Vol 1, No 3, March -, 2021
P-ISSN 2775-3735- e-ISSN 2775-3727

ANALYSIS OF FLOOD HAZARDS AND ECONOMIC VULNERABILITY IN PRODUCTIVE LAND IN BONE DISTRICT

Muhammad Munawir Syarif
Indonesian Muslim University
E-mail: munawir.syarif@umi.ac.id

Received: **03 March 2021**
Revised**: 13 March 2021**
Approved**: 15 March 2021**

Abstract

Analysis of disaster hazards and vulnerability of the economy are the two essential components of disaster risk level assessments that provide an overview of the dangers and threats against potential losses when a disaster occurs in an area. Flood was a natural event that routinely occur each year in the Bone Regency in rainy season, when the events occurred on land or an area that is worth a productive course would cause economic losses. The purpose of this research is to find out and analyze the threat of flood hazard areas and the potential magnitude of dollars of economic losses that will be caused. Methods used in the analysis to follow general guidelines for disaster risk assessment set by the BNPB. In the process of analysis of the danger of flooding on productive land use geographic information system (GIS)-based spatial data with ease in the analysis of keruangan as well as tervisualisasi served. The results of this research show the danger of flood extents reach 95,247 ha. The potential danger of flooding to occur in Bone Regency categorized grades are in the area that have a spread of high danger exists in Sibulue Subdistrict, Cenrana and two Boccoe. The total potential loss of the rupiah ranged from 9.5 trillion rupiah or reach 31% of the total GDP Bone Regency with potential losses on productive land amounted to 3.3 trillion rupiah. The highest loss sector found on agricultural land amounted to 2.9 trillion rupiah.

Keywords: Flood Hazards, The Vulnerability of the Economy, The Loss of Rupiah, Productive Land

INTRODUCTION

Bone Regency is one of the regencies in Indonesia which has the potential for economic development in the agricultural, fishery, trade, and service sectors. (Amalia, 2012) This is due to natural resources and its strategic location. From upstream to downstream, it has great potential in 3 parts, namely the northern and southern parts with the agriculture and fisheries sector, the middle part with the trade and services sector. Of course, the development of the above sectors will improve the welfare of the bone community and its surroundings.

Along with changes in the cycle of seasons when the rainy season arrives, hydrological disasters in the form of floods have occurred in several regions in Indonesia. This incident is a natural phenomenon that can cause negative impacts in the form of casualties and property. The phenomenon of flooding is often a serious threat to bone communities, especially farmers and fish farmers. (Sukirman, 2014)

From the data collected, routine flooding occurs every year in Bone Regency with natural characteristics in the form of a long river flow that crosses several neighboring districts with rainfall of up to 3000 mm / year.

The occurrence of floods that hit caused losses and reduced the economic income of bone communities, such as crop failures, both agricultural land and fisheries commodities. In 2018, a flood disaster occurred in May which became national news in electronic media and print media with a height of up to one-meter inundating settlements and several productive lands in Bone Regency.

Flood hazard is compiled based on two main components, namely the potential threat of flooding and previous flooding events. (Miharja & Panjaitan, 2013) In other words, this index is compiled based on potential data and historical records of events that have occurred floods in Bone Regency.

Flood disaster events can be mapped through several components as described in the general guidelines for risk assessment and reference to existing guidelines at ministries/agencies at the national level (Bongi, Rogi, & Sela, 2020)

Flood hazard is made based on flood-prone area data and flood hazard analysis which is estimated based on the slope and distance from the river in the flood-prone areas using fuzzy logic methods.

Meanwhile, economic vulnerability is arranged based on the area of a productive land area and GRDP per sector. The rupiah value of productive land is calculated based on the value of the GRDP contribution in sectors related to productive land (such as the agricultural sector) which can be classified based on land use data.

