Why tsunami survivors remain living in the same location? 
Evidences from Lampulo Village, Banda Aceh

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Abstract. This research aims to analyse factors influencing the Indian Ocean tsunami survivors to remain in the same location after the tsunami. Logistic model is utilized to measure factors influencing the decision to choose the tsunami affected village after the tsunami. Those factors are land ownership, income level, and profession. The concerned location is Lampulo Village in Banda Aceh, which was severely affected by the tsunami in 26 December 2004. Data is primary data generated from field interview for 200 respondents, divided evenly for respondents who used to live in the village but decided to move away and live in different locations, and respondents who remain living in the village. The results suggest that the main reason to choose resettling in the affected village is merely the land ownership. In other words, people who have lands in the village will have higher likelihood to remain living in the village 1.5 times higher than those who do not have lands. Other factors are not statistically important in decision making to remain in the village. The implication of this research show that disaster survivors will tend to choose the same location after disaster. It implies the stronger need to reduce the risks of potential disaster in those locations, making the human settlement safer against future disaster. This paper recommend policy makers to avoid relocating survivors to different locations, and to invest public funds to strengthen disaster preparedness in the disaster prone areas.

Keywords: Housing Choice, Land Ownership, Income, Profession, Logistic Model, Banda Aceh.

1. Introduction

The decision to choose a place to live, especially in urban areas, is a decision that involves many aspects and considerations. The most important consideration is the price of land parcels [1]. In addition to land prices, consideration of location amenities, proximity of dwellings to various important locations of economic and social activities, as well as socio-cultural proximity are also important. Choices will be available to humans and the decision to settle will be largely determined by the location that provides the most optimal locational satisfaction from the available budget [2].

However, in disaster settings, the availability of options becomes curbed. Disaster conditions present difficulties in making rational decisions. Material and non-material damage and loss, loss of productive assets and sources of livelihood provide difficulties in making decision, especially decision to place a new dwelling. These difficulties occur from narrowed options available in the post-disaster
conditions. The available options are usually to return to the location affected by the disaster, or move to a new location.

Based on the results of a study conducted by [3], relocation decisions were made with consideration to reduce vulnerability to disasters faced by the community. So, by moving people in disaster-prone locations to safer locations, vulnerability is reduced. Based on the relocation experience in Indonesia and India reviewed by Boen and Jigyasu, relocation decisions tend to not last long. So it can be concluded that although the purpose of relocation is good enough, namely to reduce the vulnerability of disasters, the relocation areas tend not to last long.

In addition, [4] and [5] explained that the limited choice of residential locations would be exacerbated by several factors, including: first, loss of home and land and deterioration of sanitation, which caused deterioration in health conditions; Second, damage to educational facilities and employment opportunities which caused poor access to education and decreased income; and third, the destruction of social support networks which causes various social difficulties. Thus, the decision to relocate in a new residential area becomes very difficult to choose as a voluntary choice.

The financial limitations of disaster survivors often encourage the survivors to depend their choice of housing on the availability of assistance, both from the government and other parties, such as non-governmental organizations or NGOs, donor agencies and other social institutions. In such difficult conditions, post-disaster reconstruction was also carried out without considering important aspects of the survivors’ preferences. Aid providers tend to use a top-down planning approach that has often been proven to ignore the importance of socio-economic, development and cultural aspects. In fact, these aspects are also essential aspects in the post-disaster reconstruction process. Thus, the choice to settle in the original place is a very difficult choice [6]. However, in the context of disasters such as tsunamis, the location of houses in a landscape that is prone to tsunamis always requires consideration of human safety. Therefore, the choice of relocation is always an option that is often part of policy choices.

In post-disaster event, [7] explains that housing remains essential for almost all disaster survivors. Furthermore, [7] and [8] further explained that houses are important assets for families, determinants of welfare, health, education, family and social status. In developing countries, houses are considered to be the most important asset, so that if a disaster occurs and destroys the house, the impact of the loss will be enormous. [9] asserts that nearly 98 percent of house losses due to disasters are common in developing countries, and usually become the focus of post-disaster recovery.

The earthquake and tsunami disaster in Aceh on December 26, 2004 was one of the worst disasters during modern human civilization. According to [10], the total losses due to the disaster were equivalent to 2.2 percent of Indonesia’s 2004 total GDP. The greatest losses were caused by damage and loss of houses. The estimated loss is equivalent to more than US $ 1.5 billion, three times greater than the loss in the transportation sector. From the data released by (2005), more than 160 thousand people died and disappeared, and nearly 180 thousand homes were destroyed or heavily damaged. The loss was also added to damage to health, religious and education facilities (see Table 1.)

