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Do Disaster Literacy and Mitigation Policy Affect Residents Resettling in Tsunami Prone Areas? Study from the City of Banda Aceh, Indonesia

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Abstract

It has been a decade and a half since the tsunami struck Aceh in 2004. Half of the city of Banda Aceh was destroyed. However, this tsunami-prone area has regained population density with households and communities growing despite the efforts of the local government to socialize disaster literacy and mitigation policy. Have these policies affected people in their decision to resettle in this disaster-prone area? This is the issue considered in this study. It aims to examine and analyse the impact of disaster literacy and mitigation policies on residents' decision to occupy a post-disaster area in Banda Aceh. This study employs a quantitative approach. It utilises random sampling. A set of questionnaires were distributed among 225 samples (households) across 5 sub-districts in the tsunami red-zone area. These questionnaires have been analysed using SPSS, employing a multiple linear regression technique. The outcome indicated that disaster literacy had a significant positive affect (p value=0.000, β=0.410), while the mitigation policies were not statistically significant for residents' decisions to resettle in disaster-prone areas. As the tsunami area remains vulnerable, a resulting policy recommendation is for the local government to be more active in disseminating its mitigation policies, and in helping residents to develop a fuller understanding of them (including implications of the disaster risk index and the disaster risk map). This would help achieve and put into practice the objectives of the mitigation policies.

Keywords: Disaster literacy, mitigation policy, disaster risk map and disaster risk index

1. Introduction

Banda Aceh is the area in Indonesia hit hardest by the tsunami disaster which occurred in 2004. More than two hundred-thousand lives were lost, and thousands of people were left with severe injuries. In addition, many public facilities were damaged by the catastrophe. This level of destruction could only occur because the area is located between two faults (east - north and west - south), both of which are active faults (BPBD, 2017). Banda Aceh is thus considered as one of the areas with a high risk of a tsunami disaster (BPBA, 2015).

After the disaster, the government issued several mitigation policies to guard against the possibility of a future tsunami causing a large number of casualties in this vulnerable area. Through the Agency for Reconstruction and Rehabilitation (BRR), the government issued a master plan for re-the development of Aceh in mid-2005, heavily emphasizing the development of coastal areas. This institution divided the area into 5 zones. Zones 1, 2 and 3 are areas with limited development. House construction is permitted in zone 4, and zone 5 is set aside as a conservation area (BRR, 2005).

Coastal zoning is used to restrict development in areas at significant risk of tsunami inundation (Goltz and Yamori, 2020; Herrmann, 2013). In zone 1, Coastal

land use planning also plays an essential part in minimizing coastal hazards (e.g. tsunami) impact (Widianto & Damen, 2014). It forms a part of the mitigation strategy for coastal area protection, which aims to preserve coastal resources and to protect people living in those areas (Mardiatno *et al*., 2017).

A zoning policy was also issued by the city government (municipality of Banda Aceh) through *Qanun* (Regional Act) No. 4 of 2009, regarding Spatial Design and the Region (RTRW) of Banda Aceh for the years 2009-2029 (Pemerintah Kota Banda Aceh, 2009). Article 55, paragraph 5 states that the northern area of Banda Aceh, the main area impacted by the disaster, including Jaya Baru, Meuraxa, Kuta Raja, Kuta Alam and Syiah Kuala Districts, are to be areas with low-density housing developments.

Furthermore, in 2016, a tsunami disaster mitigation policy has been issued by the Aceh government's Disaster Management Agency (BNPB, 2016) in two parts i.e. a tsunami risk map and a tsunami risk index. The tsunami risk map shows levels of risk from low to high and highlights the areas with a particular need for additional evacuation capacity (Strunz *et al*., 2011). The risk map is designed to generate extensive geo-information to help government respond to natural disasters by making informed decisions that lead to better protection of citizens, reduced damage to property, and improved monitoring of these disasters (Brandova *et al*., 2012).

