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Mapping of Vegetation Development Zone to Enhance the Coastal Community Resiliency

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Mapping of Vegetation Development Zone to Enhance the Coastal Community Resiliency

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Abstract. Climate change has implications for the environment and community such as the existence of climate-related disasters. The changes of weather cycle triggers flooding in coastal areas, then high water discharge eroded the soil and caused landslides. Land conversion of upstream area causes low water absorption and high run-off which also contributes to flooding and landslides in the downstream area. Efforts to normalize rivers and urban drainage have not been able to cope with floods and landslides. Therefore, it needs an effort to minimize these disasters. The vegetative approach is an alternative for mitigating floods and landslides that are considered more comprehensive which not only conserves landscapes but also contributes to increasing green open space provision. This study aims to analyse the possibility of applying a vegetative approach to improve the physical and socio-economic community's resiliency in coastal areas from climate-related disasters. The research method used a quantitative method with data collection techniques through literature studies, field observations, and questionnaires. The data processing stages include analysis of the physical condition to determine the physical vulnerability of the area through the physical natural map overlay technique; analysis of the climate-related disasters impact on society through descriptive statistical analysis techniques; and analysis of the possibility of applying the vegetative approach by using spatial analysis techniques to determine the level of vulnerability and priority zones for vegetation development.

Keywords: *vegetative approach, climate-related disasters, coastal area*

1. Introduction

Global climate change directly impacts the changing weather cycles felt by various countries in the world through changes in temperature, rainfall, and sea-level rise, thus climate change can significantly affect lives and resources [1]. Coastal areas are one of the areas that are vulnerable to the impacts of climate change accompanied by various kinds of land use by humans causing environmental problems such as flooding, rob, abrasion, erosion, soil degradation. These problems will generally directly affect the livelihood systems of coastal communities around the world [2,3], which will encourage the vulnerability of both environmental and social communities.

It can be said that vulnerability includes various elements that tend to be easily affected by the dangers of climate change [4]. Thus, the importance of understanding vulnerability as a result of climate change needs to be done to know the impacts and risks of future disasters. Thus, the vulnerability level of a region needs to be identified to get the right strategy or adaptation efforts to be carried out [5].

Indonesia is no exception as an archipelagic country with a coastline of 108,000 km, which means that Indonesia has a fairly wide coastal area, where around 42 million people live in coastal areas. In addition, 75% of big cities are located in coastal areas that tend to be vulnerable to change climate [6].



It is indicated that climate change in Indonesia's coastal areas has an impact on increasing temperatures and rising sea levels which encourage environmental damage including tidal flooding, abrasion, erosion to damage to infrastructures such as buildings, roads, bridges which will have a broader impact on the economy and social community. One of these conditions is found on the north coast of Semarang City, every year the coastal area of Semarang city experiences environmental problems such as flood disasters both from the increase in seawater volume and flood shipments from upstream areas that are the impact of climate change. These problems describe the coastal environment of Semarang tends to be vulnerable, judging from the social vulnerability condition of the coastal area of Semarang city can be categorized moderate to high based on population density factors, gender ratio, poverty ratio, ratio of disabled people, age group ratio, while the economic vulnerability of coastal areas of Semarang city can be categorized low to high based on GDP and productive land [7].

Adaptation efforts can be made to reduce vulnerabilities and improve resilience systems [3,8]. Government involvement in efforts to adapt to the impacts of climate change is one of the important things to do [2,3,9,10]. There are still many people who are not well aware that changes in the availability of resources in coastal areas are caused by climate change. Therefore, knowledge of the impacts of climate change must be applied in the community so that coastal communities can determine the right adaptation measures in the face of climate change [3,9].