Table 1. Estimated Losses from the Indian Ocean Tsunami.

| No | Type of losses               | Unit   | Losses   |
|----|------------------------------|--------|----------|
| 1  | Died or missing              | person | 165,945  |
| 2  | Injured                      | person | 4,662    |
| 3  | Displaced                    | Person  | 522,462  |
| 4  | Damaged houses               | Unit   | 179,312  |
| 5  | Damaged health facilities    | Unit   | 240      |
| 6  | Damaged religious facilities | Unit   | 2,742    |
| 7  | Damaged education facilities | Unit   | 1.226    |

Sources: BNPB (2005)

The authors calculated the degree of losses from damaged houses and social economic facilities and found that the losses are enormous. From the estimation of tsunami losses assessment conducted by World Bank, the value of losses from damaged houses in Aceh is equivalent of 30.06 percent of 2005
GRDP of Aceh. This loss is considered massive, as the tsunami has created housing loss equivalent to almost one third of total economy in Aceh. Compared to other value of losses from damaged health, education, social and religious facilities, the value in housing losses is beyond comparison (see Table 2).

### Table 2. Estimated Value of Losses from the Indian Ocean Tsunami.

| No | Type of losses                  | Value (billion IDR) | % of GRDP |
|----|--------------------------------|---------------------|-----------|
| 1  | Damaged houses                  | 13,365              | 30.06     |
| 2  | Damaged health facilities       | 854                 | 1.92      |
| 3  | Damaged religious facilities    | 776                 | 1.75      |
| 4  | Damaged education facilities    | 1,194               | 2.69      |

Sources: World Bank (2005)

Note: 1) the 2005 GRDP of Aceh was IDR 44,467.16 billion; data was from BPS Aceh

According to [11], relocation of disaster survivors to safer locations is part of the post-tsunami reconstruction policy in Aceh. However, difficulties in implementation caused the relocation process did not proceed smoothly. Most survivors decided to stay at their original location, and reject the option of relocating to a safer place.

One of the locations that suffered total damage in the tsunami event was Lampulo Village which is located in Syiah Kuala District, Banda Aceh. Lampulo is inhabited by the majority of fishermen and aquaculture, in addition to traders and other professions. Lampulo is one of the areas directly affected by the tsunami and indirectly affected from water pollution and deteriorating environment. However, it is observed that despite the massive losses and waning environment, people decided to resettle in the location. This paper aims to investigate factors affecting the decision making of staying in the same location after disaster. This paper, to our best knowledge, is the first paper to analyse this phenomenon. Thus, this paper serves to fill the knowledge gap and help decision makers to design more efficient housing provision aftermath devastating disasters.

### 2. Literature Review

#### 2.1. Housing demand theories and Land Ownership

Some researchers have documented the theories on housing demand, for example [2] describe the developments of housing demand thoughts. Quoting [12], [2] concluded that house is the most important commodity purchased by a consumer, because the house provides shelter, a place for various economic and life activities, and a form of investment that is beneficial for the owner. The basic theory of housing demand was developed from the basic assumption that the number of houses was limited but homogeneous, so that the known demand theory could be used as an analytical tool (see [13] and [14]). [15] argue that the demand for a house, besides being influenced by the price of the house, the demand for the house is also determined by the physical characteristics and location of the house. Location factors play an important role because each house offers different utilities due to location.

In addition to price, [2] further explained that based on the findings of various empirical studies, in addition to price and income factors, it is also important to add spatial variables as stated by [14], [13] [16]. [17] used location variables (ie distance to medical services) as variable that influenced the willingness to pay for housing for retirees in Spain. [18] used the variable of the proximity to the location of a landfill as one of the determinants of the willingness to pay for the urban area of Calabar, Nigeria. [19] argue that distance to the workplace is an important variable and determinant of housing demand by low-income people in the State of Benue, Nigeria, because transportation costs are an important factor.
One of the philosophical foundations underlying the development of the most influential home demand theory is the theory developed by Rosen [20]. Rosen developed a market theory for goods that have various characteristics, such as houses. Rosen argues that housing demand is derived from optimizing consumer satisfaction derived from home purchases and consumption, as well as composite goods at a unit price level. Rosen developed the bid-rent theory developed by British classical economist David Ricardo. The magnitude of the desire to pay a buyer indicates the optimum bid-rent that buyers can offer to a variety of house characteristics.