In addition, the municipality of Banda Aceh has also made changes to this zoning policy as stipulated in *Qanun* No. 2 of 2018 in which it issued a tsunami risk map, by dividing the area into 3 zones, colour-coded red, yellow and green. Most of the areas fall into the red zone - an area at high-risk of a tsunami disaster. This is clearly seen from the Risk Map issued by the municipal government in 2017. According to Sambah and Miura (2019), there are two goals for tsunami risk mapping i.e. first to reduce the effect of a tsunami on the coastal area where the population is dense, by generating a good mitigation plan and defining the priority area that needs to be first evacuated when a tsunami does hit. Similarly, Shigenobu *et al.* (2008) emphasized that the tsunami risk map is one of the effective tools in communicating tsunami disaster risk across society to encourage the development of sustainable high levels of awareness and preparedness.

If the tsunami risk map tried to designate post-disaster locations based on vulnerable status by measures such as implementing the zoning system, the tsunami risk index attempted to measure locations' vulnerabilities and risk-related aspects using quantitative or qualitative indicators (Carreno *et al.,* 2007). These mitigation policies were launched as part of the 2015-2019 Disaster Management Policy and Strategy (JAKTRA PB)(BNPB, 2016), with all regions assessed as having a potential for disaster across all provinces in Indonesia being included

In this document, Banda Aceh is considered as a high tsunami risk index area compared to other regions in Aceh. Based on the index showing the tsunami risk for 136 cities in Indonesia collated in 2016 by the National Disaster Management Agency (BNPB) the disaster index risk for Banda Aceh was calculated as being at a high level (167.2) which brings with it implications for residents of Banda Aceh; they need to be aware of the need for resettlement.

However, these disaster-prone areas are currently full of houses, which is not in line with the government's efforts to reduce the risk of recurring tsunami disaster, articulated for example in the Public Works Service Agency 's statement (Dinas Pekerjaan Umum) that development should be directed to areas lying to the south of Banda Aceh such as Lueng Bata, Batoh and Ulee Kareng (PU, 2015).

The research by Akbar and Ma`arif (2014) asserted that there is a mismatch between policy and conditions in the field, where the research found that the establishment of settlements tends to increase in the northern areas of Banda Aceh, near the Malaccan Strait. After the tsunami, this disaster area was re-inhabited, being settled by both tsunami victims and non-

victims.

From a disaster point of view, an important factor in residents' decisions about living in a disaster area is their level of disaster literacy. Tsunami disaster literacy could take the form of basic knowledge about the disaster itself and about its impact and evacuation procedures. According to Torani *et al.* (2019), disaster education aims to disseminate knowledge among individuals and groups to help them take action to reduce their vulnerability to disasters. Based on their finding, they claim that disaster education is a functional, operational, and cost-effective tool for risk management. However, disaster-vulnerable groups should be identified, and special training should be adopted for these people accordingly. Therefore, disaster literacy is an important element not only in improving disaster awareness but also in mitigating the level of destruction, as can be seen from the lesson of regional government's efforts in disaster mitigation (Danugroho *et al.,* 2020).

As in the case of the population of Aceh in particular, the level of tsunami disaster literacy of people of Banda Aceh as a whole is quite adequate as shown by a study by Febriana *et al.* (2015), and Syamsidik *et al.* (2019). It is reasonable to hope that this may increase the ability of residents to prepare for and be protected against tsunami disasters in the future. Similar results were also found by Marlyono (2017) in a study of the role of disaster information literacy in West Java; such literacy has a significant effect on community disaster preparedness.

Furthermore, this study also raises questions about implementation of mitigation policy factors derived from the Disaster Risk Index and the Disaster Risk Map affecting communities living in a tsunami-prone area. Many researchers agree that local government can implement mitigation policy because they have regulatory powers to impose these measures which can directly influence society (Peacock & Husein 2011; Godschalk *et al.*, 1998; Schwab *et al.*, 2016). In the case of Aceh, the mitigation policy that was issued by the government several years ago should be one of the principles considered by the community, since the aim of the policy is to reduce the risk of disasters happening in the future. However, the level of reduced risk will be much different if residents do not comprehend the objectives of the policy, so that these objectives cannot be achieved fully. Studies of the understanding of mitigation policies by communities living in the tsunami red zone are rarely found in previous literature, and for this reason, this study will add something new to the literature. For the purpose of this study, the Disaster Risk Index and Disaster Risk Map are combined into one variable i.e., mitigation policy factors.