Various efforts to overcome climate change have been carried out by the government, including liveable programs, namely the reconstruction and rehabilitation of houses affected by tidal flooding, construction of gabions and sluice gates, prohibition of building houses on river borders. In 2009, the Semarang City Government has carried out several programs to deal with floods and tidal waves as one of the impacts of climate change, namely in the form of infrastructure development, construction of pump houses, construction of embankments, repair of polders and drainage to form a disaster preparedness community [10]. All of these efforts are top-down, namely the efforts of the government. One of the conditions of social vulnerability in coastal areas is the high level of poverty, causing the adaptation efforts made by the community to be very minimal [11]. People rely more on government assistance to make adaptation efforts to the impacts of climate change.

The efforts that have been made tend to overcome the impacts of climate change in the form of floods or tidal waves. This effort is an effort made after the flood or tidal flood occurred. In addition to tidal flooding, there is also the impact of climate change in the form of river erosion which causes landslides on riverbanks. Coastal areas generally have soil characteristics that are very sensitive to erosion caused by, among others, rainfall, soil type, slope, land use, and geological structure. However, land use has a great influence on erosion areas [12]. The wider the water catchment area, the lower the potential for landslides that will occur.

Efforts to deal with landslides that are affected by erosion through a vegetative approach are one of the preventive measures that can be taken to overcome the impacts of climate change in coastal areas. A vegetative approach can reduce water run-off to provide a low chance of erosion. The difference in the amount of erosion in each area is influenced by vegetation, this is because the vegetation can inhibit the kinetic energy of rainwater or run-off that falls to the ground surface so that soil particles will not be separated from their aggregates [13]. Therefore, maintaining vegetation as a ground cover is very important to protect soil erosion [12–16]. So, it is necessary to study efforts to handle the impacts of climate change in coastal areas with a vegetative approach.

Therefore, this study aims to analyse the possibility of applying vegetation as an effort to overcome the impacts of climate change to reduce the level of vulnerability, both physically and socio-economically of the affected community. Based on research [17] climate change, one of which has an impact on the occurrence of soil erosion (erosion) in coastal areas which causes threats to community livelihood systems, specifically for livelihoods, so that in the application of this vegetation approach, of course, it is necessary to pay attention to the physical and socio-economic characteristics of the community [17]. Physical characteristics in terms of soil type, slope, rainfall, vegetation. While the socio-economic characteristics in terms of population, dependency ratio, level of education, livelihoods.

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2. Data and Methods

2.1 Study Area

This research is focused on Mangunharjo and Mangkang Wetan Urban Villages, especially in the area around the downstream Beringi sub watershed. Geographically, the Urban Villages of Mangunharjo and Mangkang Wetan are located on the north coast of Semarang City, in the north, it is directly adjacent to the Java Sea. The northern coast of Semarang City is an area that cannot be separated from the impact of climate change, in the Mangunharjo and Mangkang Wetan Urban Villages, environmental problems often occur, both sea-level rise, runoff flooding, abrasion, and erosion that cause landslides on riverbanks. Based on data obtained from the Semarang City Regional Disaster Management Agency (BPBD) in 2020 there was a landslide disaster on the riverbank of the downstream Beringin sub watershed which caused damage to the embankment, the incident was caused by high rainfall intensity increasing the volume of river water reaching 60-70 cm during 3 hours. The proximity of the river to settlements and agricultural land has an impact on the entry of overflow water into residential areas and agricultural land, causing overflow flooding.

