System (Pgis) as the mapping approach. The purpose of using this approach is to produce a disaster risk potential map as the reference in determining the priority of disaster risk reduction based on the information that exists in the local area. This participatory mapping is an essential part of creating the social-technical resilience by the community.

Keywords: *disaster risk, map, participatory*

INTRODUCTION

As an area located in a plateau, the foothills of Arjuna and Panderman mountains, Batu city owns various natural resources, such as Umbul Gemulo water spring, and other water spring spots. The fertile soil of the Batu region also plays an essential role in supporting the agricultural sector of the local people. Principally, the soil and water have become the primary source of income for the Batu people; there is also another economic activity to support the financial earning, such as the tourism industry that has been improving very significantly.

Nevertheless, the ecological situation in Batu also holds significant disaster potential. According to the Regional Disaster Management Authority (BPBD) of Batu, in the year 2018 occurred ninety-five natural disaster outbreaks with six fatalities, three injuries, and nineteen displaced victims. In terms of the disasters, one of the areas with a high potential risk is Tulungrejo village in the Bumiaji sub-district, Batu. In general, there were thirty-two outbreaks occurred in Bumiaji (Mastur, 2019). As an addition, in the previous year, the BPBD of Batu appointed Tulungrejo village as a disaster resilient village.

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Nevertheless, Tulungrejo, as a disaster resilient village, does not yet have a disaster risk map that consists of hazard and peril maps. Additionally, the village also has never conducted any study in assessing disaster threats, vulnerability, capacity, and risks, as seen by the local people’s point of view. Until now, all sources of disaster mapping come from the *Regional Development Planning Board of Batu city*.

Based on the explanation, this research aims at gaining accurate data on disaster issues according to the local society. The perspective of local people is the source to identify the disaster issues and potential according to the local insights. Therefore, to prepare society for the disaster potential, the data collection on disaster risk mapping based on the local people’s in-depth information is very significant.

Conceptually, two essential issues prompt to the disaster to occur; they are hazard and vulnerability. Hazard is the potential that comes from natural phenomena such as topographic slope, soil types, water resources, and other similar phenomena. On the other hand, vulnerability is the factor that comes from human interaction, such as urban planning, poverty, corruption, social mobilization, and industrialization. In other words, vulnerability is due to interaction in human life. The combination of hazard and vulnerability, will double the risk of disaster potential, also known as the crunch model. (Hansford, Dellor, & MacPherson, 2007, p. 15).

The following scheme explains the two leading causes of disaster risk:

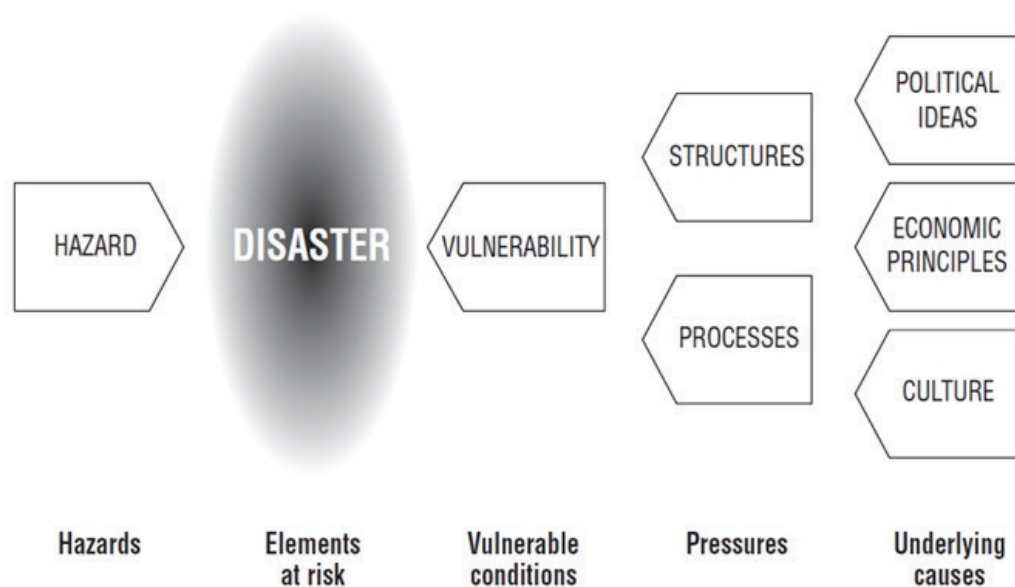


Figure 1. Crunch model scheme (Hansford, Dellor, & MacPherson, 2007, p. 15)

The above scheme shows that natural disasters may occur due to the confluence between natural and socio-cultural factors. A society with a vulnerable socio-cultural aspect will face natural phenomena in their environment. The main issue is to find out the society's readiness in facing the hazard potential. Specifically, Tulungrejo of the Bumiaji sub-district is a village with a high intensity of disaster outbreaks in the year 2018; there were thirty-two events.

