Estimating the Economic Losses Value Caused by Flood Disaster in Sampang Regency Using Tangible Damage Assessment

Campina Illa Prihantini
Bakti Bangsa Pamekasan Institute of Economic Science,
Email: campinailla@stieba.ac.id

Abstract. Flood disaster is a natural disaster that can cause losses, both economic losses and social losses. Flood disaster in Sampang Regency is a routine natural disaster every year. The flood disaster in this district occurs in urban areas, where the center of economic and administrative activities is located. Sampang regency is a liaison district for the other two districts in Madura Island, namely Pamekasan and Sumenep. This study aims to estimate the economic losses of flood disaster experienced by people living in urban areas of Sampang Regency. The Tangible Damage Assessment consists of two commonly used tools for estimating economic losses due to natural disasters. Averting Behavior Method is used for tools to estimate the impact of total loss due to flood disaster. The results showed that the value of losses felt by the people affected by flooding is Rp 5,881,948,800, this loss consists of structural losses, loss of household property, vehicle damage, loss of salary or income, health loss for medical treatment, and educational loss. The results of this study will be expected to be used as a basis for policy recommendations in an effort to reduce the impact of flood disaster in Sampang Regency.

1. Introduction
Sampang regency is one of the districts located on the island of Madura. This district can be said as a liaison between districts on the island of Madura, especially for Bangkalan and Pamekasan. Its strategic location makes this district as one of the districts that need to be developed, especially after the emergence of the issue will be the establishment of Madura Province.

Flood is one of the natural phenomena that can be categorized into the negative impact of climate change [1-3]. As we know that to date, climate change has been the concern of people around the world. One of the definitions submitted by the Ministry of Environment of the Republic of Indonesia explains that climate change is a change in the physical condition of the earth's atmosphere, among others, the temperature and distribution of rainfall that bring widespread impact on various sectors of human life. Changes that occur not only occur in a short time, even can occur in a long time. While the term global climate change is a climate change with a reference area of the Earth as a whole. Climate change has actually been felt by various parties in the world. No exception on the coast of Asia was not negatively affected by climate change, such as floods, sea level rise, storms that can cause damage to the national and regional economies [2]. Climate change has the potential to cause flooding through increased rainfall, increased glacier river flow, and rising sea levels [3].
Floods that often occur in some areas was also occurred in Sampang regency. This natural phenomenon can be categorized as a natural disaster as if it became the annual agenda of this district. Even the district that has this slogan of the City of Bahari was known as 'Flood Every Day' due to frequent flooding. Worse, the flood natural disaster in Sampang Regency was actually hit in urban areas, where office and community services are located. Not only that, the areas affected by the floods precisely the area that became the main route or the main road of the province. That is, transportation from two other districts, namely Sumenep and Pamekasan, will be hampered when the floods hit the Sampang regency.

Flood disaster that occurred in Sampang Regency certainly have a significant impact on the lives of people living in areas affected by floods. Not only that, various sectors in Sampang Regency are also suspected to suffer significant losses due to this flood disaster. The National Disaster Management Agency (BNPB) mentioned that in February of 2016 was a devastating flood disaster impacted to the economy of Sampang Regency. This is because the flood affected areas reached 13 villages and / or districts [4]. The most affected areas are people living in Jalan Mawar and Jalan Melati which belong to Dalpinang Village, Sampang Regency. BNPB (2016) mentions that the number of affected household heads (KK) is 1,600 households or about 5,000 people [4].

Various flood impacts that need to be studied and researched further. For example on the causes of flood disaster, the impact of flood disaster, which then the results of research and assessment can be used as a suggestion and recommendation for the government of Sampang District in the prevention of flood disaster in the future. Bappenas in 2007 mentioned that the five year cycle flood that occurred in 2007 was the most serious flood in Jakarta. About 60 percent of the land in Jakarta was submerged during the five-year flood and caused an estimated loss of US $ 453 million. These losses include damage and loss from all sectors [5].