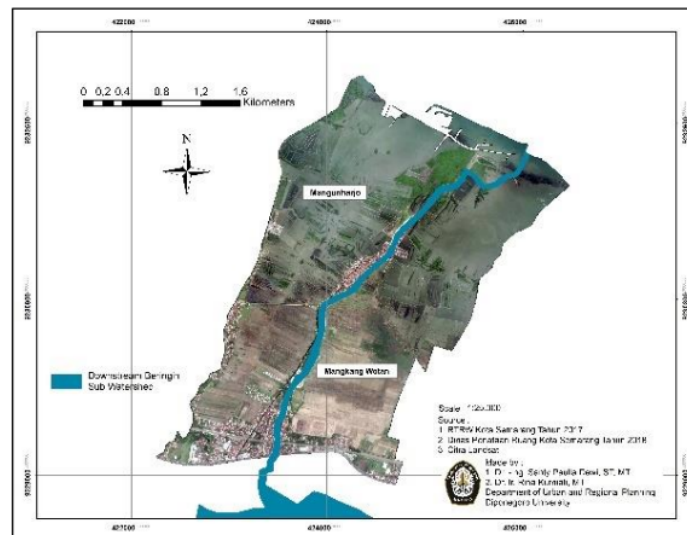


Figure 1. The Map of Focus Research

(Researcher Analysis, 2021 based on RTRW Kota Semarang, 2017, Dinas Penataan Ruang Kota Semarang, 2018 & Citra Landsat)

This research uses descriptive quantitative method through spatial data analysis method with Geographic Information System (GIS) approach and rational method. The following steps are carried out in the preparation of research, including.

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2.2 Data Collection

The data used in this study are secondary data obtained through a review of documents, literature and online data from agencies (BPBD Kota Semarang, Dinas Tata Ruang Kota Semarang, BMKG Kota Semarang). The following data are used.

Table 1. Data

Component	Data
Environment	Rainfall
	Soil
	Slope
	Land Use
Social - Economics	Total Population
	Dependency Ratio
	Education Level
	Livelihood
Citra	Landsat 8

Researcher Analysis, 2021

2.3 Analysis

The analytical techniques used in this study include spatial data analysis using a Geographic Information System (GIS) approach and rational method analysis to determine the level of runoff from the downstream Beringin sub watershed. The final result of the GIS approach has obtained a map of rainfall, soil type, land use which will then be overlaid to obtain a landslide-prone map and a map of the level of vegetation density through the calculation of the Normalized Difference Vegetation Index (NDVI) vegetation index. In addition, an analysis using a rational method was also carried out to determine the level of runoff from the downstream Beringin sub watershed. The following are the stages of research analysis.

2.3.1 Analysis of Landslide Potential Area

Landslides in an area are influenced by soil type, slope level, rainfall, land use, and geological structure in an area. Through a spatial approach with the overlay method. The initial step is to score each criterion including soil type, slope level, rainfall, land use, and geological structure which is then overlaid or overlapped [18]. The following are the stages of determining the level of landslide susceptibility in the research area based on the landslide-prone estimation model by the Directorate of Volcanology and Geological Hazard Mitigation in 2004 [19].

- The first stage of the process includes delineation of the research area, then continued with the overlay method or overlapping of factors including soil type, slope level, rainfall, land use, and geological structure, through the following formula [19].

$$\text{Score} = (0,2 \times \text{Slope Factor}) + (0,3 \times \text{Rainfall Factor}) + (0,2 \times \text{Soil Type Factor}) + (0,1 \times \text{Land Use Factor}) + (0,2 \times \text{Geological Structure Factor})$$

- The second stage is based on the results of the weighting in determining the mapping of landslide-prone areas and then making a classification zone related to the potential for landslide susceptibility, namely high, medium, low through the following equation [19].

$$\text{Class} = \frac{\text{Highest Score} - \text{Lowest Score}}{\text{Number of Classification Class}}$$

$$= \frac{22-10}{3} = 4$$

Thus, will produce a class value, where the lower the class value, the lower the landslide potential, conversely the higher the class value, the higher the landslide potential, following the classification of landslide potential.