Risk mapping is the process of establishing spatial and temporal risk boundaries that combines information about probability and consequences (Syarif, Barus, & Effendy, 2013) Algorithm-based GIS using DEM data generally simulates flooding in two cases, namely based on flood volume and based on flood height (Zhou, Xu, & Luo, 2011)

The lack of information in the form of spatial data related to areas with a potential flood hazard can increase the losses that will be incurred in the future. Therefore, to reduce the impact of losses due to floods, it is necessary to research the analysis of flood hazards and economic vulnerability on productive land in Bone Regency. This study is very important as a step in implementing flood disaster management and identifying productive areas affected by floods.

This study aims to determine the potential distribution of flood hazards and the magnitude of losses due to floods. By knowing the likelihood and magnitude of these losses, the focus of planning and integrated implementation of flood disaster management will be more effective.

In other words, this study is the basis for ensuring alignment of direction and effectiveness of flood disaster management in Bone Regency.

Previously, several previous studies were relevant to this study, one of them is research conducted by (Munarsyah, 2020) with the title Analysis of the Impact of Bili-Bili Overflow on the Economy of Rural Communities, Bontomarannu District, Gowa Regency. This research discusses the impact of the Bili-Bili and overflow on the economy of rural communities in the Bontomarannu sub-district. The overflow was a disaster that occurred in Gowa Regency. The purpose of this study was to determine the coverage and impact of the Bili-Bili dam overflow disaster. Where the advantages of this method are obtaining more accurate data, as well as being a comparison between the data obtained from the agency and the actual data in the field.

Based on the results of Overley through GIS, the results of the overflow area of

P-ISSN 2775-3735- e-ISSN 2775-3727

the bili-bili dam are 476.72 Ha or 8.8% of the area with a vulnerability level of 19.79 Ha or 0.3% which is classified as low, then classified as moderate at 107.96 or 2%, and classified as high 345.97 Ha or 6.5%. Then the impact of the overflow of rural communities suffered losses, namely damage to houses, agriculture, infrastructure, and reduced community income.

This study is different from previous research because in this study the focus of the study will also examine the economic impact or the extent of losses from the flood hazard.

RESEARCH METHODS

The research was conducted in Bone Regency, which administratively consists of 27 districts consisting of 328 villages and 44 sub-districts. The distance of Bone district from Makassar city can be reached about 175 km in the direction with geographic coordinates of 4 ° 13'- 5 ° 6 'latitude and between 119 ° 42'-120 ° 30' east longitude. The area of Bone Regency is 4,559 km. The data used in this study is based on the need for analysis which is considered to be a trigger factor for flood inundation. Each data from these factors and variables, as well as the analysis method is presented in table 1.

Table 1. Data used in the analysis

Number.	*Types of Data*	*Forms of Data*	*Source*
1.	*Administrative Limits*	*Vector (Polygon)*	*BPS/BIG*
2.	*Watershed boundaries*	*Vector (Polyline)*	*BPDAS / KLHK*
3.	*DEM SRTM*	*Raster*	*NASA/LAPAN*
4.	*Land Use*	*Vector (Polygon)*	*KLHK*
5.	*Main River Network*	*Vector (Polyline)*	*BIG*
6.	*Flood History*	*Tabular*	*BPBD & Community*

Flood prone areas can be created using the DEM raster data. (Manfreda, Di Leo, & Sole, 2011) have developed a flood inundation model using DEM data with the topographic index method with the equation:

$$TI_{m} = log\left(\frac{a_d^n}{tan(\beta)}\right)$$

Where TIm is the modified topographic index, ad is the flow area per unit contour length (or flow accumulated value based on DEM data analysis; value depends on DEM resolution), tan (β) is the slope (based on DEM data analysis), and n is the exponential value . The value of n is calculated with the formula n = 0.016x0.46, where x is the DEM resolution. After the topographic index is generated, the flood-prone areas can be identified through the use of a threshold (τ) where the flood-prone areas are if the topographic index value is greater than the threshold value (TIm> τ). After the topographic index is generated, the flood-prone areas can be identified through the use of the threshold value (τ) where the flood-prone areas are if the topographic index value is greater than the threshold value (TIm> τ). As for the value of τ, that is τ = 10.89n + 2.282. (BNPB, 2016)