Conceptually, the mapping is according to the document of Sendai Framework for Disaster Risk Reduction 2015-2030 on priority 1. The priority target is to provide an understanding of the potential of disaster risks. For this purpose, the local insights are significant to support a community's understanding of disaster risk potential. There is a high expectation that these local insights can support scientific information to reduce disaster risk potential.

“To ensure the use of traditional, indigenous and local knowledge and practices, as appropriate, to complement scientific knowledge in disaster risk assessment and the development and implementation of policies, strategies, plans and programmes of specific sectors, with a cross-sectoral approach, which should be tailored to localities and to the context” (UNISDR, 2015).

RESEARCH METHODS

There has been participatory research in Tulungrejo by using Participatory Geographic Information System (Pgis) to support the emergency management and mitigation preparation, by increasing the knowledge on disaster risk potentials. The researcher invited participants to draw their spatial living map. The P (uppercase P) and gis (geographical information system using lowercase) sign that the participatory process is more dominant than the digital geographic information. Therefore, the participants produce more mappings than the satellite image data.

Maps are essential in the process of recognizing disaster risks through the local perspective. The maps are also beneficial for the arrangement of resilient disaster policies coming from the local initiatives. There are two essential components in the mapping of disaster risk at Tulungrejo village of the Bumiaji sub-district in Batu city; they are hazard and vulnerability mappings. A combination of two mapping types resulted in the Disaster Risk map. By using the Participatory Geographic Information System (Pgis), there is an expectation of producing identification based on the perspective of the local people's insight.

This mapping involved several representatives of some groups using the Focus Group Discussion (FGD) method; they are the local government officials, Destana group, youth organization, farmer group,

tourism group, and women organizations. Therefore, the appropriate FGD strategy is very significant so that the solution can achieve its purpose; it can be through the following steps:

1. The identification of disaster risk using secondary data

The secondary data from the BPBD of Batu city is the base of FGD activity. This data becomes the general guidance to achieve data from the discussion result. Therefore, the research altogether with participants can search and do the data mapping on hazard and vulnerability sources that precipitate the disaster outbreaks. Through this identification, there is a formulation of a reaction model towards disaster risks based on the local insights potential.

2. The preparation of basic geographic map

A disaster risk map arrangement requires the original map of Tulungrejo village. Following the map preparation, there will be identification and data addition on (a) population distribution, (b) land distribution (farming, plantation, and forestry), (c) hazard points, and their types. The target groups as the research's participants are from the representatives of local government officials, BPD, BPDB of Batu city, women's organization, youth organization, religious leaders, farming group, Forest village community organization (LLMDH), Tourism Awareness Group (Pokdarwis), and the representative of Resilient Village.

3. The drawing of disaster risk

The participants must draw the basic geographic map of their village. They must consider and draw the natural hazard spreading points on the hills, watersheds, water resources, the potential cause of forest fire causes, basin area, and the tornado potential. The next step is that the participants must draw the vulnerability spreading points by identifying the areas with high population density, the poverty enclaves, public facilities, tourism spots, and other infrastructures. This drawing process is a part of the identification of vulnerability mapping, which has social, political, and cultural characteristics. This drawing process is a part of the identification of vulnerability mapping, which has social, political, and cultural characteristics.

4. The report delivery to the people and BPBD

After transforming to a digital form and undergoing the printing processes, the next process is to submit the map to the stakeholders appointed previously. This process aims at shaping a perspective that the people make the map by experience and knowledge from the local environment.