Table 2. Parameter Score and Weight

Factor	Parameter	Score	Weight
Slope	0 – 2% = Flat	1	20%
	2 – 11 15% = Sloping, Wavy	2	
	15 – 30% = Slightly Steep	3	
	30 – 45% = Steep	4	
	>45 45% = Very Steep	5	
Rainfall	<1000 mm/year	1	30%
	1000 - 2000 mm/year	2	
	2000 - 2500 mm/year	3	
	2500 - 3000 mm/year	4	
	>3000 mm/year	5	
Soil Type	Alluvial	1	10%
	Brown Latosol Association	2	
	Brown Latosol	3	
	Andosol, Podzolic	4	
	Regosol	5	
Land Use	Fish Pond, Reservoir, Water	1	20%
	City/ Settlement /Industry	2	
	Forest and Plantation	3	
	Shrubs	4	
	Moor, Rice field	5	
Geological Structure	Alluvial Rock	1	20%
	Sediment Rock	2	
	Volcanic Rock	3	

Researcher Analysis, 2021 based on [19,20]

- c. The second stage is based on the results of the weighting in determining the mapping of landslide-prone areas and then making a classification zone related to the potential for landslide susceptibility, namely high, medium, low through the following equation [19].

$$\begin{aligned}
 \text{Class} &= \frac{\text{Highest Score} - \text{Lowest Score}}{\text{Number of Classification Class}} \\
 &= \frac{22-10}{3} = 4
 \end{aligned}$$

Thus, will produce a class value, where the lower the class value, the lower the landslide potential, conversely the higher the class value, the higher the landslide potential, following the classification of landslide potential.

Table 3. Landslide Hazard Classification

Landslide Hazard Class	Parameter
10 – 14	Low
14 – 18	Medium
18 – 22	High

Researcher Analysis, 2021

2.3.2 Calculation of Vegetation ²Normalized Difference Vegetation Index (NDVI) Result and Analysis

³⁶ The vegetation index is sensitive to the density spectral channel of plant variation. Through the Normalized Difference Vegetation Index (NDVI) method, which is a combination of band functions from Landsat 8 imagery, namely band 4 and band 5. Calculation of Landsat 8 Satellite Imagery is then analysed using spatial analysis through the following equation [21,22].

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

NDVI : Value of Normalized Difference Vegetation Index

NIR : (Near Infrared) use band 5

RED : The value of the red spectral use band 4

After the NDVI value is obtained then classification is carried out to determine the level of vegetation density. The following is the NDVI Density Level Range.

Table 4. NDVI Density Level Range

Class	NDVI	Density Level	Characteristics
1	-1 - 0,32	Low	rocks and bare ground
2	0,32 - 0,42	Medium	savana, grassland
3	0,42 - 1	High	tropical rain forest, vegetation

Departemen Kehutanan, 2003; Dasuka et al., 2015

³⁵ Data analysis techniques used in this study include calculating the peak discharge to determine the level of runoff and spatial analysis through the calculation of the Normalized Difference Vegetation Index (NDVI) vegetation index so that the level of vegetation density can be seen.

2.3.3 ⁹Peak Discharge (Qp)

Calculation of peak discharge (Qp) through the rational method with variable ²⁷of surface run off coefficient, watershed area, rainfall intensity where each variable can be calculated using the following formula [23].

$$Qp = 0,00278.C.I.A$$

⁹Qp : peak discharge m³/sec

C : surface flow coefficient

I : rain intensity (mm/hour)

A : watershed area (ha)

The area of the downstream Beringin sub watershed (A), based on research by Rifqi et al. [23] The downstream Beringin sub watershed has an area of 440,8 ha [23]. While the Surface Flow Coefficient (C), the Surface Flow Coefficient (C) parameters are based on three indicators according to Hissing based on the combination of slope parameters (Ck), soil (Ct), land use (Cp). The following are the runoff coefficient parameters. Each coefficient of runoff data is calculated using the following formula [23],

$$total = Ck + Ct + Cp$$

C total : total flow coefficient value

Ck : slope value

Ct : land value

Cp : land use value

Table 5. Parameters of Surface Flow Coefficient with Hassing Method

Slope (Ck)	Soil (Ct)	Land Use (Cp)
lowland <1% = 0,03	sand dan gravel = 0,04	Forest = 0,04
wavy land 1 – 10% = 0,08	sandloam = 0,08	Agriculture = 0,11
hills 10-20% = 0,16	Clay and silt = 0,16	grassland = 0,21
highlands >20% = 0,26	Stone Layer = 0,26	No Plants = 0,28