One study of the impact of floods conducted in the UK explains that the impact of floods is felt also by the commercial sector. The study shows that there are at least 73 commercial sectors at risk of flooding. The number is 43 percent classified as a service industry, 26 percent retail, 12 wholesalers and the rest are manufacturing and construction. However, of the 73 companies, only 56 were included in the study while 17 others (23 percent) were unwilling or refused to participate [6]. Research on the impact of floods in Sampang Regency is still very little done. Therefore, it is necessary to conduct further research and study on the impact of flood in Sampang Regency.

One of the main causes of the flood disaster in Sampang Regency is the location of this district which is below sea level (about 80 cm) [4]. In addition, high rainfall causes sea levels to rise and further aggravate the condition of Kali Kemuning River. That is, when the rain flushed the northern region of Sampang regency, then the southern region of this district must be prepared to receive floods that can be categorized as banjir bandang. However, BNPB (2016) mentions that other causes of Sampang flooding are sea water seabed, thus categorized as rob flood [4].

Floods that occur in some areas in Indonesia cause huge losses for the community, such as loss of property, water shortage, post-flood diseases, and damage to homes [1-3]. Even so in people affected by floods in Sampang District, especially for people living in the Village area Dalpinang. This causes people to flee to a place free from flooding. In addition to the perceived losses of the people, the floods caused losses to public facilities, the property sector, industry and the commercial sector. The existence of annual floods cause social costs or externalities in the form of additional costs that must be paid to replace goods damaged by flooding or the cost of adaptation issued. Based on the above problems then the formulation of the problem in this study is how much the value of economic losses due to flooding in Dalpinang district, Sampang regency through Averting Behavior Method (ABM) approach.
2. Methodology

This research was conducted in Dalpinang district, Sampang regency, East Java Province. Site selection was done purposively with the consideration that Dalpinang district based on the data is the worst affected by the flood disaster. This study was conducted for six months, from February to July 2018.

Data used in this research are primary data and secondary data. Primary data were obtained from direct interviews in questionnaires to respondents. Primary data used in this research include data of physical damage from the existence flood disaster, actions performed by the community in the face of offlood disaster. Secondary data needed in this research is data related to research area and other data needed in this research. This data is obtained from related institutions, various libraries such as books, journals, and the internet. Sampling method in this research is done by snowball random sampling. The snowball random sampling method is applied in secondary data retrieval and interviews with competent sources in accordance with the information required by the researcher. The number of respondents taken in this study were 60 household respondents.

2.1 Estimated Economic Loss by Flood By Using Averting Behavior Method (ABM)

The value of economic loss due to flood in Dalpinang Village, Sampang Regency calculated in this research is direct and indirect losses [7]. Direct economic losses include the cost of losing domestic appliances and the cost of repairs to both houses and household appliances. Indirect economic losses include medical expenses consisting of medical expenses (medical expenses), lost income due to non-employment and educational losses. Here are the methods used to calculate the losses in this study:

2.1.1 Cost Of Repairs. This loss is seen from the costs borne by the respondents is calculated from the expenditure of a sum of money to repair the damage to house and household appliances caused by flooding. The cost of this improvement is estimated using the market price approach method. Damage to the building in question includes doors, windows, floors and sills. Damage to household appliances in question is furniture (beds, chairs, and cabinets) and refrigerators. The average cost for the effort of repairing house and household appliances can be obtained through the following equation [8]:

\[ BB = \frac{\sum_{i=1}^{n} BBi}{n} \]  \hspace{1cm} (1)

Information:
- \( BB \) = Average repair cost (Rp /Household)
- \( BBi \) = Repair cost made by respondent i (Rp)
- \( n \) = Number of respondents (Household)
- \( i \) = The i-th respondent (1, 2, 3, ..., n)