It is feared that the increase in residents' settlements in the red zone area will trigger high casualties due to this area's proximity to the shoreline. Elevation is a factor as well as proximity. Low-lying areas at or below sea-level also experience large numbers of casualties because there the tsunami reaches quite far inland (Triatmadja, 2011). Therefore, the effects of disaster literacy and mitigation policy factors are all the more dramatically seen here. a disaster risk index and a disaster risk map are vital tools whose potential for informing the framing of policy and the strategy for its dissemination must be investigated. These resources and questions about them are therefore included in the current study.

2. Research Method

This study aims to analyze the disaster literacy and mitigation policies affecting residents living in tsunami-prone areas, post-disaster. The research has employed a quantitative methodology in which facts are collected from respondents using a close-ended questionnaire comprising a number of questions and a structured-interview. The study area is a red zone tsunami disaster area in Banda Aceh. The population of this study is householders (HH) residing in villages located in the red zone in five districts: Jaya Baru, Meuraxa, Kuta Raja, Kuta Alam and Syiah Kuala. The distribution of population by district can be seen in Figure 1.

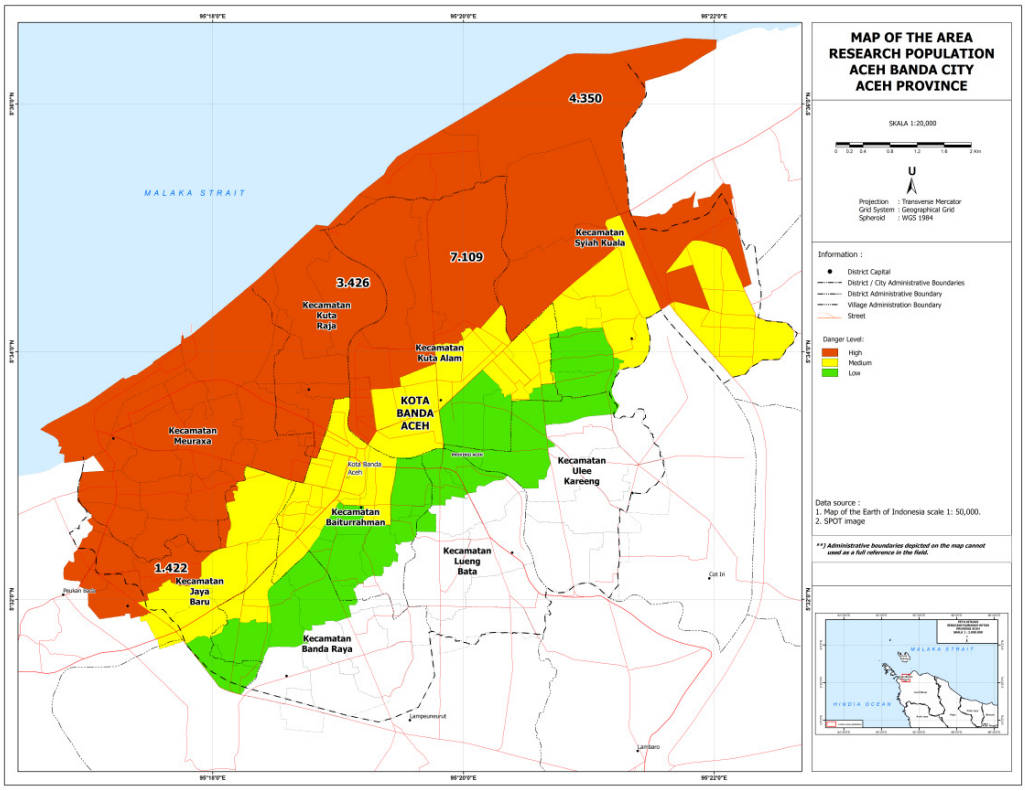

Figure 1. Population area map.