Rifqi et al., 2017 based on Suripin, 2002:141

The Rain Intensity Coefficient (I), downstream Beringin sub watershed is based on data on the thickness of the rain, the maximum duration of rain (t) on January 19, 2021, and the duration of the rain is assumed to be the same as the Hellman type automatic rain gauge, Semarang City Climatology Station. Rain intensity in the Lower downstream Beringin sub watershed can be calculated based on the following formula [23].

$$I = \left[\frac{R24}{24} \right] \times \left[\frac{24}{t} \right] (0,67)$$

I : rain intensity (mm/hour)

R24 : maximum rainfall (mm)

t : long time rain (hour)

Table 6. Rain Intensity Data for the Lower Downstream Beringin Sub-Watershed In 2021

Rain Station	R24 (mm)	t (hour)	I (mm/hour)
Stasiun Klimatologi Semarang	42,4	8	9,5

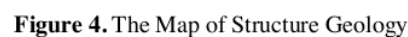
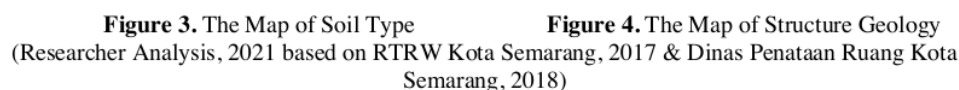
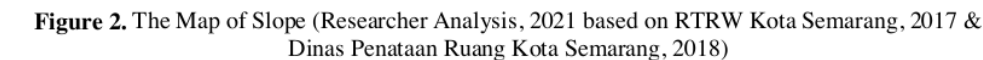
Rifqi et al., 2017 based on Suripin, 2002:141

3. Results and Discussion

3.1 Natural Physical Condition of Mangunharjo and Mangkang Wetan Urban Villages

The city of Semarang has a varied topography, in addition to the hilly area, the city of Semarang also has a coastal area in the north which is directly adjacent to the Java Sea. Mangunharjo and Mangkang Wetan are urban villages in Semarang City which are geographically located on the north coast and directly adjacent to the Java Sea. So that the topography of the coastal area is in the range of 0 – 0,75 meters above sea level with slopes reaching 0 – 2%, so it can be said that the coastal area of Semarang City has relatively flat contours. when sea-level rise occurs [24].

In addition, the Urban Villages of Mangunharjo and Mangkang Wetan are dominated by alluvial soil types formed from deposits, as well as weathering that occurs in the upstream area of the river which is then deposited in the downstream area of the river [25]. Alluvial soil tends to have fertile soil properties so it is suitable for agricultural land [26]. But on the other hand, this type of soil is easily eroded by the flow of river water. Likewise, the type of geological structure which is mostly formed from an alluvial rock is easily eroded by the flow of river water.



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Table 7. Number of Precipitation

Month	Number of Precipitation
January	301,30
February	393,20
March	231,80
April	291,60
May	267,40
June	22,10
July	71,80
August	56,40
September	90,80
October	160,80
November	240,40
December	380,10

Source: Badan Pusat Statistik Semarang, 2021

3.2 Socio-Economic Conditions of Mangunharjo and Mangkang Wetan Urban Villages

In general, the social and economic conditions of the people of Mangunharjo and Mangkang Wetan Urban Villages can be identified based on the population, dependency ratio, education level, and livelihood. Based on data from [28] the total population of Mangunharjo Urban Village reached 6,372 people with a proportion of 3,194 men and 3,178 women [28]. Meanwhile, in Mangkang Wetan Urban Village, the population reached 6,463 people with the proportion of men 3,340 men and 3,123 women [28]. In addition, the number of households based on Tugu District data in 2018 figures, Mangkang Wetan Urban Village has a higher number of households reaching 1,780 households, while the number of households in Mangunharjo Urban Village reaches 1,619 households [28].

