

COMMUNITY RESPONSE TO DISASTER MITIGATION IN THE IMPACTED AREA OF MUDFLOW DISASTER

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Abstract: The impact of the mudflow disaster in Sidoarjo, Indonesia, which is still being felt by the community since 2006 until now, sets a background against which this review of disaster mitigation efforts that have been carried out so far is conducted. This study aims to find out the community response to disaster mitigation efforts that have been carried out in the hope that the programs remain evaluable, more targeted and more relevant to community needs. This research was conducted by a survey method using questionnaires and interviews and by quantitative-descriptive research data analysis. The results showed that the level of community understanding of disaster mitigation was very good, and the community participation was quite good, but the relevance of the mitigation activities conducted was felt to be still not meeting the community expectations and they have to achieve a desirable level of sustainability. Therefore, a greater level of community involvement in mitigation activities is required to create disaster preparedness and resilient villages.

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Introduction

No human being certainly hopes to be hit by natural disasters, and neither do the people who used to live in the area impacted by the Lapindo mudflow disaster in Sidoarjo, East Java Province, Indonesia. The location of this study, Sidoarjo, is actually not a disaster-prone area. Even flood had never before stricken this region. However, ever since the mudflow disaster sprouted the first time in the region in 2006 with a considerable area of impact, Sidoarjo finally is now better known as a disaster area. Even the causes of the mudflow disaster, whether they be due to natural factors or due to human negligence, are still attracting debates around the world (Schiller et al. 2008, Tingay et al. 2015, Mohsin 2017). Neither the local government institutions nor the community itself were prepared to deal with the unexpected disaster, at that time.

To date, mud and gas are still gushing out from the centre of the blast, causing the affected area to continuously expand. The impacts felt by the surrounding community range from the mudflow itself – to as it happens, land subsidence, land movement, and even cracks and spewing gas with widespread pungent and widespread odour (Agustawijaya 2017). The groundwater in this area grows murky and it stinks strongly, making it an unsuitable source of clean water (Humaida et al. 2010). As a consequence of the disaster, people are now forced to lose their homes, agricultural land, jobs, and even the historical and cultural environments.

Fundamental debates about the causes of the disasters have led to protracted community land compensation (Novenanto 2016) while the efforts to help the people affected by the disaster to recover are still very limited (Iftita and Zurinani 2018). Moreover, at that time, the Indonesian government had yet to recognize the mudflow disaster as a national disaster (Schiller et al. 2008) so the handling of victims fell on the private exploration company PT. Lapindo Brantas. Although the disaster was triggered by human negligence on the company's part, the government should still be obliged to protect its citizens by providing security for them. The government has asked some victims whose houses were flooded or affected by other conditions to take part in the resettlement programs to several locations. However, some of those who have been asked to move are reluctant and remain in their homes for various reasons, while those whose houses are not included in the impacted map developed by the government, remain in their villages and try to adapt to the changing environment.

From the results of previous studies in the impacted areas in Porong, Jabon and Tanggulangin Districts, it is known that most villages in these three districts have a medium to high level of disaster risk, but some people choose to stay in their settlements (Ekawati et al. 2020), while according to the Sidoarjo Regency (2009), this location is an uninhabitable, a disaster-prone area. The problem raised in this research is that the various disaster mitigation efforts that have been carried out – both by NGOs

and by the government – have apparently yet to meet the needs of the community, and they especially need to improve the economic condition of the community. Disaster mitigation, a series of efforts to reduce disaster risk, through physical development, awareness raising and capacity building to face the threat of disaster (President of the Republic of Indonesia 2007), is an important activity that needs to be continued. The community must be encouraged to recover from the 'trauma' of the disaster in a shorter recovery period. This aims to reduce the impacts of the disaster felt by the community.

This study investigates the response of the community to disaster mitigation activities that have been carried out since the occurrence of the Lapindo mudflow disaster to date and to compile an evaluation of these activities based on the results of interviews conducted with local respondents. The novelty of this research is a review of the importance of community response as input in the review and evaluation process of several mitigation programs that have been implemented so far by accommodating the community needs to realise community-based disaster mitigation. If Dharoko (2006) used understanding, awareness and participation as indicators of community response, this research used understanding, participation and community needs in comparison to mitigation programs that have been implemented as a manifestation of the relevance between the two. Based on the data acquired in this study, it is hoped that the disaster mitigation programs that have been carried out so far can continue to be reviewed and evaluated, more on target and more in line with community needs. Research on community response is also useful so that the community can build a better settlement environment in their villages in the future.

Literature review

Research on disaster mitigation shows that such a topic is very important and relevant both today and in the future. Chadraabal et al. (2020) conclude that early action is an important factor in reducing the damage caused by the disaster. Hu et al. (2018) suggest that climate disasters in China only encourage innovation in the field of disaster mitigation, and Iwata et al. (2014) analyzes the difference between the public and private disaster mitigation. From the number and wide coverage of flash flood events in the Mediterranean region, Stavropoulos et al. (2020) suggest that the consequences have led to global efforts to mitigate impacts before, during and after the flood event. Andreastuti et al. (2019) conducted a comparative study of the character of the community response in two volcanic crises in Indonesia. Meanwhile, Goulding et al. (2018) found that, in times of crisis, the form of community response in Japan was to utilise social networks, cultural practices and collective intervention to build back better.