2.1.2 Cost Of Losts. This loss is seen from household appliances that are damaged and can not be reused according to function. The method used is the actual market price approach. The cost of loss of household equipment experienced by the public can be seen from the initial purchase price and the year of loss of the household equipment. The calculation of the average cost of loss of respondents is obtained by dividing the total cost of loss by the number of respondents who suffered damage to household appliances. The average value of the cost of loss can be seen in the following equation [8]:

\[ BK = \frac{\sum_{i=1}^{n} BKi}{n} \]  \hspace{1cm} (2)

Information:
- \( BK \) = Average cost of loss of property (Rp / Household)
- \( BKi \) = Cost of loss experienced by the respondent to-i (Rp)
- \( n \) = Number of respondents (Household)
- \( i \) = Respondent i (1, 2, 3, ..., n)
2.1.3. Cost Of Healths. Another economic loss from floods is health losses. Health losses are the amount of costs incurred by respondents to treat diseases from flooding and loss of income of respondents due to not working due to illness. This loss is estimated using human capital approach (Health Capital Approach) that is health cost. Public health costs derived from the sum of income loss due to illness with medical costs can be seen in the following equation [8]:

\[ C = P + BO \]  \hspace{1cm} (3)

Information:
- \( C \) = Health cost (Rp)
- \( P \) = Revenue lost (Rp)
- \( BO \) = Medical expenses (Rp)

2.1.4. Lost Revenue. A further disadvantage is the loss of people's daily incomes due to floods that prevent them from working. This loss is estimated through a lost income approach or Loss of Income. This lost income is the daily income that the respondent did not get because respondents chose not to work during the flood. The following equations are used in the calculations [8]:

\[ HP = \sum_{i=1}^{n} PRI \times BL_i \]  \hspace{1cm} (4)

Information:
- \( HP \) = Loss of income per respondent (Rp / Household)
- \( PRI \) = Daily revenue lost on the i-th respondent (Rp / day)
- \( LB \) = Old does not work (day)
- \( n \) = Number of respondents (Household)
- \( i \) = The i-th respondent (1, 2, 3, ..., n)

3. Findings
Flood that always happens every year in Dalpinang district, Sampang has a height of flood puddles that vary so that people cause losses. The general definition of "disadvantages" caused by a disaster includes several classifications including the number of casualties, the amount of damage to buildings, the costs incurred for repair/replacement, damage or loss of communication, transportation and other infrastructure, the cost of business disruption, residential houses, and so forth [9]. The economic loss felt by the people due to floods in this study is a tangible loss. Tangible loss is divided into two, namely direct loss and indirect loss. Information on tangible loss is obtained through interviews and direct observation with the people of Dalpinang district, Sampang. The total estimated losses are based on the amount of the loss of the people affected by the flood.

3.1. The Direct Economic Losses
The direct economic losses experienced by respondents consist of the cost of repairing to house buildings (structural), loss and repair of household equipments, and the cost of repairing vehicles. That house repairing cost is the cost paid because some structures of the house have been damaged by floods. The losses incurred by the respondent's household is Rp 5,267,660. The number of respondents who experienced loss of house construction are 12 households, so that every household, the loss suffered is Rp. 438,917. The second direct economic losses is the loss due to loss and / or cost of repairing the household appliances. The intended household equipments losses is Rp 5,982,180. The number of respondents who experienced losses are 24 households, so the average loss of household equipments is Rp 249,257 per household. Finally, the cost of repairing vehicles. This losses is experienced by a number of people, namely 8 households with total losses is Rp 4,628,200. The average vehicle losses experienced by the respondent's household is Rp 578,525. All of that components of losses are then added up, so that the direct losses is Rp 15,878,040.
3.2. The Indirect Economic Losses
The indirect economic losses in this study includes losses of income earned by choosing not to go to work, health costs consisting of medical expenses, and education losses. Losses due to lost income experienced by the community amounted to Rp 12,540,000. The number of respondents who chose not to work when the flood happened are 30 households, so that the respondent's household lost Rp 448,000. Economic losses due to health costs incurred by respondent households amounted to Rp 1,857,000. Households that experienced health losses are 38 households. The average health cost to be paid is Rp. 48,868. Finally, the total education loss experienced by the 12 respondent households is Rp 1,235,000, so the average education losses is Rp 102,916. The total indirect economic losses experienced by the respondent's household is Rp 15,632,000.

