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RIVERBANK EROSION IN PART OF TIBO VILLAGE, DONGGALA REGENCY

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ABSTRACT

This study aims to identify riverbank erosion in some Tibo villages, Sindue Tambusabora District, Donggala Regency. This type of research is descriptive qualitative with a spatial approach. The data analysis technique used in this study includes a qualitative descriptive analysis in the form of a unit analysis of the area of landform from the fluvial process in Tibo Village, Sindue Tambusabora District, Donggala Regency. The data used in this study include primary data and secondary data. Primary data are the results of field ground checks and direct measurements, while secondary data are Landsat 8 OLI images and RBI maps of 1:50,000 scale 2015-65. This type of research is descriptive qualitative with a spatial approach. The data analysis technique used in this study includes a qualitative descriptive analysis in the form of a unit analysis of the landform area from which the fluvial process originated in the village of Tibo. Mild to moderate erosion and sedimentation rates. Erosion of cliffs is very high, especially at the bend of the river where erosion occurs due to high river discharge so that many charred rivers are found in Tibo village due to high erosion and sedimentation.

Keywords: *Erosion; Sedimentation; River.*

A. INTRODUCTION

The classification of landforms of fluvial origin relates to areas of deposition (sedimentation) such as large river valleys and alluvial plains (Raharjo, 2013). All processes that occur in the fluvial origin of landforms are caused by the process of water flow both from rivers and runoff (surface runoff). Formation of fluvial origin is formed due to river activity that causes erosion and sedimentation. Water flowing along river channels is able to mobilize sediment and carry it downstream in the form of bedload, suspended load, or dissolved load (Noor, 2014). The process of erosion and sedimentation, it produces a unique landscape due to the influence of surface water.

The problem in the research area is the erosion and transportation of river material due to the high river discharge. Geomorphological processes caused by exogenous forces such as erosion caused riverbanks to continuously decline and be eroded by water, resulting in cliff landslides. Riverbank erosion generally occurs at river bends (Aldhila Gusta H.Y dan Widiyanto, 2016). The increase in riverbank erosion that occurred in the study area was caused by soil cover in the

form of shrubs vegetation, farming patterns in the form of plantations, and high river discharge.

Tibo village is geologically located on an alluvium plain and coastal sediments whose land can be used for agriculture. Many agricultural lands and plantations on the banks of the Tibo river are used by the community for farming. Problems arise when floodplains used for agriculture turn into threats. The heavy flow of the river that erodes the edge of the cliff is a problem that needs to be solved. The absence of a cliff edge barrier causes water to quickly erode the sloping and steep side of the cliff so that people's agriculture and plantations are degraded.

The slope of the riverbank is one of the factors that also affect the vulnerability of riverbank landslides. River channel changes, such as bank erosion, down cutting and bank accretion, are natural processes for an alluvial river (Kummu et al., 2008). River cliffs that have a high slope are more likely to experience the potential for cliff landslides when the cliff conditions are unstable due to scouring due to river flow (Aldhila Gusta H.Y dan Widiyanto, 2016). On a large scale, if riverbank erosion continues, it will cause losses to community land and increase sedimentation to downstream areas due to erosion of soil, sand, and river sediment. The higher sediment buildup has the potential to reduce the river's capacity for large-intensity rainwater, especially in the rainy season (Ardiansyah et al., 2013).

The process of erosion and sedimentation on the side of the river slope is a process that occurs naturally due to the flow of the river. Erosion that most often occurs with the highest level of sediment production (sediment yield) is sheet erosion, trench erosion, and riverbank erosion (Wulandari, 2021). Erosion that occurs continuously erodes the layer of organic matter on the soil surface. The higher sedimentation reduces the capacity of the river to accommodate heavy rainfall so that river water overflows and causes flooding (Ardiansyah et al., 2013). The riverbank has a great potential for erosion and sedimentation. (Aldhila Gusta H.Y dan Widiyanto, 2016) research in the Code chopping Banteng-Gondolayu river has an erosion or scouring process that can cause cliff landslides. If this process occurs continuously, it causes silting of the riverbed and can change the pattern of river flow. In addition, riverbank erosion is influenced by flow velocity, vegetation conditions along riverbanks, farming activities on riverbanks, river depth and width, river channel shape, and soil texture (Asdak, 2007). The large rivers

have quite an unpredictable behavior with the permanent risk of riverbank erosion. Riverbank erosion can exceed one kilometer per year and poses a substantial risk to floodplain dwellers and is one of the most controversial management issues in alluvial corridors (Rahman, 2013); (Nardi et al., 2013).