Source: (Redraw by author based on Administrative Banda Aceh City Map)

Table 1. Distribution of population by district.

No	District	Villages	Total of Household
1	Jaya Baru	Ulee Pata, Lamjamee, Lampoh Daya and Bitai.	1422
2	Meuraksa	Pie, Surien, Lambung, Blang Oi, Lamjabat, Ulee Lheue, Asoe Nanggroe, Lampaseh Aceh, Punge Ujong, Alue Deah Teungoh, Deah Baro, Gampong Blang, Gampong Baro and Cot Lamkuweuh.	5653
3	Kuta Raja	Peulanggahan, Keudah, Merduati, Kampung Jawa and Kampung Pande.	3426
4	Kuta Alam	Peunayong, Kampung Mulia, Lamdingin, Lampulo and Lambaro Skep.	7109
5	Syiah Kuala	Alue Naga, Deah Raya, Jeulingke, Tibang and Rukoh.	4350
Total of Population			21960

Source: BPS, 2018

As can be seen from Table 1, the population of this study is 21,960 households living in the five districts of Jaya Baru (4 villages: 1422 residents), Meuraksa (14 villages: 5653 residents), Kuta Raja (6 villages: 3426 residents), Kuta Alam (5 villages: 7109 residents) and Syiah Kuala (5 villages: 4350 residents).

Table 2. Distribution of samples per district.

No	The red zone district	No of HH	% sample	Selected Sample
1	Jaya Baru	1422	(1422/21960)*100% = 6.7% of 255	17
2	Meuraxa	5653	(5653/21960)*100% = 25.1% of 255	64
3	Kuta Raja	3426	(3426/21960)*100% = 15.7% of 255	40
4	Kuta Alam	7109	(7109/21960)*100% = 32.2% of 255	82
5	Syiah Kuala	4350	(4350/21960)*100% = 20.4% of 255	52
	Total HH	21960	100%	255

Source: Data Analysis

The sample has been chosen using a simple random technique, quota sampling. It consisted of 255 householders resettling in the red-zone area. The sample meets the following criteria: he or she resides in the tsunami red zone area of the Municipality of Banda Aceh and is the head of the family, either a husband or a wife. Table 2 presents the number of samples in every district.

2.1. Data collection method

In this study, researchers used a Likert scale with an interval scale approach. The Likert scale is a scale that can be used to measure a person's social attitudes, opinions, and perceptions in which the variables to be measured are described as variable indicators. These indicators are then used as a starting point for arranging instrument items which can be statements or questions (Sugiyono, 2015) (Table 3).

Table 3. Measurement scale.

Measurement Scale	Value
1	Strongly Disagree
2	Disagree
3	Undecided
4	Agree
5	Strongly Agree

Source: Sugiyono, 2015

The variable indicators for disaster literacy include knowledge and awareness of tsunami disasters (Priyowidodo & Luik, 2013), information on tsunami disasters (Marlyono, 2017), an understanding of the dangers of the surrounding environment, early warning systems, evacuation rates, and disaster mitigations (BNPB, 2012). Meanwhile, the variable indicators for mitigation policy are, among other things, the availability and intelligibility of information, levels of understanding of the disaster risk index and the disaster risk map, and whether the disaster affected a decision to stay in the disaster-prone area (BNPB, 2016).

2.2. Analysis Method

Multiple regression models are employed to perform analysis. Two independent variables, tsunami disaster literacy and mitigation policy, will be examined against the decisions of residents to resettle in a disaster-prone area as the dependent variable. All variables have been measured using a Likert-scale questionnaire (ranged 1 to 5).