3.3. Total Estimation of Economic Losses
Information on economic losses was obtained through interviews and observations made on households sampled in the study. These economic losses include structural losses (walls, floors, roofs, doors, windows, etc.), property losses (mattresses, sofas, washing machines, TVs, cabinets, etc.), vehicle damage, jobs, health losses that require people to pay for treatment, and the loss of education that causes a person to not go to school. Based on Table 1 the total economic losses of respondents due to the last flood in 2018 amounted to Rp 31,510,440 and the average economic losses to be borne by each household per year of Rp 525,174 per flood period. If in a year there is an average frequency of rain as much as seven times, then the total economic losses felt by people in the Village Dalpinang, Sampang District is Rp 5,881,948.800 per year. This value is so big. The government should make a strategy to minimize this negative disadvantages. Other result of Rosemary’s research in North Jakarta showed that the economic losses was big enough. The biggest losses experienced was the loss of salary or income [8]. That value was same with the negative impact of rob flood disaster in some cities near the beach [11].

| No. | List of Disadvantages of Community Economy as a Result of Flood | Value (Rp) |
|-----|---------------------------------------------------------------|------------|
| 1.  | Structural Losses                                            | 5,267,660  |
| 2.  | Household Property Losses                                     | 5,982,180  |
| 3.  | Vehicle Damage                                                | 4,628,200  |
| 4.  | Loss of salary / income                                       | 12,540,000 |
| 5.  | Health Losses for Medication                                  | 1,857,000  |
| 6.  | Education Losses                                              | 1,235,000  |
|     | **Total Economic Losses Per Period (Rp)**                     | 31,510,440 |
|     | Total Household Respondents (People)                          | 60         |
|     | Average Economic Losses per Couple Per Period (Rp / Houseload / Period) | 525,174 |
|     | Average Flood Frequency in a Year (Times)                      | 7          |
|     | **Total Economic Losses per Coupon in a Year (Rp / Houseload)** | 3,676,218 |
|     | Total Households in Dalpinang District (People)               | 1,600      |
|     | **Total Economic Losses Due to Flood in Dalpinang Urban Village (Rp)** | 5,881,948,800 |

4. Conclusion
Based on the objectives and results of the research that have been obtained and elaborated in the discussion on estimating the value of economic losses and adaptation strategies for flooding in Dalpinang Village, Sampang Regency, it can be concluded that the economic loss value of the community is calculated based on direct and indirect losses. The total estimated value of economic losses experienced by the people of Dalpinang district, Sampang in the last period is Rp 5,881,948,800.
Suggestions that can be given are (a) based on the value of losses from floods experienced by the community, it is hoped that the government of Sampang Regency and the related parties will immediately prepare steps for adaptation strategies including planting and maintaining mangroves, cleaning culverts regularly and relocating dwellings which is comprehensive and efficient so that people do not lose. This preventive action is same with the other suggestion’s research [12-13]. (b) Prevention measures undertaken by communities in the face of floods by taking into account factors such as household income levels, length of stay and total economic losses. So with regard to these factors are expected to be able to take action to prevent the flood [18]. (c) Village officials should pay more attention to the impact of flooding on the condition of people living in coastal areas so that all aspirations and complaints of the community can be accommodated and coordinated with the government and taken real action [12-14]. (d) Improve existing community and institutional participation in adaptation actions along the Kali Kemuning River. It is important to minimize the negative impact of flood disaster. All oh that suggestion are nothing without community’s participation and government’s support [15-16]. Further discussion on the impact of floods is about economic losses for each sectors. Economic losses in the economic, business, agricultural, aquaculture, and infrastructure sectors are attractive to be studied further. In addition, studies on the level of vulnerability to flooding are also interesting to do in Sampang Regency, as was done by Wijayanti et al in 2016 [17].

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