Indonesia is a disaster-prone country, and it is even referred to as a disaster supermarket because it has various types of disasters. Hence, we need disaster

mitigation programs that continue to be carried out on a massive scale throughout the region. The importance of people's life safety, the efforts to reduce property damage and the limited funds of disaster management will certainly require a higher national priority for efforts to mitigate hazards, prevention and preparedness activities (Bruce et al. 1999). Especially now the numbers of disasters in Indonesia and the world tend to increase as a result of climate change (Anderson et al. 2018, Winsemius et al. 2018, Benevolenza and Derigne 2019, Zandalinas et al. 2021).

Sarwidi (2013) mentions a three-step option that can be taken as a priority to reduce the impacts of disasters: (1) humans are kept away from the sources of disasters; and/or (2) the sources of disasters are kept away from humans; and/or (3) humans live in harmony with the threat of disaster by utilising and developing knowledge, science, technology and maintaining effective local wisdom, which is logically applicable.

Because many people chose to remain in the impacted area, disaster mitigation is absolutely necessary as an effort to reduce the impact of the disasters (Ianoş et al. 2019). The community also needs to adapt to the existing conditions of vulnerability. The vulnerability itself is a potential loss (Cutter et al. 2003), but some researchers claim that vulnerability is a function of exposure, sensitivity, and adaptive capacity (Gallopín 2006, Frazier et al. 2014, Sariiffuddin et al. 2016). To reduce vulnerability, the adaptive capacity needs to be increased while mitigation activities that are in accordance with the needs of the community need to be continued to reduce the impacts of the disasters felt by the community.

Each region in Indonesia has different levels of vulnerability and types of disasters. For this reason, different ways of handling disaster preparedness and understanding are needed. Awareness of the potential and vulnerability of this disaster must be built in Indonesian society to reduce risk based on disaster mitigation education (Kastolani and Mainaki 2018). This proposal is reinforced by Preston et al. (2015) who revealed that, in education, community learning is an important feature for disaster response, especially in countries that have experienced natural disasters. Since an important element in preparing for a crisis event is community resilience and capacity (Preston et al. 2015), the community capacity needs to be improved with adequate disaster mitigation activities.

Disaster mitigation can be in the form of structural mitigation related to physical development and construction efforts as well as non-structural or non-physical mitigation (Wikantiyoso 2010, Saravanan 2016, Buchori et al. 2018), such as regional land use planning, community education/training, psychology, sociology, economics, law and so on. Disaster mitigation efforts through urban planning and design cover four aspects, namely: urban planning, architectural design, regulations in the field of urban and/or building planning & design, and the social preparation of the community. The potential use of local wisdom through understanding local

knowledge, local technology, local culture and local traditions that have been “tested” and present in people's daily lives turned out to be able to contribute to disaster mitigation (Wikantiyoso 2010). For example, through informal and traditional methods, the community is able to implement disaster management which is dominated by social mechanisms (Pratama and Sariffuddin 2018).

It is important to build and strengthen community preparedness for disasters with the application of community-based disaster risk reduction (Maarif et al. 2012). Key factors for the success of good practice in community-based disaster mitigation approaches involve the use of formal and informal community leaders and the development of related activities with the support of local disaster committees and volunteers (Victoria 2003). However, natural disaster mitigation must place an emphasis more on social rather than physical approaches, in which case these approaches are not only reactive, but they must be more proactive. In addition, the mitigation policies and programs that are made must be reviewed, evaluated and modified (Weichselgartner 2001).

Disaster preparedness will not be effective without the participation of vulnerable communities (Newport and Jawahar 2003). For this reason, it is necessary to know the community's opinions, responses to and desires for the disaster mitigation efforts that have been implemented. By definition, the response refers to the impression experienced when the incentive is removed, and in this case the response of the community can be seen through perception, attitude and participation (Gani 2014). According to Dharoko (2006), however, the community response has basic elements of understanding, awareness and participation. Setiawan and Bahri (2017) state that the response of the community takes the form of responses, reactions and answers. Meanwhile, Utami et al. (2014) and a comparative study from Preston et al. (2015) explored community learning and adaptation as a community response in disaster. This community response needs to be investigated to find out about the implementation of the disaster mitigation activities that have been designed, the level of community participation, the community's response to the activities that have been carried out, and the community's expectations of mitigation activities that are more in line with its current needs.

Methodology

This research investigating the community response to disaster mitigation in the areas impacted by the Lapindo mudflow disaster, Sidoarjo, used a survey method with primary data extracted through questionnaire (using Google Forms and paper) and in-depth interviews with the inhabitants of the study sites (Figure 1). Data analysis was carried out quantitative-explanatorily, with the results of the questionnaire in the form of scores in tables and charts being then described. Given some of respondents' low education levels, assistance was provided by the interviewers for them in filling out

the questionnaire by explaining the purpose of the questions they had to answer in the local language which was simpler and easier for the public to understand.

