Sumatra Journal of Disaster, Geography and Geography Education
ISSN: 2580-4030 (Print) 2580-1775 (Online)
Vol 2, No. 2, (pp. 16-23), December, 2018
http://sjdgge.ppj.unp.ac.id

Strategy for Community Adaptation in Facing Flood Natural Disasters in Pesisir Selatan District, West Sumatra

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*Corresponding Author, Received: October31, 2018, Revised: November 25, 2018, Accepted: December5, 2018

Abstract

Adaptation of the community to flood natural disasters is part of the flood mitigation natural disaster that often occurs in the rainy season. The aims of this research are to analyze landform units and land characteristics that have flood hazards and community adaptation strategies in dealing with flood natural disasters. The method used in this research is the survey method, which is to collect data on land characteristics as characteristics or characteristics of flooded areas and interviews with local communities about adaptation strategies undertaken to deal with flood natural disasters. The results showed that the landform units formed due to the flood process in the study area were in the form of floodplains, back swamps, alluvial terraces, depression inter beach ridge, and alluvial plain complexes. The unit characteristics of landforms generally have flat morphometry with slopes ranging from 0 - 2%, the genesis of these landform units due to fluvial and marine processes. The constituent material in this area is mud to coarse sand. The rock conditions in this area are rocks originating from volcanoes and undergoing a process of destruction due to processes from the river so that the rocks in this area are gravel, rough sand, fine sand. Soil conditions in each unit of landform also vary from the formation of soil to on newly developed land. Vegetation that grows in each unit landform of this is in the form of natural vegetation and lovely water vegetation or vegetation which requires a lot of water for its growth and development. The community strategy in dealing with flood natural disasters is in the form of staging houses, knowing the time of occurrence of tides, and opening the river estuary if the river estuary is covered by sediment.

Keywords: Landforms, Land Characteristics, Adaptation Strategies.

Introduction

Indonesia is a country that has a very complex potential for disasters, this is due to Indonesia's geographical location in the equator. Indonesia is also located at the confluence of three large plates of the world, namely the Indo_australian plate, the Eurasian plate, and the Pacific plate. As a result of Indonesia's geographical location, Indonesia has the potential for natural disasters in the form of floods, flash floods, droughts, volcanic eruptions, landslides, earthquakes, tsunamis, forest and land fires (Hermon, 2012).

Natural disasters that often occur during the rainy season are floods, flash floods, and landslides (Su Rito *et al*., 2011; Anggara *et al*., 2013; Muh Aris *et al.*, 2014; Oktorie, 2017). The intensity of natural disaster events in the Indonesian region tends to increase from year to year, this causes losses due to natural disasters

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tend to increase along with the intensity of the occurrence of natural disasters. Regions that have the potential for natural disasters generally have their own characteristics, which are formed as a result of past natural disasters (K.J. Gregory *et al*., 2008; Hermon, 2015). To find out the potential of natural disasters that occur in an area can be seen from the constituent material of the land that is characteristic of the land due to natural disaster activities that occurred in the past. Most of the people who live in areas that have the potential for natural disasters have adaptation patterns to adapt to the natural disasters that will occur in the future (Nick *et al*., 2005; ISDR, 2009; Hermon, 2014; Sampei *et al*., 2016). This community adaptation is generally inherited by their ancestors, who had already lived in the area (Jeannette *et al*., 2006; Hongjian *et al*., 2016; Hermon, 2016; Hermon, 2017). The development of science and technology in recent years has also led to changes in the adaptation of people living in areas that have the potential for floods. One of the areas in West Sumatra that often occurs in natural disasters is Pesisir Selatan District, which is located in the southern part of the city of Padang (Hermon, 2010). The occurrence of this natural catastrophic flood often occurs in plain areas near the coast, causing loss of property and also the human soul, as happened in the Kambang area. The flooding that occurred in this area caused losses in the form of the destruction of several houses, the breakdown of the Painan-Bengkulu highway and human casualties. To reduce losses due to natural floods, mitigation measures need to be taken in the form of knowing the landform units and characteristics of the land that have the potential for natural floods, as well as community adaptation strategies in the face of floods.

Method

The method used in this study is the survey method, namely by taking measurements in the field and interviews with the community. Measurements in the field were carried out to determine the characteristics of the land that has the potential for floods and interview techniques to determine the community's adaptation strategies in the face of floods that often occur in the rainy season.