RESULT

The BPBD of Batu city has announced several villages and urban-villages to become Resilient Villages (from now on know as Destana) by referring to the regulation of the chief of BPBD number 1 the year 2012

a. Hazard Map

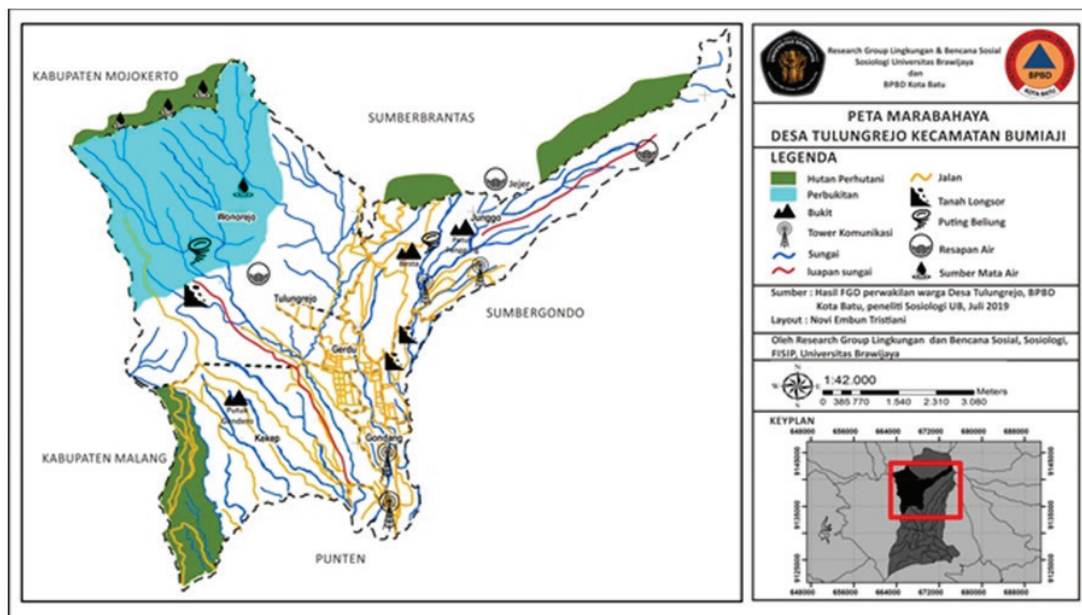


Figure 2 Hazard map of Tulungrejo village

about General Manual on Resilient Villages. The regulation contains some criteria about Destna, which include three levels; they are 1) the Main Resilient village, 2) the Intermediate Resilient village, 3) the Tertiary Resilient village. There are some indicators of Destana formation; there are legislation, planning, institutional, funding, capacity development, and disaster (Anonim, 2012). One of the success indicators for Destana, according to BNPB, is the conduct of village risk review. This activity is by measuring the values of threat, vulnerability, capacity, and disaster risk analysis (Pristiyanto, 2016). Therefore, this research requires the representatives of local people to measure the elements based on their experience daily.

The basis of the hazard map is the crunch model that suggests that disaster is the encounter of natural hazards and the socio-cultural vulnerability. The hazard in

these terms refers to a definition by Ventn and Hansford; they suggest that hazard is a situation that can prompt any loss and injuries for humans (Venton & Hansford, 2006). Not only does hazard relate to natural events, such as earthquake and volcano eruption, but also it relates to human activities, such as failures in technology and ethnic conflicts. To measure the hazard potential, in terms of time and place of occurrence, it may use the perspective of the local community. The hazard measurement can include its form, the effects, and its impact level towards the local society, and it can also measure the hazard priority level within the community (Venton & Hansford, 2006, p. 35).

The hazard mapping activities in this research used the assessment based on Venton and Hansford's measurement. The map shows the recorded hazard phenomena recorded through the insight of local people

that includes landslide and tornado. Participants also identify the hazard in terms of communication towers during the rainy season. The participants consider that the recharge area, rivers, and water source also necessary for the map content. The river overflow mixed with plantation avalanches become a hazard threat as an addition to the previous causes.

The landslide outbreaks have attracted more attention from the society because the Tulungrejo village is on the hillside that has turned many of its areas becoming farmland and plantation. The hillside as a natural landscape has now transformed into farmland and plantation area; this may also have an impact on the tornado outbreaks. Regarding rivers and water sources, the government of Batu city has massively planned it integrated with the tourism industry in the area. One of the examples is the building of Rayja Hotel nearby Gemulo water source,

which considered to become a threat to the natural resource by the local people, not only according to Tulungrejo village but also other villages in the surrounding area. The crisis due to capitalistic tourism development has, in turn, created the environmental movements (Amiruddin, 2016).