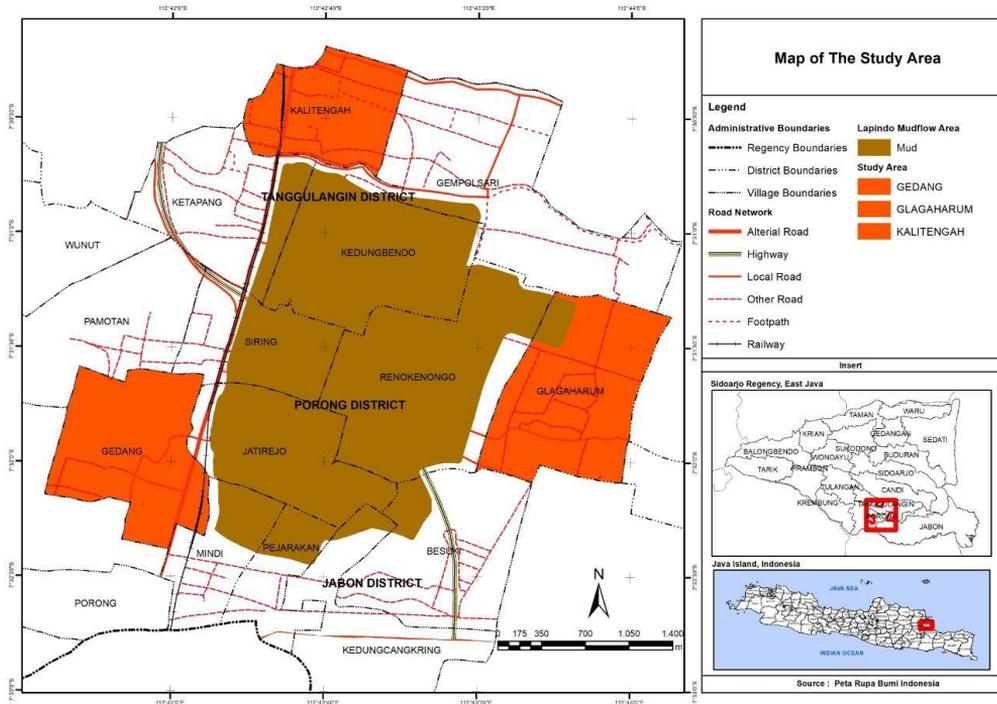


Figure 1. The study site in the area impacted by the Lapindo mudflow disaster, Sidoarjo, Indonesia
 Source: processed from Peta Rupa Bumi Indonesia (2020)

The data collected consisted of primary data from the questionnaire answered by 146 respondents in three impacted villages – Gedang and Glagaharum Villages, in Porong District, and Kalitengah Village, in Tanggulangin District, Sidoarjo. The determination of the minimum number of respondents was based on the formula: $n = \frac{N}{Nd^2 + 1}$, where n = sample size, N = population size, and d = precision (10% of the population). Using this formula, the minimum number of respondents was found to be 100 (Kalitengah Village: 55 people, Glagaharum Village: 18 people, and Gedang Village: 27 people). In terms of population, Kalitengah Village of Tanggulangin District is the most populous village. Therefore, the highest number of respondents was taken from this village (Table 1). The selected respondents were those who were still living in the mentioned villages and who were of various ages, education levels and occupations, so as to obtain diverse input responses. The research questionnaire includes the community response to the assessment of the understanding of the importance of disaster mitigation, community participation, comparison of disaster mitigation programs that have been implemented and the most needed ones, and the variety of disaster mitigation activities that have been carried out after the 2006 mudflow disaster. The respondents' answers

were then tabulated and analysed. The next stage of the analysis was to compile and to explain the respondents' responses on the disaster mitigation activities.

Table 1. Population Size and the Number of the Respondents

| Villages | Population Size in 2019 | Numbers of Planned Respondents | Σ Respondents |
|--------------------------|----------------------------|-----------------------------------|----------------------|
| Kalitengah | 12,978 | 55 | 61 |
| Glagaharum | 4,144 | 18 | 42 |
| Gedang | 6,325 | 27 | 36 |
| Another impacted village | - | - | 7 |
| Total number | 23,447 | 100 | 146 |

Source: data processed based on the Village Population Data (2020)

To strengthen the results of the study, in-depth interviews under certain topics were carried out with some of the respondents in order to figure out the rationales behind their responses. The respondents' answers were then classified in a table to make it easier to understand in relation to the topic. The results were then tabulated and analysed. The next stage was the scoring, which aimed to determine the community responses to the disaster mitigation efforts according to the respondents' perceptions.

Marfai et al. (2015) analysed the community response to flooding (in Jakarta) based on the chronology of events, perceptions on factors that heightened vulnerability and the importance of post-flood organisations/institutions. However, the indicators used to determine the response of the community to disaster mitigation in this study were adapted from the main elements of community response proposed by Dharoko (2006): (1) public understanding of disaster mitigation activities; (2) relevance of mitigation programs that have been carried out for the needs/expectations of the community; and (3) community participation in disaster mitigation activities.

Results

Reasons for the Community to stay in the Impacted Area

It is known that many non-displaced people choose to remain in the village even though the environmental conditions have changed and there is a high level of disaster risk. The results of the in-depth interviews with some community members as well as several local community leaders in the three affected sites revealed the reasons for the choice of the community to stay in their settlements as follows:

- Economically, the compensation money received by the community members is not enough to buy new houses within the same area as the houses they currently occupy.