Stages of Research

The research is carried out through several stages, namely the pre-field stage, the field stage, and the post-field stage, while the details of the activities are as follows;

Pre-field stage

The activities carried out at this stage are preparing literature related to the problem of good research from previous research reports and journals related to flood natural disasters. Prepare satellite imagery and maps needed to carry out data collection in the field and determine sample points for field data retrieval, especially those related to the characteristics of land which has the potential for flood natural disasters.

Stage Field

At this stage, the sample map is matched with the actual conditions in the field, after which sampling characteristics of the land that has the potential for a natural catastrophic flood are carried out. The characteristics of land collected in the field are data collection, geology, geomorphology, soil, hydrological conditions, and land use. To find out the adaptation star great to flood natural disasters, interviews were conducted with communities living in areas that have the potential for floods.

Post-Field Stages

The post-field stage is an activity carried out after completion of collecting data in the field. Activities carried out at this stage are classifying data, tabulating data, analyzing data, and interpreting data to draw conclusions. Make a map of results and research reports.

Data analysis

Analysis of the data used to answer this research question is as follows;

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a. To determine the landform units that have the potential for natural disasters floods are to use a geomorphological approach and interpretation of satellite images to determine the boundaries of landform units. The landform units that have the potential for flooding can be seen from the constituent material, vegetation type, and regional morphometry (K.J. Gregory *et al.*, 2008; Ellen *et al.*, 2011),
b. To find out the community's strategy in dealing with floods natural disasters are conducted by interviewing local communities, especially those who live in areas that often experience flooding (Su Rito *et al.*, 2011; Muh Aris *et al.*, 2014).

Results and Discussion

Land characteristics are a characteristic of land that distinguishes one land from another. The characteristics of the land in the flood area can be seen from the constituent material of the land which is in the form of material carried by the river and deposited on the left side of the river (Jeannette*et al.*, 2006; Barry *et al.*, 2011; Kai Kai *et al.*, 2018; Putra *et al.*, 2017). Differences in land characteristics can be seen from landform units found in the area around the river flow. The characteristics of the land as a marker for flood areas can be seen in the following table:

Table 1. Characteristics of Land in Flood Areas

NO	Landform	Land Characteristics					
		Relief-morphology	Processes	Rock Type	Soil	Hydrologic Situation	Vegetaion-Land Use
1	floodplain	Almost flat land, disekitar aliran sungai	Results of river deposits	Mud, sand or pebbles in tropical countries, beach rock may be formed by sedimentation of river	No soil development	Shallow groundwater	Typical absence of vegetation: no agriculture,
2	Back swamp	Smooth surface, morfometri berupa cekungan	Results of river deposits	Mud, sand, or pebbles in tropical countries,	No soil development	Always inundated	Lovely water vegetation
3	Alluvial terrace	Smooth surface, morfometri berupa dataran	Results of river deposits	All kind of rock	Tanah mulai berkembang, solum tanah dangkal	Groundwater is good	Cover of natural vegetation, the farther from the river shows the old alluvial terrace with varied vegetation
4.	Depression inter beach ridge	Elongated ridges, more or less parallel to one another, varying to height. The surface may be smooth, or irrigular. Elongated, almost flat bottomed depressions may separate the ridge	Results of marine activity	Basically fine sand, but gravel and shells may be included or dominante. The interridge depressions may contain finer sediments.	Young beach ridges may have a vary limited soil development.older ridges, especially in the humid tropics, may have deep soils. The interridge depressions may display soil development	In principle, in drained ground saltwater may be available, particularly in intensive beach ridge complexes. The interridge depressions are frequently wet	Cover of natural vegetation typically ranges from open to dense. The interridge depressions are densely vegetated or nypa and mangrove
5.	Alluvial plain complex	Smooth surface, morfometri berupa dataran	Marin and river action is the dominant process, fine sand is dominant matter. depending on the vegetation cover.	Sand, maybe some fine sand,small pebbles or shell fragments	Initial soil development, depending on the age of complex alluvial plain)	Basically well drained. In the depressions) ground water may be near or at the surface; an aquifer may be found	Cover of natural vegetation typically range from open. Agriculture mostly absent