The theory developed by Rosen was refined by Quigley [16] who argued that the characteristics of a house would vary due to spatial factors. Quigley criticizes the view of empirical studies that developed the explanation of variations in house prices from the factor of house prices. Quigley argues that spatial factors provide differences in home demand. Polycentric urban characteristics will encourage prospective home buyers to consider distance and transportation costs into the decision to buy a house. Quigley concluded that the desire to buy a home actually shows the effective price, namely the level of house prices adjusted for the cost of transportation that must be paid to travel to the workplace.

Further empirical findings supported [13], such as [21], [14] and [16] and argues that in theory, settlement locations in urban areas are derivations from optimizing satisfaction from consumption of houses and other goods and services. Consumers who optimize the satisfaction of choosing a house with spatial characteristics, or house amenities. Therefore, Straszheim believes that the location of the house is a determining aspect of the desire to pay and demand for a house.

Another factor affecting housing demand is socio-economic and demographic aspects. [22] explain that there is a close and significant relationship between housing demand and socio-economic and demographic aspects, such as income level, household size, education level and profession. In Sweden, house demand is influenced by age distribution. The older a consumer is, the consumer has a higher demand for a home, both to be occupied by himself, and as a form of investment. Lindh and Malmberg's research is consistent with research conducted by [23] in Austria, [24] in the Netherlands and [25] in Japan.

2.2. Location Proximity and profession of the (future) owner of the house

Determination of the selection of land parcels for the city is largely determined by the distance between the land parcels and the main activity locations. The activities in question are: the location of the workplace, the location of the market for shopping and public facilities such as schools and hospitals, in addition, the price of land, income is a determining factor, see [26] for details.

Lamb [27] states that choosing a good place or location is an important decision, because: first, the place is a long-term resource commitment that can reduce the flexibility of the future of the business. Second, the location will affect future growth. The area chosen must be able to grow economically so that it can maintain business viability and third, the local environment may change at any time, if the location value deteriorates, the business location must be moved or closed.

According to [28] study in Sri Lanka rebuilding tsunami-damaged homes in Sri Lanka was carried out in the original place because of the focus of NGOs and international donor agencies providing housing assistance in their original locations. NGOs and international donor agencies did not relocate tsunami victims to safer locations. The quality of the houses being built is also substandard because of the rushed development. This observation was not only observed in in Sri Lanka but also in India. Such substandard housing resulted from poor toilets and kitchens situation.

3. Methods

Population size is not well documented. Authors found no reliable records of total survivors in Lampulo, making the sample size determination rather difficult. It was also difficult to find the records of survivors who moved away from the village and where they have moved to. However, authors selected 200 sample sizes to allow logistic modelling to work, considering the model nature of non-
linearly, which tend to work well with large sample size. Authors selected 100 samples for each category: survivors who moved away from Lampulo and survivors who remain in the village.

Logistic model is employed and modelled as the following:

\[
E(Y|x) = \frac{e^{(\beta_0 + \sum_{k=1}^{p} \beta_k x_k)}}{1+e^{(\beta_0 + \sum_{k=1}^{p} \beta_k x_k)}}
\]  

(1)

The value of \(E(Y|x)\) is the odd of success, namely the odd of respondents to choose to remain in Lampulo, so the expression can be rewritten as:

\[
p(x) = \frac{e^{(\beta_0 + \sum_{k=1}^{p} \beta_k x_k)}}{1+e^{(\beta_0 + \sum_{k=1}^{p} \beta_k x_k)}}
\]  

(2)

Eq.(2) is transformed into:

\[
y = \ln \left[\frac{p(x)}{1-p(x)}\right] = \beta_0 + \sum_{k=1}^{p} \beta_k x_k
\]  

(3)

And operationalized into the following regression:

\[
y = \ln \left[\frac{p(x)}{1-p(x)}\right] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3
\]  

(4)

\[
y = \ln \left[\frac{p(x)}{1-p(x)}\right] = \beta_0 + \beta_1 LO + \beta_2 INC + \beta_3 PROFF
\]  

(5)

Where \(y\) is the binary value of moving away respondents (zero) and remaining in Lampulo respondents (one); \(LO\) is binary value of people who own land (one) and without land (zero), \(INC\) is income and \(PROFF\) is binary value of people who work in fishery, aquaculture and the relevant (one) otherwise zero.

4. Results and Discussions

4.1. Selected Respondents Characteristics

According to sex, most of the respondents who were willing to provide information for this study were men. A total of 141 of the 200 respondents (or equivalent to 70.5 percent) are men. The remaining 59 out of 200 respondents (or equivalent to 29.5 percent) are women.

Based on the age of the respondents, the majority of respondents aged between 30-38 years. As many as 80 people or 40 percent of the total respondents were in that age group. A small proportion of respondents are relatively elderly. There were four respondents or two percent of the total respondents older than 56 years. The rest, evenly distributed between adults, with the proportion of 44 respondents or 22 percent aged 21-29 years and 42 respondents or 21 percent aged between 39-47 years.