- The already occupied houses are inherited from the parents. The compensation fund from the government is not enough to buy new homes for all heirs. The community members chose to remain in the houses that they inherited from their parents with all the risks of the impact of the mudflow disaster.
- From the socio-cultural point of view, people who have been born in the village find it difficult to adapt to new environments. Some people feel reluctant to move because they are bound by the mandate of their parents to look after the houses that they left behind. Many of the residents who have received government compensation for relocation chose to buy houses in the closest locations to their original settlement or houses in the neighbouring villages.
- In terms of transportation, some residents already feel comfortable living in their villages because of the proximity to work locations or the children's schools.

Land Use Change

Regarding the changes in land use in the three villages that became this study's sites (Figure 2), the 2005 situation shows the condition of land use before the disaster, the 2006 situation represents the condition of the land after the disaster (29 May 2006), and the 2017 situation is the most recent land use condition. It appears that in the post-disaster period 2006-2017, the area of the embankment holding mud increased very rapidly and submerged the paddy fields and the village community settlements such as those in Kedungbendo, Renokenongo, Siring, and Jatirejo Villages, and parts of Mindi and Pejarakan Villages.

Based on the data from the satellite imagery of land area changes in the area impacted by the Lapindo mudflow disaster, it was found that: the area of settlements and paddy fields decreased (Figure 3), while the area of water bodies, mud, vacant land and mud embankments increased significantly (Ekawati et al. 2020). This shows that the levels of disaster risk and vulnerability of the community settlements in the area affected by the Lapindo mudflow disaster are high and they require more attention (Ekawati and Sulistyowati 2021). Moreover, based on the 2017 situation, to the east of the mud embankment wall, there are still water bodies that have begun to inundate the locations around the community settlement in Glagaharum Village, so it is feared that the expansion of the mud embankment will be carried out again by the PPLS (the Sidoarjo Mudflow Management Center).

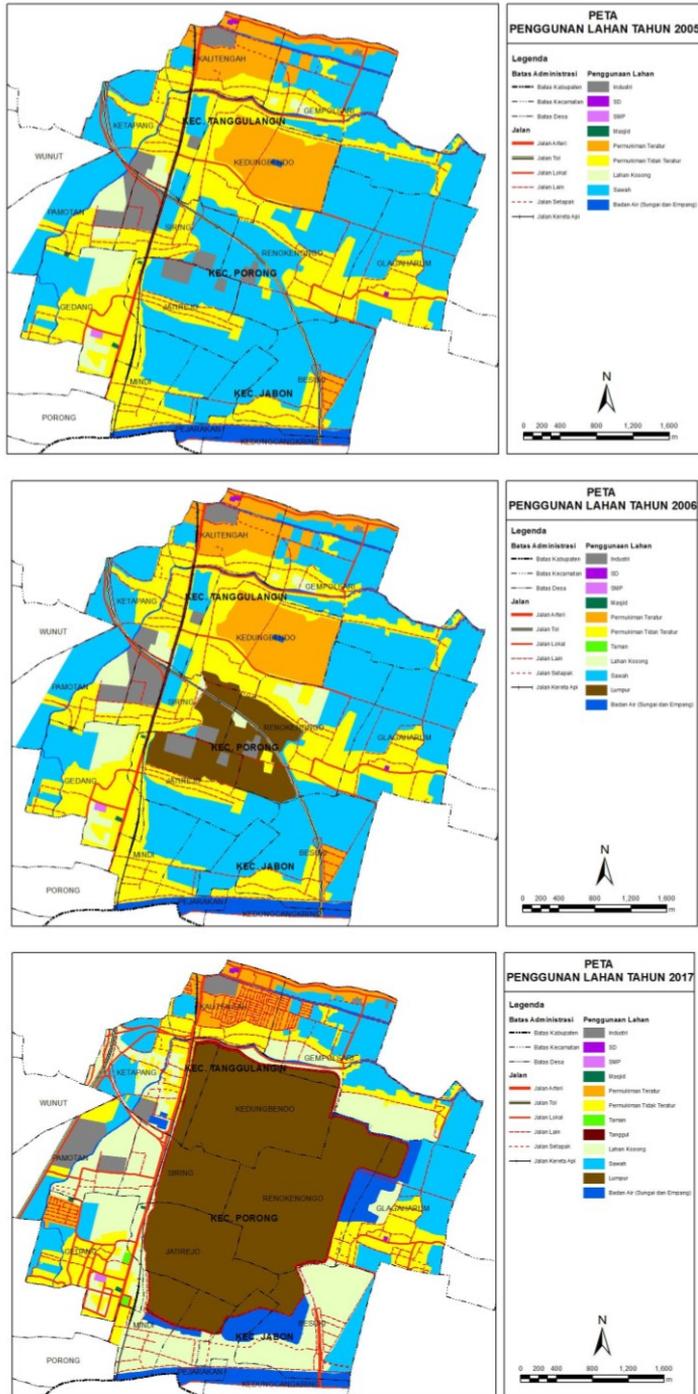


Figure 2. Land use change in the area impacted by the Lapindo mudflow disaster, Sidoarjo
 Source: data processed and interpreted from Google Earth (2020)