In line with the hazard map, the vulnerability map also derives from the local people’s data. The vulnerability in this map based on the local people’s daily experience. Before the formation and drawing of the map, the facilitator provides adequate information about the vulnerability to the local people. Previously, the facilitator provides information on the hazard potential, which has a strong relation with natural and human-made events. As for the vulnerability, it relates to the inability of society to anticipate any socio-cultural threats, natural and human-made. Vulnerability is “a condition or a series of situations that can reduce one’s ability

b. Vulnerability Map

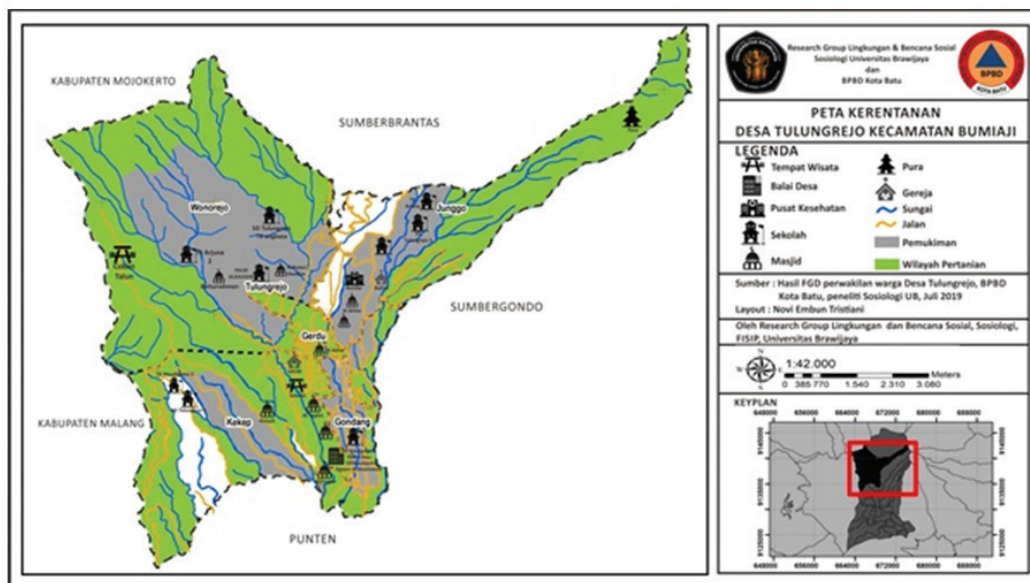


Figure 3 Vulnerability map o Tulungrejo village

c. Disaster Risk Map

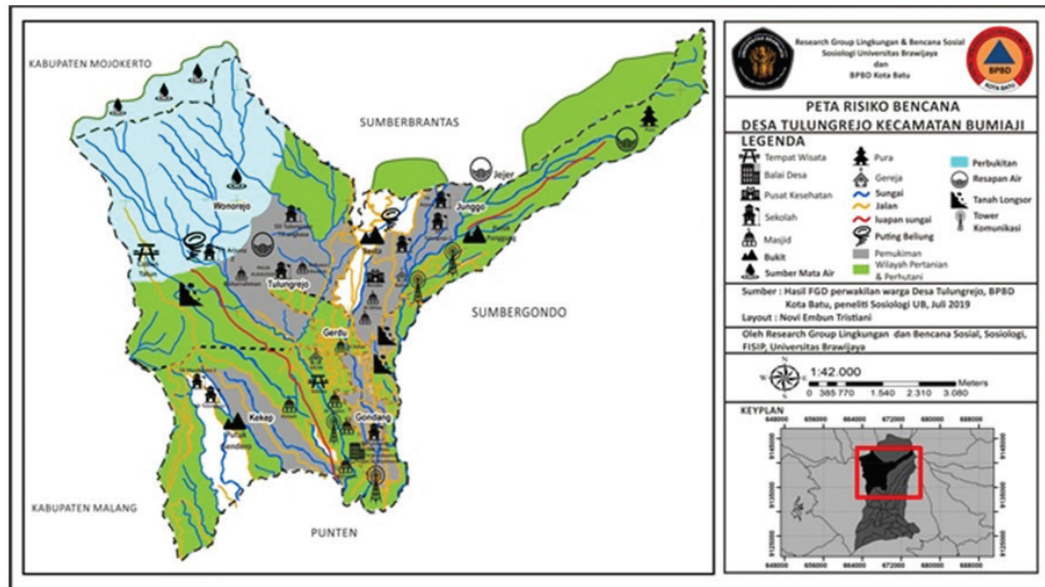


Figure 3 Disaster Risk Map of Tulungrejo village

to prepare in facing a particular hazard” (Hansford, Dellor, & MacPherson, 2007).

