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THE EFFECT OF LAND USE CHANGES ON THE PAYA TUMPI FLASH FLOOD, CENTRAL ACEH DISTRICT

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ABSTRACT

Central Aceh Regency is a highland area with little risk of flooding due to its elevation, allowing water to drain quickly. Floods began to occur more frequently in the Central Aceh District in 2015s, with overflowing water in Urban Drainage in various locations. The land use of the Paya Tumpi Waterway Network has shifted from forest to agricultural. As evidenced by the high flow coefficient, which can lead to flooding in the Paya Tumpi watershed area, insufficient agricultural land processing can wreak havoc on the hydrological function of the water flow network. A low topography characterizes the site. Due to an overflown of the water flow network in Paya Tumpi village, Central Aceh Regency experienced a Flash Flood on May 13, 2020. The main issue addressed in this research is the impact of land changes on the hydrological function of the water flow network against Banjir Bandang. Using hydrological analysis and land change, we determined the flood discharge that occurred. In deciding the flood discharge, hydrological analysis and land change analysis using GIS software were used. The findings revealed that the flood influenced changes in land use, causing the water network's capacity to become ineffective.

Keywords: Perubahan Lahan, Banjir Bandang, SIG (Sistem Informasi Geospasial

1. INTRODUCTION

The Paya Tumpi area is an area that has a low topography. On May 13, 2020, there were flash floods in Paya Tumpi Baru, and Paya Tumpi villages. As a result, the flash flood caused damage to dozens of residents' houses, and the river currents dragged along goods, household appliances, and vehicles. Changes in land use in the Paya Tumpi Waterway Network from forest to agricultural land and inadequate agricultural land processing can damage. The hydrological function of the water flow network is indicated by the high flow coefficient, which can cause flooding in the watershed network area. Paya Punti. High rainfall intensity > 100 mm/day occurs with soil conditions becoming saturated to prevent infiltration and percolation. The effect of runoff/landslides, coupled with blockages due to landslides in river channels forming natural weirs during heavy rains resulting in flash floods with carrying heavy materials, crashing into community settlements in Paya Tumpi Village and Paya Tumpi Baru Village, Kebayakan District, then heading to Pinangan Village, Kebayakan District. Flash floods also occurred in Daling Village, Bebesen District.

2. LITERATURE REVIEW

Rainfall, The amount of rain that falls to the earth's surface, is expressed in the thickness of water (millimetres). Rain intensity is the amount of rainfall in one unit of time (mm/hour, mm/day, mm/year, and so on). Rain duration is the time calculated from when the rain starts to fall until it stops, usually expressed in time units. Rain recorded in one rain station is called point rain (Aryanto, 2010). The calculation of the planned rainfall is carried out using the following equation:

$$X_T = X + K.Sd \qquad (1)$$

Infiltration

Infiltration is the flow of water into the soil through the soil surface. Some rain that falls to the earth's surface enters below the soil surface, fills the soil pores, and becomes soil moisture. In Indonesia, water flows in a lateral direction as interflow, or vertically, known as percolation. Infiltration rate is calculated based on the following equationinfiltrasi

$$t\ f_t = K((\psi\ \Delta\emptyset)/F_t + 1) \qquad (1)$$

Surface Flow Discharge

Mamok Suprapto (2008), Chow uses the continuity equation to estimate the amount of discharge per unit width of the overland flow, and the momentum equation to get the flow velocity of the overland by calculating the Reynolds number to distinguish laminar and turbulent flow. Overland flow is seen as a thin flow (sheet flow) that flows in a flat area with slope and path length parameters. There is surface roughness along the water path, which interacts with rain events and infiltration processes before the flow is concentrated in natural or artificial channels. Man. Channel discharge can be estimated using the equation:

Plan Debit

According to Kamiana (2011), the planned discharge (Q_T) is the discharge scheduled for a specific return period (T) that is expected to pass through a river or water structure. Plan discharge can be determined by selecting the method. Determination of each technique in calculating debt generally depends on data availability. The Rational Debit Formula is as follows:

$$Q = 0.278.C.I.A \qquad (5)$$

SIG(Geographic Information System)

History and Development of GIS The development of Geographic Information Systems (GIS), or in English known as GIS (Geographic Information System), is inseparable from the development of Information Technology. Information Technology is the result of human engineering in delivering information.

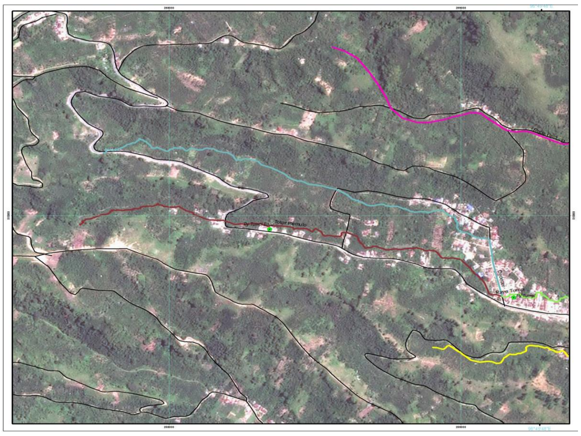
3. RESEARCH AND METHODS

The research implementation stages included literature study, data collection, and data processing to obtain research results as for the initial stage, namely the study of literature which consists of a literature study of the materials needed in this research. Then for the next step, collect the data required for the calculations obtained from the relevant agencies and direct observation in the field. In this case, the data collected is primary data and secondary data. Primary data itself is from topography in area images, contour data in elevation height, and time-related data with flow depth. At the same time, secondary data consists of rainfall and Central Aceh Map, especially Paya Tumpi Village and temperature data from government agencies.