Furthermore, the majority of respondents completed education up to high school. A total of 112 respondents or 56 percent had such an education level. A balanced proportion is also seen in respondents who have a junior high school; 40 respondents or 20 percent, and those who earned higher education degree which is 39 people. Only nine respondents were equivalent to primary school education, or 4.5 percent of the total respondents. In term of income, the majority of respondents have an income level of between IDR 1,600,000 and IDR 2,600,000. A total of 125 people or 62.5 percent of the total respondents are in the income group. A small percentage of respondents have a high level of income, which is greater than IDR 2,600,000, which is 23 respondents or equivalent to 11.5 percent. However, the other majority, as many as 52 respondents or 26 percent have the lowest income level of between IDR 600,000 to IDR 1,600,000.
4.2. Model Estimation

Table 3 show the estimated coefficient from the logistic regression model.

| Variables      | Coefficient | Odd Ratio    | Std. Error | t-value | Critical t-value |
|----------------|-------------|--------------|------------|---------|-----------------|
| Land Ownership | 0.43262     | 1.54129041905 | 0.19840    | 2.1806  | 1.96            |
| Income         | -0.00000020441 | 0.99999979559 | 0.00000016156 | -1.2652 | 1.96            |
| Profession     | -0.087331   | 0.91637372572 | 0.18128    | -0.48174| 1.96            |

Source: Authors’ calculation (2018)

The coefficient of land ownership variables is positive and estimated at 0.433, which means that land ownership is related to the decision to settle in Lampulo after the tsunami. The estimated odds ratio is 1.541 which means that respondents who own land in Lampudo before the tsunami have a 1.541 times greater chance of settling in the village after the tsunami compared to respondents who do not own land. The calculated t-ratio of this variable is 2.1806 and the critical value for the 95 percent confidence level is 1.96. Thus, this variable is statistically significant at 95 percent confidence level in explaining the decision of respondents who settled in Lampulo after the tsunami.

While income and profession variables have negative values and are estimated to be -0.00000020441 and -0.087331, respectively, which means that the two variables have an opposite direction to the decision to settle in Lampulo after the tsunami. The opportunity value of the income variable is 0.999 which means that respondents who have a higher income level tend to leave Lampulo 0.999 times greater than lower income respondents. The opportunity value of the profession variable is 0.916 indicating that respondents with the fishing profession tend to leave this location 0.916 times greater than the respondents who are non-fishermen profession. However, both of these variables are not statistically significant.

The empirical results show that the major determinant for dwellers to remain in Lampulo was the land ownership. The results suggest that those who own lands in Lampulo will be more likely to remain in Lampulo than those who does not own lands. The majority of profession is linked with fishery and aquaculture and it suggests that people who work in these fields also have likelihood to remain in Lampulo, however the variable is not statistically significant. These findings provide the empirical evidence that the decision to remain in tsunami affected village is mainly determined by the factor of land ownership. The fact that after more than a decade aftermath the event of disaster people have settled in tsunami prone and tsunami devastated village suggest more challenging policy for reducing the hazard and improving the quality of disaster preparedness. Further researches are suggested to evaluate the degree of hazard and vulnerability, to ensure that policy makers have better understanding to plan for disaster risk reduction and mitigation.

5. Conclusions and Recommendation

This study analyses why the survivors return to the original village after the tsunami. This paper found that first, the main factor that determines the decision of disaster survivors to settle at the disaster affected location or move to another location is the ownership or non-ownership of land at the tsunami affected location. The results of logistic regression showed that disaster survivors who owned land in Lampulo had a tendency or opt to resettle in Lampulo 1.541 times greater than those who did not own land in the village. Disaster survivors in Lampulo who do not own land are usually tenants of rented property, or live with relatives and family.
Based on this trend, and also reinforced by the availability of assistance for housing development by both the government and non-government at that time, the tsunami-affected areas, including the Lampulo, were resettled after the tsunami. Empirical results also show that occupation factors are not statistically dominant in influencing the decision to resettle in the tsunami affected areas.

Second, the type of occupation factors that are closely related to the location of the affected area have no direct relationship with the decision to settle in the tsunami affected area. This phenomenon is different from the empirical findings in Sri Lanka and several other tsunami affected locations. This shows that in the period before the tsunami, fishermen were not able to buy land in Lampulo. Most of them only rent houses in these locations because the village facilities are proximate to the coastal areas where fishermen run their economic activities. So, after the disaster, the tenant fisherman cannot decide to settle in Lampulo, because of the absence of the land.

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