The combination of hazard and vulnerability maps resulted in the disaster risk map of Tulungrejo village. The hazard map, which contains both natural and human-made threats, will complete the vulnerability map with the socio-cultural deterrent. The maps compilation is to consider that the outbreaks can be as the encounter of hazard and vulnerability threats. Based on the explanation, the hazard will transform into a disaster when the people are vulnerable toward the threat (Hansford, Dellor, & MacPherson, 2007, p. 8). Hazard relates significantly with nature, while the vulnerability is more to the socio-cultural structure in the society.

DISCUSSION

This mapping model is the implementation of the ethnoscience

perspective in the disaster review. Ahimsa-Putra explains that the ethnoscience perspective tries to seek other opinions on society and their response towards the disaster risks. Through this perspective, there will be a complete and comprehensive description of the insight of the society about threats in their lives and the attempts to overcome them (Ahimsa-Putra, 2012).

The ethnoscience paradigm, as stated by Ahimsa-Putra, is a part of the integration effort of scientific findings and the insights of the local community on the Disaster Risk Reduction (DRR) using the dialogic approach model, between the researcher and the subject of the research. Although this finding is relatively new and not very easy to apply, the participatory mapping can create an integrative approach with various stakeholders (Cadag & Gaillard, 2012). The idea is in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, which is

attempting to combine and integrate the local insights and formal knowledge and science in creating the disaster risk reduction strategy.

In general, data obtained from the FGD process become the direct source for the participants to draw the map in the form of dots and shading. Each dot and shading must be different, both in terms of color and different dot. To make it easier to process the data, the facilitator must conduct data rechecking. The data rechecking can be in the form of re-questioning about the landslide and point of location. The activity aims at getting high accuracy from the data. To prevent the participants from dominating the discussion forum, the facilitator conducts the data rechecking, including the outbreaks intensity, poverty enclaves, public facilities venues, and others. In this matter, the facilitator functions to control the discussion and data validity.

Before the map drawing, the facilitator provides a brief material on the disaster issues and the causes. The purpose is to open the perception and to find out experiences among the participants. The activities take a research finding by Khan et al., as its basis; the finding is about a flood in Pakistan, which ensured that the experience and perception on the disaster risk has a significant impact on the mitigation process.

The community experience and perception of the disaster affect their readiness to face the outbreaks (Khan, Johar, & Baba, 2017). After conducting all

field processes, the next step is to digitalize the map. The map with complete shading and dots by the participants will become the object of digital photo imaging. The result of digital imaging will undergo a process using several computer software. The digitalization will transform all the shadings, and location dots become a digital image. The process also equips the map with title, scale, compass point, legend, and other related information to ease up the society in reading the map that they have produced. This process is not only about the description of how society gets a complete image of their perception concerning perils that threaten their lives and how to overcome them but also about the significance of the local insights in reducing disaster risk potential, as stated by Ahimsa- Putra (Ahimsa-Putra,2012).

The participants of this research come from several community groups. The FGD result with appointed target groups will be, expectedly, able to produce a disaster risk map for further guidance in determining the priority of disaster risk reduction. Nevertheless, this participatory hazard mapping has a time limitation about the disasters recognized by the community. McCall provides several notes about this issue; there is no time limit in the data processing result, there are no fixed criteria to find out the data validity, and no accuracy and precision on the hazard outbreaks data (McCall, 2008, p. 3). Nevertheless, despite the notes made by McCall, hazard mapping has

its characteristics that derive from the local people's perspective. A detailed and thorough control during the data collection process can reduce the issues proposed by McCall.

Besides hazardous, another significant element for the mapping is vulnerability. The vulnerability has socio-cultural characteristics, which derive from human interaction, both with other humans and with nature and its surroundings. One essential thing is that the vulnerability of one society differs from others. The rural society has different vulnerability levels and types with urban ones. Men and women have different models and levels of vulnerability among them. Poor people groups have different vulnerabilities from the wealthy groups, and so forth. This diversity also occurs in Tulungrejo village, whose society has an agricultural background and is experiencing industrial tourism threats.