Data analysis employed multiple linear regressions, and thus the equation model is as follows:

$$Y = \alpha+\beta_1X_1+ \beta_2X_2 + e \quad (1)$$

Or

$$Dec = \alpha+\beta_1DL + \beta_2MP + e \quad (2)$$

In which

Dec (Y) = Decision to inhabit tsunami area
α = Constanta (value Y if X=0)
β = Coefficient regression
DL = Disaster Literacy Factor
MP = Mitigation Policy (Risk Index and Risk Maps)
e = *Error term*

3. Results

Descriptive respondent profiles of samples living in the tsunami red zone are defined based on gender, age, educational background, type of occupation, income range, number of dependents, village of origin, length of stay, and house's status.

The description of the characteristics of the 255 respondents can be summarised as follows; there are 123 male respondents (48.2%) and 132 female respondents (51.8%), while the majority of respondents' ages falls in the range of 25-40 years old (48.6%). In terms of educational background, respondents mostly come from the diploma and graduate group (50.2%), which indicates that more than half of the total respondents are well educated. In terms of occupation, most respondents own their own businesses (38.8%), as can be seen from Figure 2 below.

When we turn to the number of dependents, we find that more than 50% (140 respondents) have a family of between 4-6 dependents. The data concerning region of origin show that 60% of the respondents came from the disaster area. In terms of the length of their stay, more than 50% had occupied the area for more than 10 years. Finally, 57% of respondents own their own houses, either having inherited them or purchased them themselves, as can be seem from Table 4 below.

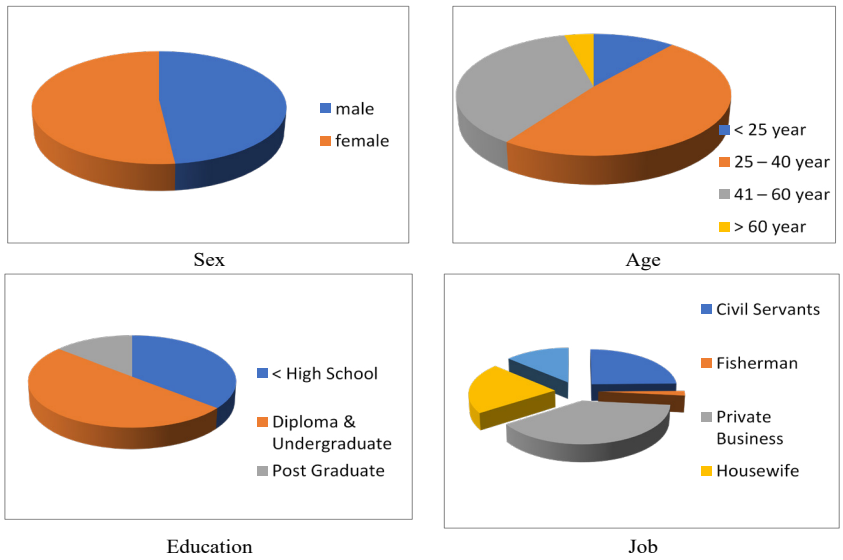

Figure 2. Demographic profiles of respondents.

The income level of respondents is dominated by the group with an average income below 3 million Rupiah (59.6% or 152 persons) (Figure 3) indicating the majority's income level is less than the Minimum Wage (UMR) of Banda Aceh, which is set at Rupiah 3.1 million / month.

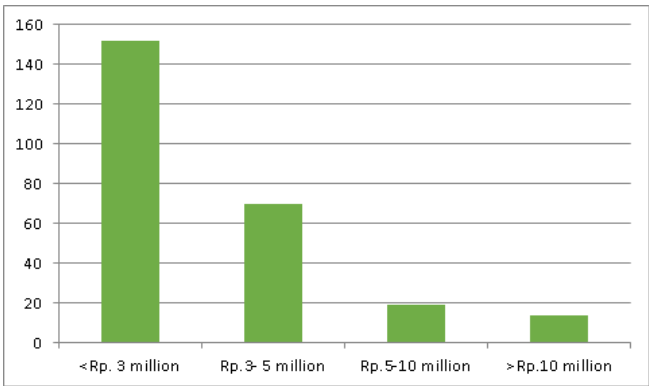

Figure 3. Income level of 255 respondents.