Land damage due to erosion and sedimentation can significantly disrupt the surrounding land. The dynamics of land use on riverbanks in Tibo village from time to time have not changed significantly. Communities around the river use the land as a place to grow crops, both agriculture, and plantations. Land use is related to human activities that are directly related to land, where there is use and utilization of existing land and resources and causes impacts on land (Imam Hardjono, 2016). The long-term impacts of riverbank erosion can be, consisting not only of income/expenditure poverty but also of human poverty among the displaced people who derive income from, or live on, land next to rivers (Atkinson et al., 2003; Das et al., 2017).

The rate of riverbank erosion is significantly affected by parameters related to the pulses of water against the bank, changes in water level, the partitioning of rainfall between surface overland flows and subsurface pathways is a potentially significant driver of flood risk, as it determines the speed at which water is transferred from hillslope to the river channel (Pattison & Lane, 2012; Saadon et al., 2021).

The research area in Tibo village is a flood plain with mountainous morphology. If it rains with high intensity and long duration, the plain will turn into a waterlogged area. The width of the flood plains at the study site varies between 15-25 meters. This study aims to identify riverbank erosion in some Tibo villages, Sindue Tambusabora District, Donggala Regency.

B. MATERIALS AND METHODS

The study area of this research was carried out in Tibo village, Sindue Tombusabora District, Donggala Regency in March 2020 (Figure 1). This study used tools and materials, including; RBI map 1:50,000 scale, Landsat 8 OLI image of the research area, hardware (hardware) in the form of laptops, GPS, digital cameras, roll meters, measuring meters (signs), and software using the ArcGIS 10.2 program. The data used in this study include primary data and secondary data. Primary data are the results of field ground checks and direct measurements, while secondary data are Landsat 8 OLI images and RBI maps of 1:50,000 scale 2015-65.

This type of research is descriptive qualitative with a spatial approach. For interpretation of floodplain landforms combined with topographic data and field ground checks in the form of river bank slopes which are then analyzed. One of the geomorphic processes that drive shear stress is river erosion (Sutikno, Suparpto Dibyosaputro, 2019). The research location point is a flood plain so that it affects the flow rate of the river (Soetoto, 2019).