The vulnerability has three layers; they are underlying causes, dynamic pressures, and unsafe conditions. The outer layer is the underlying cause, which consists of regional politics and local government policies. The dynamic pressure consists of a community's socio-economic condition, such as land ownership and infrastructure accessibility. The last one is unsafe condition which consists of unworthy housing, high density of population, the close distance between housing facility and the hills, and others (Hansford, Dellor, & MacPherson, 2007).

Venton and Hansford classify the causes of vulnerability namely (1) economic, such as poverty, the social gap between the poor and wealthy people, (2) nature, such as the community access to particular natural resources, (3) physical construction, such as land use, housing area (4) personal, such as knowledge on disaster potential, and (5) social, such as social bonds in a community (Venton & Hansford, 2006, p. 13).

From the explanation given, it is relevant that during the mapping process, the participants discuss the housing area that is near their vegetable farming more than other points. Commonly, most Tulungrejo inhabitants work in the agricultural sector. The problem is that they use previously natural forest vegetation as their farming land. In the early 2000s, based on the people's forest policy, the inhabitants started to transform the land into their vegetable plantation area. There was a change in the land use process in a massive movement for this purpose. The society understood that the transformation process of land use into the agricultural area had created the vulnerability.

From the economic point of view, several participants suffer from vulnerability due to their sole dependence on the agricultural sector—only a few people who understand and manage other sectors such as tourism. On the other hand, their housing area that is very close to farming land has the potential to cause the landslide. The Tulungrejo village that has many rivers also

affects the participants in understanding the vulnerability. Besides the housing, participants also marked several vulnerable public facilities such as community prayer places, schools, medical facilities, and village hall.

The process of participants in making the vulnerability map shows that it has a very close relationship with the socio-cultural situation that a community has. According to Venton and Hansford, a community can strive for living by relying on various elements it has, such as agriculture, housing, community bonds, and others. When each element is weak and vulnerable, the hazard can quickly threaten the area by any possible disaster risk (Venton & Hansford, 2006, p. 12). The above vulnerability image, as seen on the map, shows that risk is the description of the mechanism of a social group, by a particular political and economic authority and power, become the most vulnerable during an outbreak (Cyr, 2005).

A disaster risk map is a result of a combination of hazard and vulnerability mappings. Conceptually, the source of disaster lies in society's social structure (Quarantelli, 2005, p. 339). Therefore, natural disasters have a close connection with the socio-cultural structure of society; the outbreaks can affect the structure, and vice versa, the social, cultural structure can also affect the condition of a society and environment. The response of society in understanding the outbreaks in its surroundings indicates

the close connection between the socio-cultural structure and the disaster itself. For example, the farmer community would see the outbreak in a different perspective from the fishermen group. The community that is active in the tourism industry would view the disaster differently from the farmer group. This situation, in return, will affect the map display.

The participatory disaster risk mapping allows society groups to formulate the sociotechnical resilience process. This process significantly related to the organization and management of particular information dealing with the emergency response in a specific community (Amir, 2018, p. 10). Therefore, the participatory mapping process is a part of information management for the particular community. The sociotechnical resilience process is under the construction process independently by the community using Pgis.

The map, as a result of the FGD process, is also a projection of the local community insights; it describes the disaster risks as well as the previously occurring outbreaks. This map is an early stage of communication media for the society on the disaster according to their perspectives. The participatory mapping enables the community to draw the area with the potential of hazard and vulnerability; this can also reduce the disaster risk (Cadag & Gaillard, 2012, p. 101). Therefore, the Pgis mapping process has indirectly applied the points of Sendai Framework for Disaster Risk

Reduction 2015-2030 on priority 1. This priority aims at reproducing the local insights on the disaster outbreaks.

CONCLUSION

After the map production finished, the participants (BPBD and the inhabitant of Tulungrejo village) received a report on the mapping process and its result. This report is an essential step as a part of disaster information access. Disaster information in the participatory model aims at reducing the disaster risk in a more informative way. The participatory mapping model is a part of disaster preparedness in the community with the ecological change, notably similar to Tulungrejo village inhabitants.

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