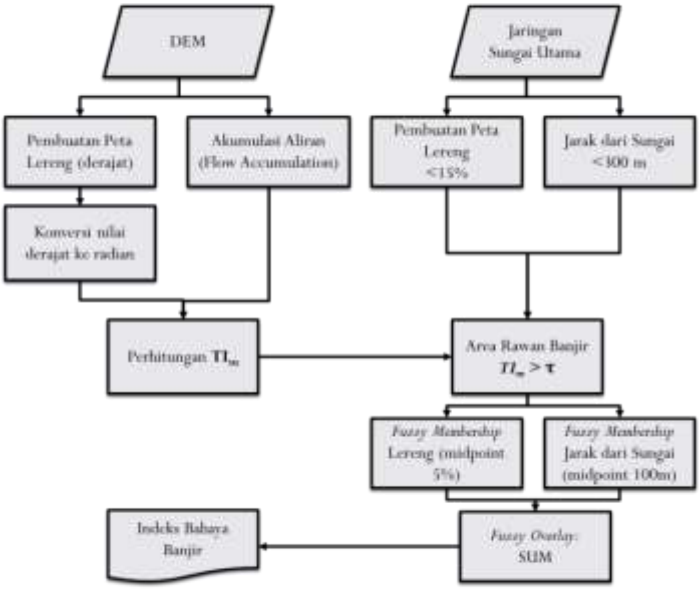

Figure 1. Flow of Flood Hazard Analysis Process

$$RLP_i = \frac{PLP_{tot-i}}{LLP_{tot-i}} \times LLP_{Kec-i} \qquad (1)$$

$$RPP_{desa-i} = \frac{RPP_{KK}}{LKK} \times LD_i \qquad (2)$$

Information:

RLPi is the rupiah value of productive land for the ith land use class at the Village / Kelurahan level
PLPtot-i is the total rupiah value of productive land based on the rupiah value of sector i at the district / city level
LLPtot-i is the total area of the ith productive land at the Regency / City level
LLPdesa-i is the ith productive land area at the District level
RPPdesa-i is the rupiah value of sector GDP in the i-district
RPPKK is the rupiah value of sector GDP at district / city level
LKK is the area of the Regency / City
LDi is the area of the i-th District

Table 2. Reclassification of land cover / use classes into productive land classes

Reclassification	
Closure / Land Use	**Productive Land**
Hutan Tanaman Industri (HTI)	Forestry
Plantation	Plantation
Dryland farming	Food Plants
Rice fields	
Mining	Mining
Others	Non Productive

P-ISSN 2775-3735- e-ISSN 2775-3727

Table 3. Economic Vulnerability Class

Parameter*	quality (%)	Class		
		Low	Medium	High
Productive Land	60	<50 million	50-200 million	>200 million
PDRB	40	<100 million	100-300 million	>300 million
Economic Vulnerability = (0,6 * score of Productive Land) + (0,4 * PDRB score)				

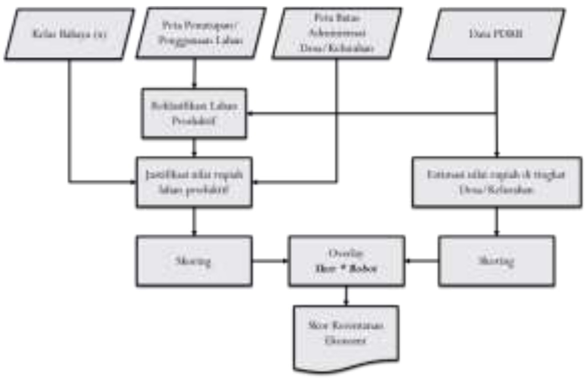

Figure 2. Flow of Economic Vulnerability Making Process

RESULTS AND DISCUSSION

A. Flood Hazard Analysis

The flood hazard level is divided into 3 classes, namely low, medium and high. The following classes indicate the level of the potential hazard.(Utama & Naumar, 2015) The high hazard level value describes the area as potentially prone to flooding and also describes its severity. Likewise with moderate and low levels of danger. Based on the results of the analysis carried out, the sub-district with the widest level of danger was Sibulue with an area of around 2,933, following the Cenrana, Dua Boccoe Districts, and so on, which are listed in the table above. From the results of surveys and interviews conducted, these 3 Districts often experience flooding with high levels of inundation.