After the data is collected, proceed the data processing stage. The first data processing is to calculate the flow rate on the Water Flow Network using a current meter research data in the field using a Current Meter. Flow discharge is obtained with several of flow data collection posts. Calculations on surface discharge, and infiltration after that, hydrological analysis can be carried out using the Rational Method. The method is supported by t frequency analysis, probability distribution, and probability distribution testing to produce the f planned discharge flowing in the water flow network from upstream to downstream.Topography and contours were obtained on the Google Earth application with the best satellite imagery to determine the slope of the water flow network, the land slope, and the water flow network slope. Thus, after the data processing stage, conclusions and suggestions can be drawn following the results obtained in the previous steps.

Study Area

The research location on the water flow network in Paya Tumpi, Kebayakan District, Central Aceh Regency, Aceh Province. To the north is But Sama, Kebayakan District, Central Aceh Regency. In the south is Takengon City, Central Aceh Regency, and Aceh Province.



3.3 SIG (System Information Geography)

To find out the Map Lay-Out at the research site using ArcGIS software. GIS (Geographical Information System) can find information - Mapping Information and Layout of water flow networks with other attribute descriptions. Apart from being used as Mapping Information, GIS (Geographical Information System) can make Natural Topography, the relationship between the high and low of an area to find out the land changes that occur. GIS (Geographical Information System) can find information - Mapping Information and LayOut of water flow networks with other attribute descriptions. Apart from being used as Mapping Information, GIS (Geographical Information System) can make Natural Topography the relationship between the high and low of an area to know the land changes that occur.

4. RESULTS AND DISCUSSION

Hydrological Analysis

Calculation of hydrological analysis is needed b to determine the amount of discharge flowing from the river to the channel to be compared with the release of the water network in the field. The data used in the analysis is rainfall data for ten years. The analysis results show that the intensity of rain increases with the magnitude of the return period. The value of R_24 will affect the power of rain.

PERIODE ULANG	Ytr	K	S_D	R_{24}	I
2	0.37	-0.15	44.68	101.70	75.35
5	1.50	0.89	44.68	148.32	109.88
10	2.25	1.58	44.68	179.18	132.75
15	2.67	1.97	44.68	196.60	145.65
20	2.97	2.25	44.68	208.79	154.69
25	3.20	2.46	44.68	218.18	161.65
50	3.90	3.10	44.68	247.11	183.08
100	4.60	3.75	44.68	275.83	204.36

Table 4.1 Results of Calculation of Rain Intensity

The runoff discharge or planned discharge in this study was calculated using the Rational Method. The results of the total calculation runoff discharge are In the following table:

PERIODE ULANG	R24	IT	Koef. Alir	Q (Km3/det)
2	101,70	22,97	0,35	29,635
5	148,32	33,50	0,35	43,220
10	179,18	40,47	0,35	52,214
15	196,60	44,40	0,35	57,289
20	208,79	47,15	0,35	60,841
25	218,18	49,27	0,35	63,578
50	247,11	55,81	0,35	72,009
100	275,83	62,29	0,35	80,377

Figure 4.1 Comparative Graph of Land Use

Land Use Change

From the analysis results, flood predictions will occur again in 2022 or 2025 if the flow coefficient is still the same or increases. Flooding will happen again, so to anticipate the occurrence of more extreme flash floods, reforestation must be carried out.

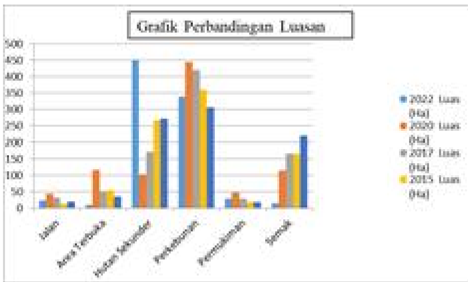
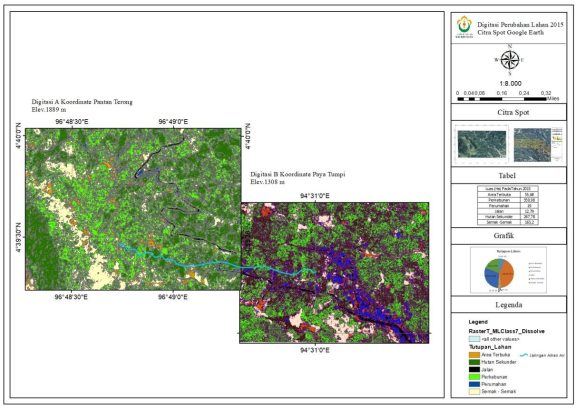