Table 4. Demographic background of respondents.

Demography Respondent	Description Profiles	Frequency	Percentage (%)
The Number of Dependents	1-3	101	39.7
	4-6	140	54.9
	>6	14	5.4
Tsunami-affected origins	Yes	159	62.4
	No	96	37.6
Length of stay at tsunami area	< 3 year	26	10.3
	3-10 year	64	25.1
	> 10 years	165	64.7
House's status	Self-ownership	145	56.9
	Rent house	42	16.5
	Family-owned house	68	26.6

Source: Data analysis

3.1. The Effects of Disaster Literacy and Mitigation Policy on resettling

The results of the regression analysis obtained for the coefficient for the disaster literacy variable (DL) is 0.410, and that for the mitigation policy variable (ML) is 0.035 with a constant of 2.193, so the regression equation model obtained is as follows.

$$Dec = 2.193 + 0.410DL + 0.035MP + e \quad (3)$$

Table 5. Multiple linear regression test results.

Model	*Unstandardized Coefficients*		*Standardized Coefficients*	T	Sig.
	B	Std. Error	Beta		
(Constant)	2.193	.198		11.059	.000
DL	.410	.056	.460	7.363	.000**
MP	.035	.041	.053	.842	.401

Source: Regression Output

The regression equation above as seen in Table 5 shows us several trends:

1. A constant value of 2.193 means that if the disaster literacy and mitigation policy variables are considered constant or zero, then the decision of residents to remain is at a positive number of 2.193.
2. The disaster literacy variable (DL) has a positive regression coefficient to decision residents to live (Y) ($\beta_3 = 0.410$).
3. The mitigation policy variable (MP) has a positive regression coefficient direction with Y, where $\beta_4 = 0.035$.

The t statistical test is used to assess the influence of each independent variable against the dependent variable. The findings show that the disaster literacy variable has a statistically significant effect on residents' decision to resettle in the tsunami-prone areas (with a significant value of 0.00), while the mitigation policies do not have a significant effect on the decision of residents to reoccupy the tsunami area (Y) (The significance value exceeds 0.05 i.e., 0.401).

3.2. Model Representation

Table 6 explains the R value of 0.487, which means that this model represents the variables of disaster literacy factors and mitigation policy factors affecting residents living in disaster-prone areas as much as 48.7% above other variables examined. The R^2 value of 0.237 means that 23.7% of the factors that influence citizens' decisions can be explained by these independent factors, while almost 76.3% is explained by other variables.

Table 6. Results of the determination coefficient.

R	R Square	Adjusted R Square
.487[a]	.237	.231

Predictors: (Constant), Disaster Literacy Factor and Mitigation Policy.
Dependent Variable: Decision to stay

Source: Data Analysis Output

4. Discussion

The results of the statistical analysis could be elaborated in several observations as follows.

4.1. The Effect of Disaster Literacy

From the inferential statistics, we have found that the disaster literacy variable (X_1) has a positive relationship with the residents who lived in the tsunami area (β_1 value= 0.410), with a significance value of 0.00 (<0.05). This means that the disaster literacy variable is statistically significant and can be seen as positive in influencing residents' decisions to live in tsunami prone areas. This means that the disaster literacy program implemented by local government has brought about positive effects on decisions by residents considering whether to live in tsunami-prone areas. The program has improved the awareness of citizens regarding preparing for disaster which increased their confidence about living in that particular area.

The results of this study are in line with the study by Sunarto & Marfai (2012) in which they found communities with relatively high levels of literacy on tsunami disasters increased their preparedness to face this disaster. Similarly, the study by Oktari *et al.* (2021) of the awareness of Banda Aceh residents, found that the element of knowledge of disaster preparedness fit in the 'ready' category (It could be described as 'high').