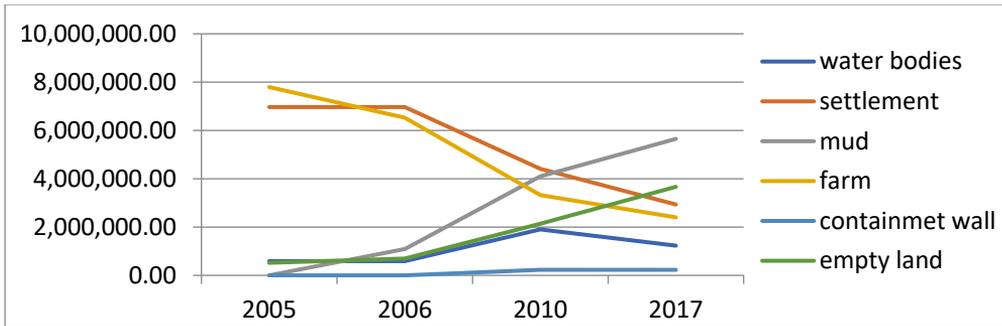


Figure 3. Changes in area of land impacted by the Lapindo mudflow disaster
 Source: data processed based on the table of land use change by Ekawati et al. (2020)

Physical, Infrastructure, Environmental, Social, Economic and Cultural Changes

The most recent field survey clearly observed that, as a result of the disaster in the community settlement area, several ancestral graves of the residents are drowned, parts of the village roads are cracked, many community settlements are damaged, and cracks in the walls and damages on the houses roofs and floors are found, but this area is still inhabited today (Figure 4). Some of the residents even live in houses that are now unfit for habitation. In the rainy season, a lot of standing water around the community settlement sites cannot flow into the ditch due to land subsidence. Well water, which is a source of clean water, has also blackened in several locations so it cannot be used for daily needs. From the results of the interviews, it was revealed that the community members do not have enough funds to renovate their houses. Another impression that can be felt immediately in the affected area is the gas odour that is very strong and it disturbs breathing in almost all locations. Some residents even stated that their health is affected by this gas smell every day. Moreover, the air temperature is also felt to have increased after the disaster.

The economic changes as a result of the mudflow disaster are also concerning. Many residents are forced to lose their jobs because many factories and agricultural land in the location are submerged in the mud, and the regional economy in East Java Province was in shock (Schiller et al. 2008). Several respondents admitted that their income has decreased since the disaster. Meanwhile, it is difficult for people to switch to other jobs because of their limited education and skills.

In the social sector, there was a social crisis at first because many people disagreed on the compensation for their properties which were impacted by the mudflow disaster (Farida 2014, Elika et al. 2017). However, based on the observation of the researchers at the analysed locations and the interviews with some respondents, the social relations of the community are currently very good as the family ties and communication between the residents have always been excellent.

(a)



(b)



Glagaharum , Porong - Sidoarjo

(c)



Glagaharum , Porong - Sidoarjo

(d)



Figure 4. The impact of the Lapindo mudflow disaster on community settlements
Note: (a), (b), (c) – some houses in a damaged condition are still in use as dwellings;
(d) – the mosque in Glagaharum Village affected by land subsidence.

Source: author's documentation (2020)

Meanwhile, in the field of culture and religion, people in the area affected by the mud disaster still maintain the cultural and religious events that were routinely carried out by their elders such as the rituals of nyekar (a tradition of putting flowers to somebody's grave), which is held every year at the beginning and the end of the month of Ramadhan, istighosah (praying together), kenduren, selamatan and others (Ekawati 2018).

Community Understanding of the Importance of Disaster Mitigation

From the results of the questionnaire, it was figured out that only 48.6% of the 146 respondents feel the impacts of the existing disaster mitigation programs so far, while the other 51.4% either have not considered or do not consider that the disaster

mitigation programs have touched their needs. This shows that most people feel that the disaster mitigation activities have not been optimal or they have not approached their specific needs. Through the interviews, some respondents stated that mitigation activities were only carried out at the outset of the post-disaster period and after that disaster mitigation activities in their villages ceased from being conducted.

From the community's assessment of the importance of disaster mitigation, it was found that almost all the respondents consider disaster mitigation as very important: 73 people (50%) consider it as very important, and 67 people (45.9%) as important (Figure 5). Thus, it can be said that the community has a good understanding of the importance of disaster mitigation, with an average score of 4.42 of the maximum 5. The community is in grave need of a sustainable disaster mitigation program because, until now, the impact of the mudflow disaster is still felt.

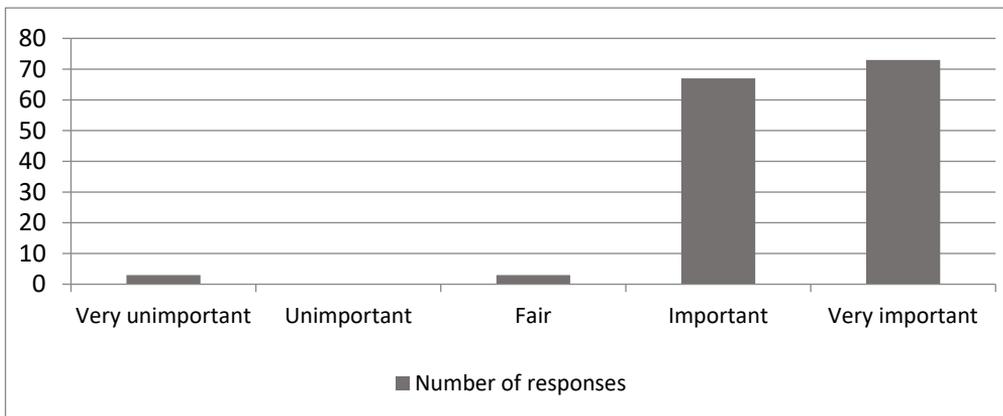


Figure 5. The importance of disaster mitigation from the community's perspectives in the impacted area of the Lapindo mudflow Disaster, Sidoarjo. Source: data processed from questionnaires