Areas that have a moderate hazard level should also be a serious threat. Mainly in Libureng, Patimpeng, Kahu, and Bengo Districts. These four sub-districts are different because the location of the sub-district is not in the downstream/coastal area. Seeing the characteristics of the position of the sub-district flanked by mountains, one day when a natural reservoir/dam occurs, there is a potential for flash floods.

This type of flooding is a serious threat because the impact can be more severe than inundation floods or river overflows. This type of flash flood is not only flowing water, but large materials in the form of mud, rocks, and large trees will also flow and hit whatever is in the flow path. Likewise with low and high levels of danger.

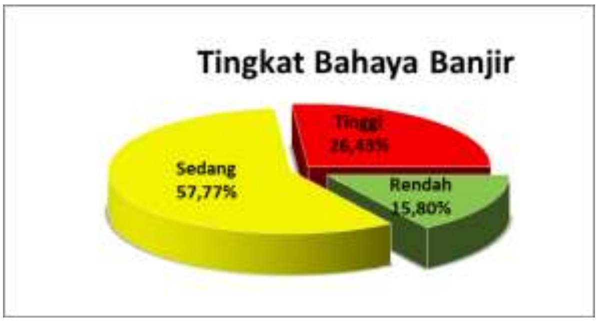

Figure 3. Extent of Flood Hazard Level

The results of the flood hazard analysis each have an area of flood hazard level, among others: low hazard level has an area of about 15,048 ha, medium hazard class area is around 55,027 ha and meanwhile for high hazard level it is 25,172 ha. The total area of the flood hazard in Bone Regency is around 95,247 ha. Based on these results, the highest area is the moderate hazard level of 57.77%, so that it can be categorized as the flood hazard class in Bone Regency as being in the moderate hazard class. The distribution and level of flood hazard in Bone Regency can be seen in the following map image.

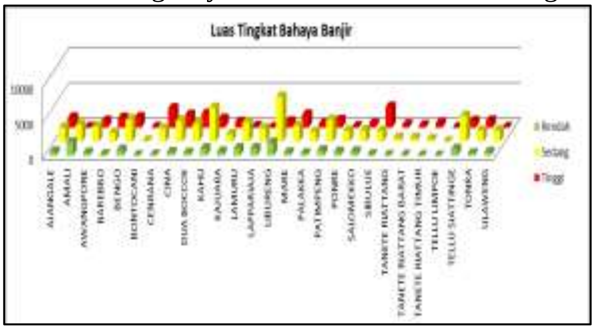

Figure 4. Distribution of Flood Hazards in Bone District

Figure 5. Map of Flood Hazard Distribution in Bone District

B. Economic Vulnerability of Flood Hazards

Vulnerability is conditions that are determined by several factors, one of which is economic factors that increase the vulnerability of a community to the impact of a disaster threat. In this analysis, economic vulnerability is obtained from the loss index analysis by combining the value of productive land losses and the contribution of GRDP. The following shows the extent and level of flood vulnerability areas in Bone Regency.