Likewise, the research conducted by Febriana *et al.* (2015) which examined preparedness in the sub-district Meuraxa in Banda Aceh, also found that the level of community disaster awareness is at a high level. However, despite these high levels of awareness of risk, the victims of the tsunami were eager to adopt mitigating measures and cope with disasters themselves rather than moving elsewhere. This was primarily for economic reasons; the local community relies on the coastal ecosystem (Kafle, 2006). These various reasons have improved disaster literacy and hence influenced residents' decisions to resettle in their home area, despite its vulnerability.

One of the reasons that the levels of disaster preparedness are high in Banda Aceh is that this area underwent a direct experience of tsunami, as contrasted with the local residents that never had similar experiences. In his study in Chile, (Herrmann, 2013) showed that the local residents have a lower level of risk preparedness due to their lack of direct experience of earthquakes and tsunamis.

4.2. The Effect of Mitigation Policy

Disaster mitigation policy factors (X_2) are represented by two indicators: (a) the disaster risk index, and (b) the disaster risk map. A high disaster risk index for the municipality of Banda Aceh, and some areas marked red on the disaster risk map show these areas are very vulnerable to tsunami disasters. The implication is that the better the dissemination of mitigation policy about these areas, the fewer the citizens deciding to return to inhabit these regions. This means that the disaster mitigation policy factor (X_2) is negatively related to the decisions of residents to inhabit the tsunami disaster area (Y).

In inferential statistics, the significance value of this Mitigation Policy Variable is above 0.05, (0.401) which means that statistically, the mitigation policy factor (X_2) is not significant in having an effect on residents' decisions about inhabiting the tsunami disaster area (Y). In the field, researchers found that the existence of a disaster risk index and disaster risk map were not yet common knowledge amongst local people or understood by most respondents, indicating a general lack of socialization both by the local government and by the authorized institutions such as BPBD (Regional Disaster Management Agency). From a similar study by Shigenobu *et al.* (2009), we see that one of the reasons that the disaster risk map was less useful was that it had been merely distributed but not well publicised and not integrated into tsunami disaster management and development planning as a whole.

This phenomenon is supported by the study by Gadeng *et al.* (2019) which indicates the tsunami risk map did not stop people residing in the disaster-prone area. (Jain *et al.*, 2017) also found that a lack of integrated engagement by multi-government departments led to the failure of mitigation policy in urban areas in attempting to relocate disaster victims. This study shows that the mitigation policy f did not succeed in getting citizens to put into practice their awareness about the implications of past and potential disasters.

5. Conclusion

The disaster literacy factor has a significant and positive impact on the decisions of residents living in the tsunami area. The level of community literacy concerning the tsunami disaster was quite good. This indicates that the government's efforts to raise awareness amongst residents by increasing disaster literacy and knowledge were quite successful.

However, mitigation policies do not significantly affect decisions of residents about whether to live in tsunami-prone areas. This mitigation policy should be the basis for all concerned, whether in government, in the private sector, or in the community, for reconstructing public facilities and housing in disaster-prone areas. However, in reality, housing resettlement projects in the tsunami red zone continue to be initiated regardless of policy.

The escalation of reconstruction in tsunami-prone areas has now resulted in the multiplication of building projects being mobilized and the steady increase of population density in these areas. This condition contradicts the stipulations of *Qanun* RTRW 2009-2029, in which parts of the area next to the coastline are designated as areas with low density. The incongruity between policy and implementation on the ground indicates the failure of the local government to put in place an effective and wide-reaching mitigation policy.

Policy Recommendations

There are several suggestions that can be elaborated from the results of this study. First, as a matter of urgency, local government should improve their efforts to disseminate a general understanding of mitigation policies by providing the populace with an explanation and working knowledge of the meanings of the high disaster risk index and disaster risk map. The objectives of disaster mitigation policies can then be fully achieved. Secondly, government needs to facilitate multi-stake holder engagement in development decision-making, ensuring participation by all parties, such as government agencies, particularly those responsible for housing, land and disaster management, community organisations, and the private sector to support mitigation policies.

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