Table 4.2 Calculation of Runoff Discharge

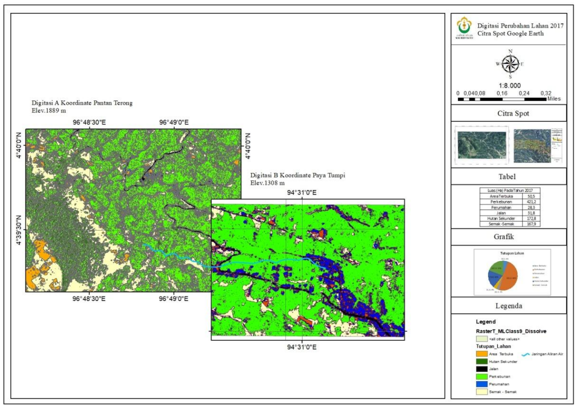
From the graph, secondary forest area should be 52% of 100% land-use area, 39% plantation area, and housing only 3% of 100 land area; roads are also only 3%, open area 1% and bush 2% from 100% land area. In 2012, the use of the land area in Figure 3.2 land used. 2012 location shows an open area of 14% of 100% the Open Area 20.2 Ha and housing by 16% of 100% of the housing area. Covering an area of 18.09 ha, bushes 33% covering an area of 220.3 ha, roads surrounding 18% covering an area of 20.2 ha, secondary forest covering 33% covering an area of 272.1 ha, and plantations covering 20%, covering an area of 307.6 ha. Land Use Changes in 2015

Figure 4.3 Land use changes in 2015



In 2015 there was an increase in the residential area to 17% with a land area of 307.6 Ha, then the open area increased from 14% in 2012 to 21%. Housing in 2015 became 17% with a land area of 19 Ha from 16% of the initial land area in 2012. Shrubs decreased to 25% with an area of 165.2 Ha. Decreased from 33% in 2012 due to the start of the function of bushland into plantations. Secondary forest still has the same position, namely 33%. Plantations increased to 24% covering an area of 359.98 Ha from 20% in 2012. Roads were reduced to 12% covering an area of 12.79 Ha from 18% in 2012, decreasing due to paths turning into bushes.

4.2.3. Land Use Change Year 2017



In 2017 the open area decreased to 20% with a land area of 50.5 Ha from 21% of land area in 2015. In residential areas it increased by 25% with a land area of 28.3 Ha from 17% of the land area in 2015. The area of land cover in shrubs is still the same as in 2015 at 25%. Plantation continues to increase to 27% with an area of 421.2 Ha from 25% in 2015. This is because the open area has become plantation land. Secondary forest decreased to 21% covering an area of 172.8 Ha from 33% in 2015, as a result of the decline in secondary forest and an increase in plantation and residential land, the road will automatically increase to 29% with an area of 31.8 Ha from 12% in 2015.

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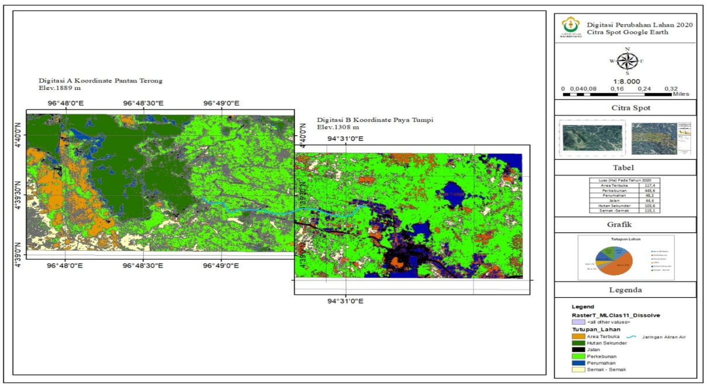
4.2.4. Changes in Land Use in 2020



In 2020 settlements increased rapidly to 41% with a land area of 48.2 Ha from 25% of land area in 2017. In open areas increased by 45% with a land area of 117.4 Ha from 20% in 2017. Shrubs decreased to 17% with a land area of 115.2 Ha from 25% of the initial land area in 2017. Plantations increased to 29% with 445.6 Ha from 27% in 2017. decreased to 13% with an area of 103.6 Ha from 21% in 2017, from 2012 to 2020 Secondary forest decreased due to land clearing for plantations. And on roads it increased to 41% with an area of 44.4 Ha from 29% in 2017. Land changes that occurred in 2012, 2015, 2017 and 2020 for the whole can be seen in the following:

5. CONCLUSION

Based on the results of digitization carried out starting from 2012, 2015, 2017 and 2020 the largest coefficient obtained was in 2020 with a coefficient of 0.36 due to the decrease in land area in secondary forest and the increase in shrubs, roads, plantations, housing and open areas. Secondary forest has a large influence on the flow coefficient as well as plantations but open areas, housing, roads, and shrubs make the flow coefficient large so that it has an impact on the design discharge and runoff.

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