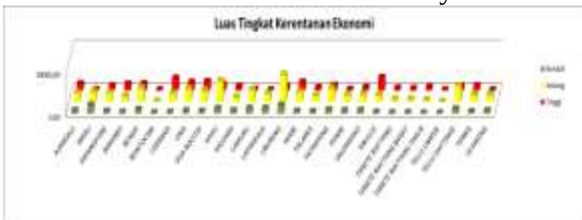

Figure 6. Flood vulnerability level in Bone District

The tabulation above shows the amount of rupiah loss when a flood occurs in each sub-district. The total loss of rupiah was around IDR 13.9 trillion with a low level of vulnerability worth 1.4 trillion, a moderate vulnerability of 5.4 trillion and a loss of high vulnerability worth 6.9 trillion. Meanwhile, the total regional income in Bone Regency in 2018 reached 29 trillion. In other words, the potential loss in the flood hazard reaches 31% of the total GRDP of Bone Regency.

C. Losses on Productive Land

Productive land is a land classification that can contribute to the economic welfare of the community, especially farmers. This land was obtained from the reclassification of existing land uses, including forestry, agriculture, fisheries and plantations with a GDP value of up to IDR 14 trillion. The following is a table of the value of productive land losses that have the potential for flooding hazards.

Figure 7. Value of Losses per Sector

The results of the table above show the magnitude of the value of the rupiah loss on productive land in each district. The potential for very high losses is on agricultural land in Libureng District. Of the total potential losses on productive land amounting to 3,369,591 million rupiah, consisting of the lowest loss in the forestry sector amounting to 8,353 million rupiahs, then plantations worth 178,782 million rupiahs, then the fisheries sector 230,245 million rupiahs, and the highest sector in agricultural land at 2,952 .212 million rupiah.

CONCLUSION

Based on the research that has been done, it can be concluded several things, namely the modified topographic index with a threshold value and a 15% zoning slope of the slope and a distance of <300 m from the river can be used to see the distribution of flood hazards. The value of the GRDP data used in this study is a combination of the forestry, plantation, fishery and agricultural sectors. We recommend that you use data values that are used as values per sector. And for the GRDP data of the fisheries sector, it is specifically for the results of fishery income on land, not a combination of the value of the income from fisheries inland (pond / fresh) and capture fisheries in the sea.

REFERENCES

Amalia, Fitri. (2012). Determination of the leading economic sectors in Bone Bolango Regency with a sector approach to forming GRDP. Ethics, 11 (2).

BNPB, the National Agency for the Response. (2016). Indonesia's Disaster Risk. National Disaster Management Agency: Jakarta.

Bongi, Anastasia, Rogi, Octavianus H. A., & Sela, Rieneke L. E. (2020). Flood Risk Mitigation in Makassar City. Sabua: Journal of the Built Environment and Architecture, 9 (1), 1–12.

Manfreda, Salvatore, Di Leo, Margherita, & Sole, Aurelia. (2011). Flood-prone area detection using a digital elevation model. Journal of Hydrological Engineering, 16 (10), 781-790.

Miharja, Nata, & Panjaitan, Seno D. (2013). Analysis of hazard and flood risk in West Kalimantan based on geographic information system (sig). Journal of Civil Engineering, 13 (2).

Munarsyah, Resky Ahmad. (2020). Analysis of the Impact of Bili-Bili Overflow on the Economy of Rural Communities, Bontomarannu District, Gowa Regency. Alauddin State Islamic University Makassar.

Sukirman, Muhammad. (2014). Study of Flood Effect on Food Crop Production in Tanasitolo Subdistrict, Wajo Regency. A lauddin state Islamic university, Makassar.

Syarif, Muhammad Munawir, Barus, Baba, & Effendy, Sabri. (2013). Determination of Agro-Hydrological Drought Hazard Index: A Case Study of the Kariango River Basin, South Sulawesi. Journal of Soil and Environmental Sciences, 15 (1), 12–19.

Utama, Lusi, & Naumar, Afrizal. (2015). Study of banjir bandang natural disasters and disaster mitigation in the Batang Kuranji River Basin, Padang City. Civil Engineering, 9 (1), 21–28.

Zhou, Feng, Xu, Youpeng, & Luo, Xian. (2011). Flood immersion simulation and risk analysis based on GIS in plain areas. 19th International Conference on Geoinformatics 2011, 1–5. IEEE.