The Relevance of the Disaster Mitigation Program

An illustration of the community's response to the existing disaster mitigation programs and the community's most needed disaster mitigation programs (Figure 6) shows that the existing programs and the needed programs have almost the same distribution of answers. This shows that the existing mitigation activities are of relatively good relevance, but they still do not answer the community's needs. Many respondents hope that the mitigation programs improve in terms of quality and quantity and they better touch the needs of the community. Regarding the disaster mitigation activities, the respondents were given the freedom to choose more than one answer because one person may need more than one type of activities. Therefore, it is seen that the number of response items to the most needed mitigation activities per answer becomes higher.

Programs in the economic sector are the programs most needed by the community, with 109 respondents (74.7%) choosing them. Disasters are indeed very detrimental to society, due to both loss or damage to physical property, the environment and infrastructure, and damage to non-physical sectors such as the economic, social, and cultural-religious sectors. Many people have lost their rice field, which is a source of family income, making the economy difficult. However, their ability and opportunity to switch to other jobs are low.

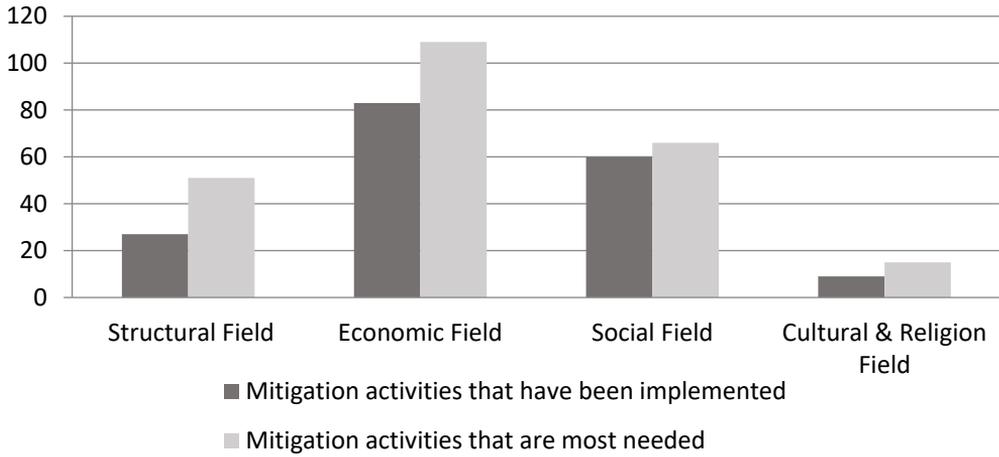


Figure 6. Community response to disaster mitigation activities in the impacted area of the Lapindo mudflow disaster, Sidoarjo. Source: data processed from questionnaires

The consequences of the post-disaster physical damage are often more important than the damage itself. Damage to the infrastructure of production facilities puts pressure on the economy (Coburn et al. 1994). Thus, mitigation also requires economic protection against disasters. Community economic empowerment needs to be prioritised with life skills training integrated with disaster mitigation programs (Sulistiyowati and Ekawati 2021).

Programs in the social sector are also highly needed by the community, as shown by the response from 66 respondents (45.2%). Meanwhile, mitigation in the structural or technical fields is needed by 51 respondents (34.9%). The fulfilment of this need is possible because mitigation in the structural sector is considered to be the full responsibility of the government and so far, the structural and technical mitigation programs have been running quite well (Figure 7). Mitigation in the field of culture and religion is needed by as many as 15 respondents (10.3%). Although not many people consider the cultural-religious field as part of the disaster mitigation efforts, some feel that cultural and religious activities are still needed to strengthen their mentality in facing disasters.



Figure 7. Disaster mitigation in areas impacted by the Lapindo mudflow disaster
 Note: (a) heavy equipment – alerted in mud embankment to dredge mud; (b) disposal of water to the Porong River; (c) elevation of mud embankment walls by means of heavy equipment.
 Source: author’s documentation (2020)

Participation and Evaluation of the Disaster Mitigation Program

Community participation in disaster mitigation activities plays a very important role (Table 2). It is one of the positive responses from the community in disaster mitigation programs, both initiated by the government, NGOs and community initiatives themselves.