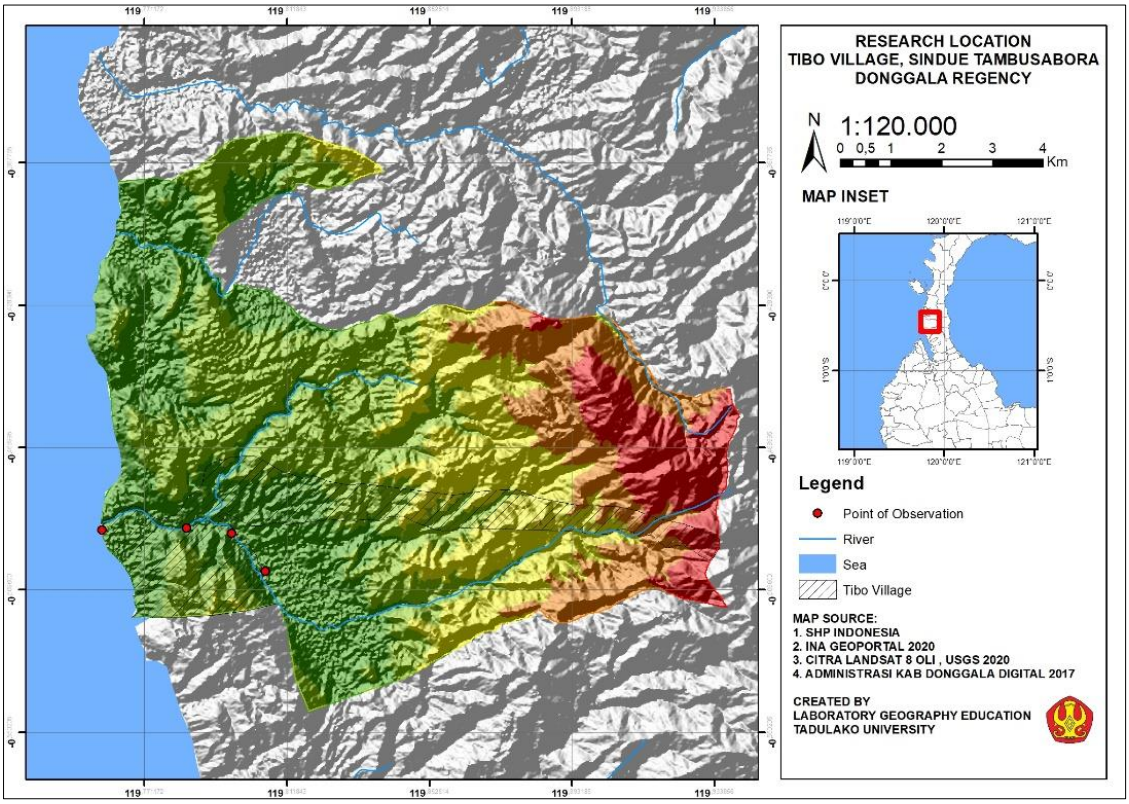

Figure 1. Research Location in Tibo Village, Donggala Regency

C. RESULTS AND DISCUSSION

Tibo Village, Sindue Tambusabora District is administratively included in the Donggala Regency area. Tibo village has a sloping to steep topography with a percentage of about 85% of the Tibo village area having a steep topography. Most of the Tibo village area is located on the coast of western Central Sulawesi. Topographic appearances which are dominated by steep topography and only slightly sloping plains are the characteristics of the island of Sulawesi. A research study in this village was conducted to identify riverbank erosion in some villages of Tibo, Sindue Tambusabora District, Donggala Regency.

The existence of a cliff landslide in the village of Tibo was caused by the erosion of the river current. The

transported material is mostly deposited on the middle side of the river which forms the river charred (Figure 2) and is deposited in the lower part of the river bordering the sea. Geomorphological processes such as erosion caused riverbanks to continuously decline, resulting in cliff landslides. Riverbank landslides are the impact of river flows that have high destructive power and can erode cliffs and riverbeds. Basically, riverbank landslides in the research location are mostly caused by river flows and high discharge so that the impact of damage to riverbanks increases from year to year. The morphological characteristics of steep land have a high potential for landslide events (Irawan et al., 2020).

Figure 2. Point Bar Caused Transport Sediment

Rainfall

Rainfall data at the Sis Aljufrie Palu meteorological station shows that in the last month, February and March 2020, Tibo village located in Donggala Regency experienced quite a lot of rain, i.e. an average of 4103.7 mm during the period from 10 February to 10 March. 2020. This shows that the higher the intensity of the rain that falls in Tibo village can result in high runoff so that some land on the banks of the Tibo river is also eroded by the flow of water. The high flow rate of the river is the main factor in eroding the river bank. The amount of sediment deposited along the river causes the downstream to experience siltation (Figure 3). Transport of sediment in the downstream or estuary also causes marine pollution.

Figure 3. Downstream of Tibo Village River

Tibo Geology

The Palu geological map shows that Tibo village has alluvial soil, mud, limestone, and coastal deposits. The ground check results in Tibo Village showed the same thing, namely the presence of sediment at the observation location. Gravel, sand, limestone are formed in a shallow river, coastal and marine environments. Alluvium soil has a coarse texture close to the flow of water and a fine texture near the edge of the flood. From geological data, it is found that the location of the river in Tibo village is a flood plain. The process of erosion and high sedimentation due to rain factors adds to the destructive power of the area.

Cliff Erosion

The land use in the research location is related to human activities. The use and utilization of these lands can cause changes in the impact on the land. The process of erosion and landslides in the research location is one of the geomorphological studies due to exogenous processes that affect landform changes. The controlling factors for erosion and sedimentation are high rainfall and the speed of river water flow. The results of the study (Lihawa, 2009) that erosion is a form of exogenous process that can change the configuration of the earth's surface. The resistance of land to erosion depends on the size and extent of the existing land cover.

There are 4 observation points in the field which are river water scouring and sedimentation. At the first point, namely observations at the mouth of the river. At this point, the sedimentation due to the high flow of the river causes silting in downstream. A lot of sediment transport in the form of river material is also carried to this point. The silting of the river is also not more than 1 meter, meaning that if at any time there is heavy rain with high intensity and long duration, the area around the river will experience impacts such as overflowing river flows due to high sedimentation.