Source: Data analysis, 2017

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Based on the table above the characteristics of the land in the flood area can be seen from the characteristics of the area. The characteristics of the land due to the flooding process can be seen from the units of land formed around the river in the form of floodplains, rear swamps, alluvial terraces, depression between the sandbanks, and the alluvial plain complex. The unit of the floodplain landform has a morphometry in the form of a plain located on the left-right side of the river, this landform unit is formed due to sediment from material carried by flooding, the land in the floodplain landforms has not developed and is still fresh, rough and gravel sand that is still fresh . Groundwater conditions are generally good and vegetation that grows in the form of plants that like water or plants that need a lot of water. For more details, can be seen in Figure 1 as follows.

Figure 1. Flood Plain in Batang Kapas District
Source: 2017 Research Documentation

Based on the figure on the floodplain in the study area still has natural vegetation in the form of grass and white plants, this shows that this flood plain still has a direct influence from flood natural disasters.The unit landform of the back swamp has morphometry in the form of a basin that is often flooded by water. The constituent material in the rear swamp landform unit is a material that has a fine size such as sand, fine sand, and mud. The vegetation that grows in the rear swamp is a plant that requires a lot of water, and is not good for use as agricultural land. The potential for groundwater is relatively large but usually has a pH of acidic water because it is always flooded by water. The unit of the form of alluvial terraces is formed due to the process of river erosion that is vertical in nature, this is because the river bedrock is not hard so it is easily crushed by river water. The alluvial terrace morphometry is in the form of terraced terrain, the farther away from the river flow shows the earliest terrace formed and the closer to the river flow shows the newly formed terrace. Old alluvial terraces generally have developed from the ground but still have a shallow soil solum that is 20-25 cm, while on the alluvial terrace that is still young has not shown the development of the soil, which is a fine sand fine material to coarse sand and gravel and has little natural vegetation. The potential of groundwater is generally good because the alluvial terrace landform unit has a constituent material in the form of sand and gravel. The unit of the shape of the depression between the sandstones is a form of land formed by a process originating from the sea. Unit morphometry in the form of depressed land between pistons in the form of a basin so that it has the potential for flooding. The constituent material in this landform unit is in the form of mud until fine sand is formed due to material carried by rising river water or due to the sea water that is installed. The hydrological potential of depression among the pebbles can be brackish water, whereas in the depression between old physical shelters the potential for water is in the form of fresh water but usually has a low or acidic water pH. The vegetation that usually grows in units of depressive land forms between the sandbanks and mangroves. In units of depressed land forms between old physical shelters can already be used as rice fields because they have no influence from sea water. The unit of landform of the complex alluvial plain is a unit of land formed by two processes, namely due to river flow and tidal sea water (Qing*et al.*, 2016; Putra *et al.*, 2013;Tom*et al.*, 2017). As a result of the two masses of water that meet at the mouth of the river resulting in overflow around the river mouth. The constituent material in the landform unit of the alluvial plain complex is in the form of mud and fine sand, this is due to the fact that two water masses lose their driving energy so that the water mass seems to stop flowing and results in overflow. Generally the landform units of the alluvial plain complex have brackish groundwater potential because of the influence of the tidal sea water. The vegetation that grows in this landform unit is

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natural vegetation and is not good for farming. For more details, please see the following Flood Hazard Map in South Coastal District; Based on the picture above, the flood hazard in the study area is spread almost throughout the study area, this shows that the plains in the South Coastal District are formed due to the influence of the sedimentation process both from the land and from the sea. The widest distribution of flooding is in Lunang Silaut District. Most of this area is used for oil palm plantations. For more details, see the following Tables and Figures:

Table 2. Flood Spatial Hazard Distribution in Pesisir Selatan District

Subdistrict	Medium hazard Area (ha)	High Hazard Area (ha)	Total area Hazard Banjir (ha)
Basa Ampek Balai Tapan	5.58	22196.97	22202.55
Batang Kapas	204.48	2334.15	2538.63
Bayang	282.78	2137.86	2424.60
IV Nagari Bayang Utara	43.38	60.93	104.31
IV Jurai	692.28	1141.47	1835.28
Koto XI Tarusan	1898.19	2244.06	6139.53
Lengayang	1142.1	7231.95	8374.05
Linggo Sari Baganti	1427.4	7989.03	9416.43
Lunang Silaut	1234.89	64314.63	65578.32
Pancung Soal	1055.52	42056.64	43112.16
Ranah Pesisir	888.12	5793.75	6681.87
Sutera	874.71	6887.25	7761.96
Total Large	9749.43	164388.69	176169.69

Source: Data analysis, 2017.