Table 2. Community Participation and Evaluation of Disaster Mitigation Activities

| Sector | Government | Community | Review & Evaluation |
|--|--|--|--|
| Physical, environment & infrastructure | <ul style="list-style-type: none"> • Construction of mud embankments, dredging of silt, disposal of mud into the Porong River, provision of pump houses • Repair of roads, bridges, channels and other infrastructure pieces • Provision of clean water and water distillation training | <ul style="list-style-type: none"> • Some community members reject the construction of mud embankments for fear of water seepage • Maintain environmental cleanliness by not littering • Making local rules: communities are prohibited from drilling new wells • Make a proposal to plant trembesi trees (<i>Samanea saman</i>) to reduce the impact of gas | <ul style="list-style-type: none"> • Community members and leaders should be involved and assisted in improving understanding of the benefits of each of the mitigation activities initiated by the government • The government should provide village funds and involve the community members for them to gain income • The implementation of the water distillation program is not well mastered, requiring more intensive training • The government should immediately respond to community proposals |

| Sector | Government | Community | Review & Evaluation |
|------------------|---|--|--|
| Economy | <ul style="list-style-type: none"> • Catfish farming training • Training in making bag crafts and products from waste recycling | <ul style="list-style-type: none"> • Participate and try to run a catfish pond business • Participate in training but with lacking skills and capital to start a business • Establish savings & loan cooperatives for emergency funds | <ul style="list-style-type: none"> • The training's intensiveness should be increased to enable people to work independently • The training should be increased in variety and be held continuously • There should be a venture capital assistance from the government to improve the community's economy |
| Social | | <ul style="list-style-type: none"> • Community work together ("gotong royong") to clean the environments and the channels around the settlements • Establish social community organisations to handle disaster mitigation activities | <ul style="list-style-type: none"> • Gotong royong activities should be encouraged for cleaner environments • The community leaders (formal or informal) should be given greater empowerment to increase disaster mitigation popularity with the community |
| Culture-religion | | <ul style="list-style-type: none"> • The community performs prayers and grave pilgrimages regularly | <ul style="list-style-type: none"> • This activity should be held more intensively to promote a culture of safety and resilience to disasters and to strengthen the mentality of those who face disasters |

Source: analysis based on questionnaires and in-depth interviews

Discussion

Disaster management is largely incidental. The community and government agencies only provide assistance at the beginning of the disaster, but then they have left the victims who are trying to overcome their own socio-economic problems (Bahransyaf 2009). Funds and goods are only used to alleviate the suffering of victims for the moment although disaster mitigation needs to be done before, during and after a disaster (Stavropoulos et al. 2020). To help people deal with disasters, empowerment is also needed. Empowering communities by internalising disaster risk reduction tools and methods is a good way to deal with potential risks in the future (Asian Disaster Preparedness Center 2008). Therefore, community skills training as one of disaster mitigation activities needs to be carried out continuously.

Community-based disaster mitigation programs are the development of mitigation policies in consultation with local groups or communities, such as the formation of community organisations with outside technical assistance. This program is considered more likely to produce actions that are more responsive to the needs of the community, so that the community can also actively participate in building awareness of the dangers to be faced and to be able to protect itself in the future (Coburn et al. 1994). Goulding et al. (2018) found that, as a community response, Japanese people make better use of social networks, culture and interventions to build their territory – community-based disaster mitigation in Japan can be a lesson for people living in disaster-prone locations such as Sidoarjo to explore and develop local wisdom potentials such as informal and traditional methods as a new culture for the community in facing possible disasters in the future (Pratama and Sariffuddin 2018).

From the results of the research on community understanding of the importance of disaster mitigation, an average score of 4.42 was obtained. In other words, 95.9% of the respondents were found to consider disaster mitigation as important and very important. This shows that the level of community understanding of the importance of disaster mitigation is very good. The high understanding of the community is certainly very encouraging and it becomes a very useful capital to develop disaster-resilient villages (Maarif et al. 2012). Disaster mitigation is an indispensable effort to reduce the impacts of disasters such as damage to people's lives and properties, given that many people choose to remain in villages that now have high vulnerability to disasters. National priority should be taken for efforts to mitigate hazards, prevention and preparedness activities, given the limited costs of disaster management. As Chadraabal et al. (2020) remind, early action is an important factor in reducing the damage caused by a disaster.

The relevance of the existing mitigation activities with the needs of the community in general is quite good. However, the community feels that the activities were not sustainable and they were only carried out at the outset of the post-disaster period. The community still hopes that these activities continue to be carried out and they have a certain degree of sustainability so that they can really improve the economic situation of some people who lost their jobs after the disaster. However, the damage to infrastructure and property will also put some more pressure on the local economy (Coburn et al. 1994).

Utilising traditional organisational structures and mechanisms (such as formal and informal community figures) is one of the key factors of success in a community-based disaster mitigation approach (Victoria 2003). A fairly good level of community participation is the main capital for the success of disaster mitigation, but it requires all possible resources to make it sustainable (Newport and Jawahar 2003). The authors agree with Maarif et al. (2012) that the community should be a key actor who plans,

designs, acts, monitors, and evaluates mitigation activities as a disaster risk reduction effort, so that these mitigation activities will continue to be sustainable according to the community needs.

Specifically, for mitigation in the physical and infrastructure sectors, the community does not participate much because it had initially been handled by the BPLS (Sidoarjo Mud Control Agency) and now it is handled by the government-formed PPLS (Sidoarjo Mud Control Center). However, community involvement is still required to some degree to discuss the mitigation programs that are planned and will be carried out, regarding their objectives, impacts, benefits and so on. With intense communication between the government and the community, all obstacles in the efforts to reduce the impact of disasters can be prevented. In accordance with Hu et al. (2018) that disasters in China encourage community innovation in the field of disaster mitigation, community-based mitigation in the study area can trigger community innovation and form a new culture in the field of awareness of hazards that can lead to environmental disasters.