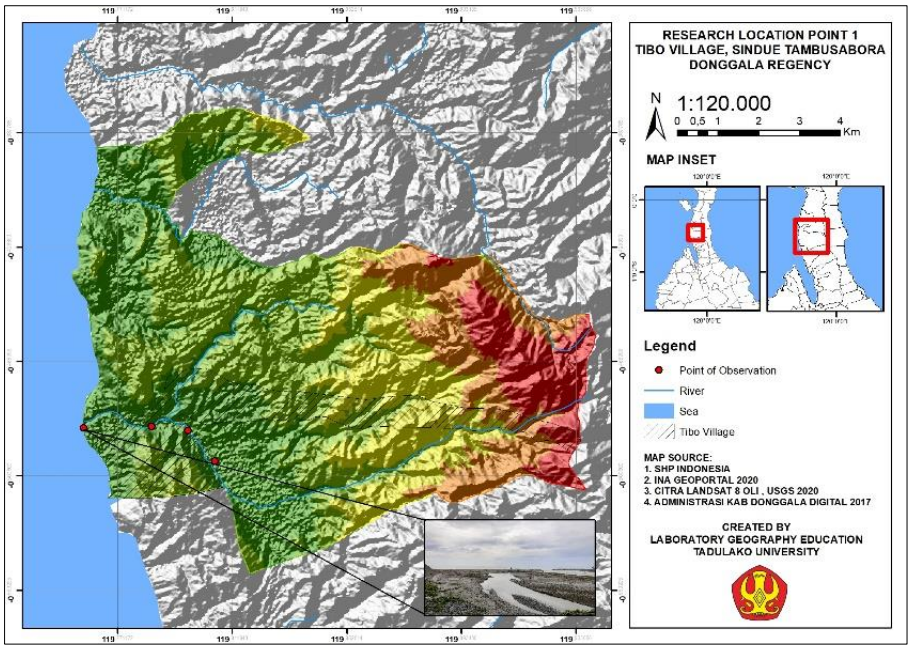

Figure 4. Observation Map of Point 1, Downstream of Tibo Village River

At point 2 of the observation location in the field, there is a river scour on the side of the road. This road is the shortest route to get to the residents' plantations. The strong river discharge at the research site caused the road conditions to be almost cut off. The avalanche length reaches 8 meters with a landslide height of 1 meter. There needs to be a barrier on the side of the road because the position of the road is right next to the river and is a river bend so that the speed and damage are high.

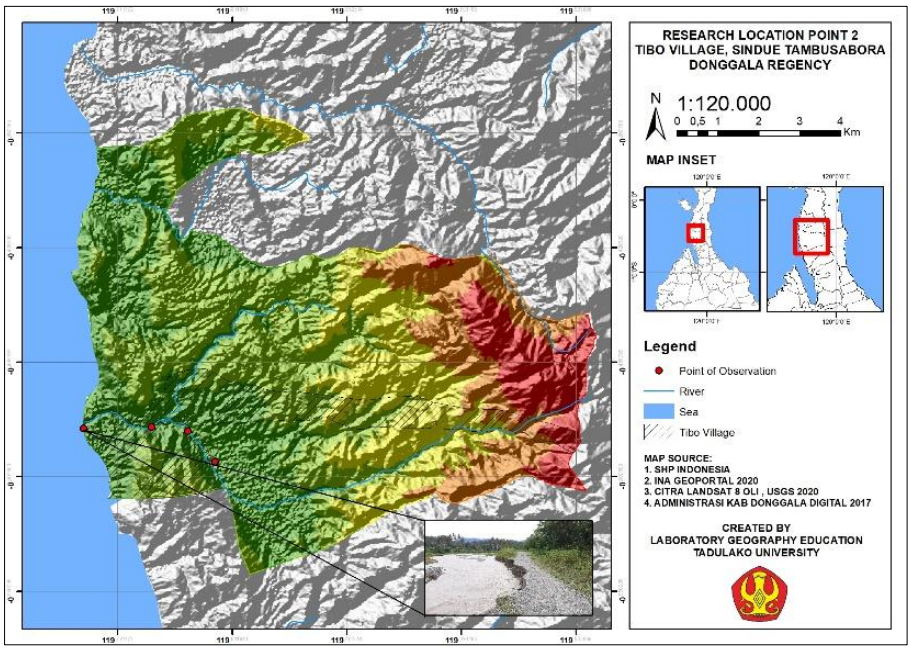

Figure 5. Observation map of point 2, scouring the river on the side of the road

At point 3 the observation location in the field there is an avalanche on the side of the road leading to the next village, namely the village of Saloya. The road is the main access to go to other villages that are close to each other. The height of the avalanche reached approximately 20 meters which were right on the side of the road. The landslide occurred due to high rainfall and the conversion of forest land into plantations so that there were no strong plant roots to withstand the heavy rain. The vegetation which is dominated by shrubs accelerates the occurrence of landslides. In addition, the condition of steep slopes, less dense soil, and rocks that are not strong are the driving factors for landslides. The change of soil to mud due to vegetation in the form of shrubs causes high runoff and triggers landslides. In steep areas, it is best to plant trees with strong roots so that they will reduce the occurrence of landslides.