Based on the table above the distribution of hazardous floods is found in Lunang Silaut Subdistrict, which is 64314.63 ha, most of this area is behind swamps which have now been used for oil palm plantations. The smallest flood hazard is found in Subdistrict IV Nagari Bayang Utara, this is because this area has a morphometry in the form of mountains with very steep slopes. Based on the network image above, it can be seen that Lunang Silaut Subdistrict which has the potential to spread experiencing floods, this is because most of this area is in the form of very large swamps which are close to the sea. The swamps in this area are made of channels to remove swamp water so that this area can be used as oil palm land both by the community and the company.Community adaptation to the dangers of flooding is an action taken by the community to adjust to the hazard of flooding that often occurs when the rainy season comes. The adaptation of the people in Pesisir Selatan District in the face of flood natural disasters is to make a house on stilts, for more details can be seen in Figures 2 and 3 as follows;

Figure 2. Permanent Stage Houses Taratak Tampatih Area, Batang Kapas Subdistrict, Source: Research Documentation, 2017

Figure 3. Stage Houses Not permanent Taratak Tampatih Region Batang Kapas Subdistrict Source: Research Documentation, 2017

Based on the picture above, the residents' houses were made a stage which aimed to avoid the entry of flood water into the house, this was made by self-help of the people living in areas that often experienced floods. The flood height in this area reaches 240 cm so that to anticipate the entry of water into the house, the stilt house is made with a height of more than 240 cm. This stage house also functions not to

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disrupt the flow of water, so that the water reaches the river mouth faster and the duration of the flood is not too long. People choose the form of stilt houses in areas that have a flood hazard because the frequency of flooding in this area can reach 3 x a year with the duration of flooding generally less than 24 hours, this indicates that this area has the potential to quickly receive floods (time to peak) when reaching the peak of the rapid and fast floods also floods to recede. Flood characteristics in this study area are very much determined by the pattern of river flows which are generally parallel ie perpendicular and the duration of rapid flooding is caused by very close river mouths.The community's adaptation strategy to deal with floods is to know the timing of sea tides, this is because flood events often coincide with the tide time. At the mouth of the river meets two masses of water, causing water from the mainland to be unable to enter the sea and sea water cannot enter the land through the river, this is what causes floods in the plains. Generally the flooding that occurs around the river mouth is in the form of overflow flooding because the river flow cannot accommodate the existing water. Knowledge of sea tide time is very much needed by the community because some of the people in the plains, especially those near the sea, have fishermen livelihoods, so knowledge of tide is very necessary to find fish in the sea when it is not in the rainy season. The community adaptation to overcome the flood disaster is by keeping the river estuary from being covered by sediments from land and sea. Usually people will see the river mouth when river water starts high, this is done to see the tidal conditions of the sea and also see the estuary door closed by sediment or not. Usually the community will work together to open the estuary from the sand deposits that cover the river mouth so that the river water flows faster into the sea and the faster the flood water will recede. This condition was carried out at the Batang Tarusan estuary by a young man who lives on Muaro Pulau Karam. Based on the above description of the community strategy in dealing with floods in the South Coastal District, conclusions can be drawn as follows;

1. Landform units that have the potential to be affected by floods are units of landforms of floodplains, rear swamps, alluvial terraces, depressions between sandstones, and alluvial terrain complexes.
2. The strategy of the people in facing floods is to make houses on stilts in areas that are frequently flooded, to know the time of tides, and to work together to open river mouths if sediment closure occurs.

Conclusion

To improve the community adaptation strategy in the face of flood natural disasters are as follows;

1. Increasing people's knowledge, especially in landform units that have the potential to be affected by floods,
2. Increasing people's knowledge especially about the time to reach the peak of the flood, (time to peak) so that the community knows how to mitigate floods,
3. Increasing community participation, especially in training on community adaptation strategies to deal with flood natural disasters.

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