It is known that disaster mitigation encompasses structural and non-structural sectors (Wikantiyoso 2010, Saravanan 2016, Buchori et al. 2018). Therefore, the community response in the study area which reveals that mitigation efforts in the non-structural sector in their villages were only carried out at the beginning of the post-disaster phase needs to be followed up properly by the government. Non-structural disaster mitigation is equally important. Community members whose income has decreased, or who have even lost their livelihoods due to the disaster, of course, need additional income or new livelihoods. The data from the research results showed that, according to the community response, the most needed disaster mitigation activities today are those in the economic and social fields, whereas mitigation in the structural field is the third most needed.

An interesting finding in this research is people's recognition of the need for disaster mitigation in the cultural and religious activities as part of the most needed disaster mitigation activities. Although the percentage of those who respond this way was not significant, the implementation of disaster mitigation through education (Kastolani and Mainaki 2018) and the initiation of disaster resilient villages (Maarif et al. 2012) in the cultural and religious fields would certainly be more easily accepted by the community as it was the case of the Japanese people who use their social networks and cultural practice to build their region for the better (Goulding et al. 2018).

Indonesia is a multi-ethnic country with more than 1000 ethnic groups and 650 languages. Each region has its own culture, religions, beliefs, and local wisdom in responding to the disasters that occur there. It was revealed in research on the community response character at two volcanic disasters in Indonesia that two communities have different response characters because they have a different local

culture (Andreastuti et al. 2019). Religion, which is part of culture, also needs to be considered in disaster mitigation (Andreastuti et al. 2019). The authors of this study do not agree that religion is considered part of culture, however. Religious activities can be part of culture in society, but that does not mean that religion itself is part of culture. However, in relation to disaster mitigation, the authors agree that religious and cultural activities need to be considered as part of disaster mitigation because they can increase the adaptive capacity of the community to disasters that occur in its area.

If vulnerability is built by three things, namely a function of exposure level, sensitivity and adaptive capacity (Gallopín 2006, Frazier et al. 2014, Sariffuddin et al. 2016), then to reduce the level of vulnerability it is necessary to increase the adaptive capacity of the community and institutions in the village to the centre. It is realised that culture and religion are very useful in an effort to increase the adaptive capacity of the community and in directing the people's actions and the understanding of disasters. Therefore, the role of religious and community leaders is needed so that people are better able to think positively and to build themselves to increase their capacity in preparing for future disasters. Approaches to disaster mitigation should be carried out with more proactive measures. However, as stated by Weichselgartner (2001), the government needs to continue to review, evaluate and modify the mitigation policies and programs that are made to better suit the needs of the community.

Conclusions

From the above description it can be concluded that the community response related to the understanding of mitigation is very good so that the community can help to evaluate the disaster mitigation activities that have been carried out and to propose some of the activities most needed by the community. The response about the relevance of mitigation activities has been distributed quite well, but the respondents argued that mitigation activities still did not meet their expectations, especially in terms of community economic empowerment. Fairly good public participation in disaster mitigation activities should be appreciated, in which case it serves as excellent capital for the success of mitigation activities. The community expects that skills training activities for economic empowerment to not only be carried out in the initial period of a disaster, but also to be continued into the future.

Through a study conducted to understand the community's response to disaster mitigation that has been implemented in this study area, it is possible to understand the character, needs and expectations of the local community, which currently needs more economic improvement to survive in the disaster-affected residential areas. With this understanding, more intense communication, better coordination and collaboration between the community and the government together in reducing the impacts of disasters in the future can improve. Education on disaster mitigation for the

community through cultural and religious activities as well as the socialisation of disaster resilient villages can involve community leaders, both religious leaders and formal and informal figures who are more familiar with the characteristics and culture of the local community. This method can inspire disaster management in other areas that have their own unique characteristics and culture.

The recommendations from the disaster mitigation activities in the area impacted by the Lapindo mudflow disaster for structural mitigation activities are that the government needs to involve local community members and leaders (both formal and informal) and to be given an explanation in order to better understand the objectives and the benefits of each mitigation activity undertaken, and that more intense communication is needed between the government and the community to ensure that disaster mitigation activities are in accordance with the needs and expectations of the community.

Recommendations in the economic mitigation sector are that the community needs to be given an introduction to entrepreneurship (with various training and business assistance) and venture capital assistance so that people who lose their jobs can start earning income and without being dependent on outside financial assistance. Economic empowerment will increase the capacity and preparedness of the community in facing future disaster risks.

In other sectors, the government needs to quickly respond to relevant community proposals such as the proposal to plant trembesi trees (*Samanea saman*) around residential areas to improve the quality of the air which is polluted with gas bursts in the impacted area. The government also needs to support the mitigation activities in the social and cultural-religious fields initiated by the community to strengthen its mental preparedness and resilience in the face of disasters. In addition, the community needs to be encouraged to become a key actor who plans, designs, acts, monitors and evaluates the mitigation activities (community-based disaster mitigation) in a disaster risk reduction effort for developing a disaster resilient village.

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