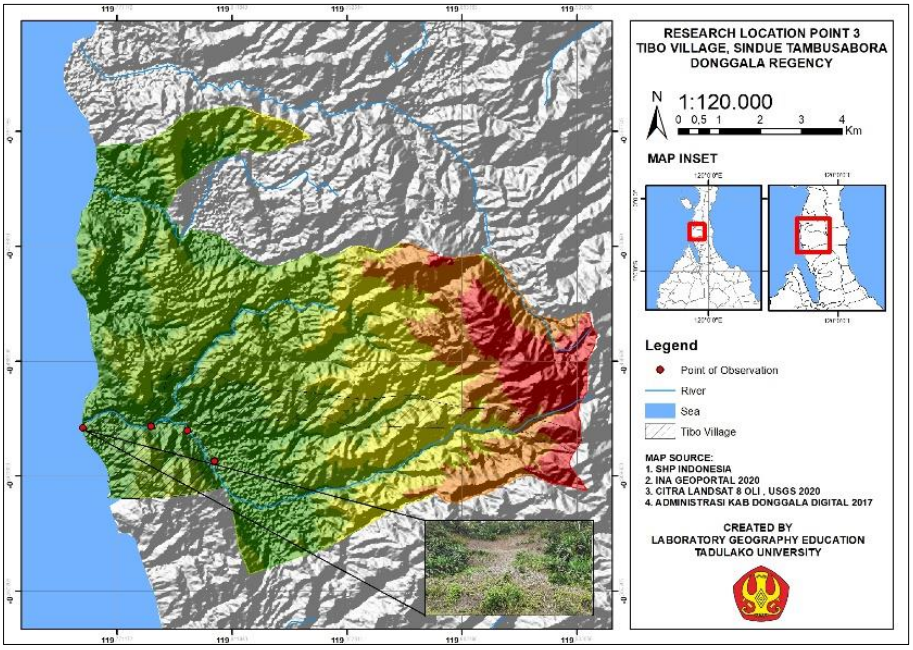

Figure 6. Observation Map of Point 3

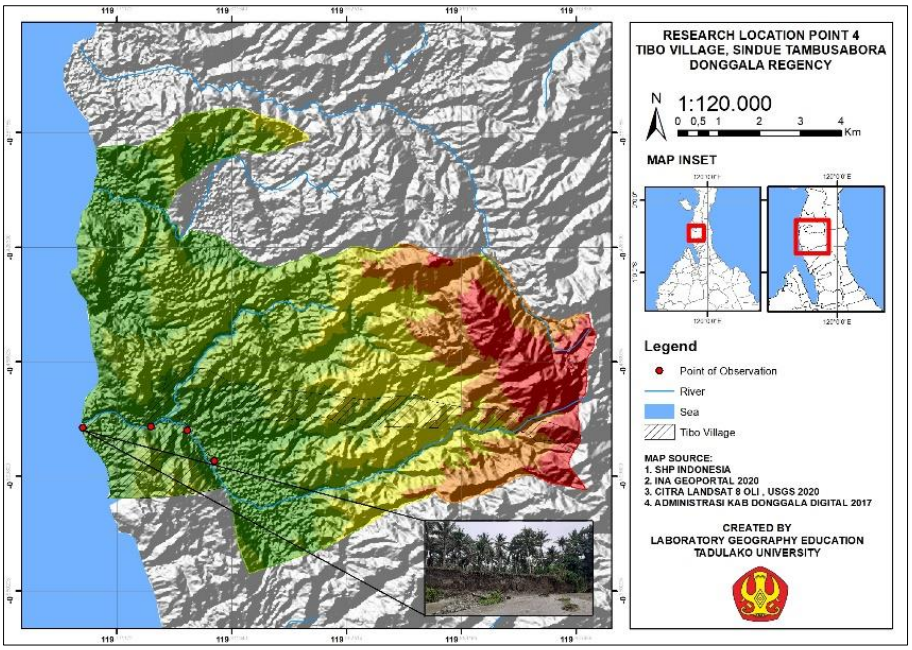

Figure 7. Observation Map of Point 4, Cliff Erosion Beside People Gardens

At point 4 of the observation location in the field, there is the erosion of the cliffs next to the people gardens. The high river discharge causes cliff erosion which erodes the plantations of the Tibo village community. Plantations located right at the bend of the river have a high impact on cliff erosion. If this is left without any mitigation to prevent cliff erosion, the community's plantations will be completely eroded. The strength of scouring on riverbanks can make changes in river flow that will widen the width of the river.

Figure 8. Slide of The Side Road

One of the rivers in Tibo village damaged the alternative road to the next village. This cliff avalanche has a length of approximately 8 meters and a width of about 3 meters. The absence of embankments blocking the river flow resulted in the erosion of the road. The high river discharge is the main factor in

the cliff landslide in Tibo village. If this is not done with mitigation efforts to overcome landslides when it rains for a long duration with high intensity, the road will be completely cut off which will have an impact on the activities of the village community.

Efforts need to be made to overcome these problems by making embankments to prevent river flow with gabions, namely the results of woven wire or bamboo filled with stones so that scouring of river flows can be minimized. In addition, riverbank erosion can be reduced by planting vegetation along the riverbank. These efforts can be carried out at points that are prone to cliff landslides, namely around river bends. Vegetation or plants can provide a roughness of the cliff to the flow of water, causing the flow of water to be restrained and reducing the energy of water to release or move sediment grains (Aldhila Gusta H.Y dan Widiyanto, 2016). Based on direct observations in the field, land use on the riverbanks of Tibo village is dominated by agriculture located on the river border. In addition, geomorphological processes in the form of erosion or scouring and sedimentation processes cause landslide susceptibility to riverbanks. In accordance with the results of research (Aldhila Gusta H.Y dan Widiyanto, 2016) that the process of erosion or scouring can cause cliff landslides if the foot of the cliff and the riverbed are eroded by water such as in the Code Penggal Banteng-Gondolayu river.

Figure 9. Erosion at The Bend of The River at Tibo Village

Figure 10 shows one of the riverbank landslides caused by river flow. This cliff landslide can occur when it rains or a heavy river flows. Figure 10 above is the result of rain with a fairly long duration with high intensity. The occurrence of scoured river flow at the bend of the river caused cliff landslides

on land owned by the community around Tibo village. The bend in the river has a great potential for erosion or cliff slides because the bend in the river has a very large impact force and erosion of the river flow. This also happened to the Code river in DIY, research conducted by (Aldhila Gusta H.Y dan Widiyanto, 2016) where the irregular river flows with many obstacles such as landslide prevention embankments can sharpen river bends and become the main cause of erosion along riverbanks. By knowing the type of landform from the fluvial process in the research area, spatial planning, especially in the agricultural sector, must always look at the risk of cliff landslides so that they can be minimized as small as possible.

Land use by the community in Tibo village

Land use in the research area is in the form of agricultural land, including coconut, corn, banana, and other fruit crops. The land use beside the Tibo river is coconut trees. The location of the plantations that are on the river border is very at risk of cliff erosion. The river flows under community plantations can erode plantation land in the event of high-intensity rain. Quality land has a high level of plant productivity. The amount of productivity of a plant is influenced by several factors, including resistance to erosion (related to relief), water availability, and soil fertility (Imam Hardjono, 2016). The upstream part of this river is a mountainous area, while the middle part is used for plantations, besides that there are also people's houses. In the middle part is the transitional part, there are rice fields, gardens for farming, and a few settlements. The downstream part of the river is dominated by residential areas. To determine the occurrence of erosion at a dangerous level or a threat of land degradation or not, it can be seen from the level of erosion hazard of the land (Ardiansyah et al., 2013).

Figure 10. Land Use in Tibo Village

D. CONCLUSIONS

The dominant landform in the village of Tibo is the origin of the fluvial process. In addition, fluvial landforms are mainly in the form of alluvial plains and floodplains. Mild to moderate erosion and sedimentation rates. Erosion of cliffs is very high, especially at the bend of the river where erosion occurs due to high river discharge so that many charred rivers are found in Tibo village due to high erosion and sedimentation. The occurrence of scoured river flow at the bend of the river which caused cliff landslides on land belonging to the community around Tibo village. The factors that cause riverbank erosion vulnerability in Tibo Village are caused by the slope of the cliff and the curvature of the river where each parameter is interrelated, so this study provides a very good overview of the areas around the river that have the potential for cliff erosion. This indicates that cliff erosion can damage the land of residents who are on the banks of the river so that vegetation is needed to withstand cliff erosion, especially in bends.

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