The population age group is generally divided into three groups, including unproductive age, namely 0-14 years, productive age, 15-64 years, and unproductive age, 65 years. In 2017, the population of Mangunharjo Urban Village was mostly classified as productive age, which was 4,323 people, followed by the unproductive age of 1,426 people and the lowest was 252 people of non-productive age [28]. Likewise, Mangkang Wetan Urban Village is mostly classified as productive age, which is 4,775 people, followed by unproductive age of 1,580 people and the lowest is non-productive age of 279 people [29]. So, that it can be seen the level of dependency ratio or the level of dependence on Mangunharjo Urban Village is 3,8 percent while Mangkang Wetan Urban Village is 38,9 percent. Based on the percentage level of dependence of the two urban villages, it can be assumed that 100 people of productive age bear 39 people of unproductive age and those of non-productive age. In addition, the majority of residents in both Mangunharjo and Mangkang Wetan Urban Villages are elementary school graduates.

The level of education is one component that will describe the ability or quality of the community. People with low education graduates tend to be more vulnerable than people with higher education graduates [30], both of which are influenced by the level of community capacity in understanding the information obtained. Figure 5 shows the level of community education graduates based on data Kecamatan Tugu Dalam Angka 2019, the level of education graduates is dominated by primary school graduates in Mangunharjo Urban Village, 1,628 people graduated from elementary school and 1,604 people in Mangkang Wetan Urban Village, followed by the community Junior high school graduates in Mangunharjo Urban Village are 1,267 people and Mangkang Wetan Urban Village are 1,234 people, high school graduates in Mangkang Wetan Urban Village tend to be higher by 1,095 people compared to people in Mangunharjo Urban Village at 851 people, while people with academic and college education graduates tend to be still low namely in Mangunharjo Urban Village of 242 people while Mangkang Wetan Urban Village of 406 people [31].

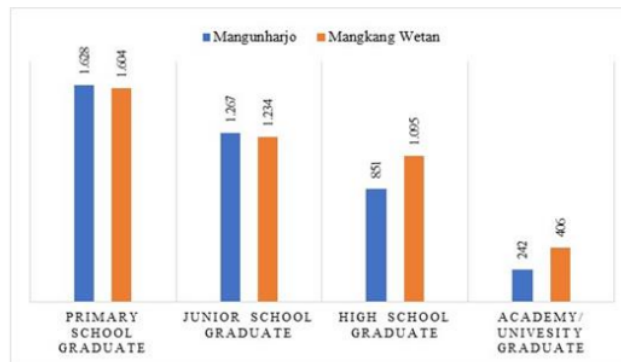


Figure 5. Education Graduate (Badan Pusat Statistik Kecamatan Tugu, 2019)

Livelihood characteristics as described in Figure 6, the majority of the people of Mangunharjo and Mangkang Wetan Urban Villages work as farmers as many as 455 people and 1,374 people, respectively. While people who work as fishermen and entrepreneurs in Mangunharjo Urban Village can be said to be low, namely as many as 54 people, in Mangkang Wetan Urban Village people who work as drivers can be said to be low, namely 23 people.

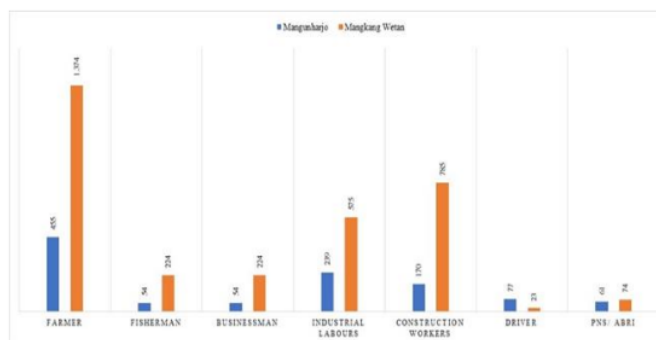


Figure 6. Livelihood Characteristics (Badan Pusat Statistik Kota Semarang, 2019)

Basically, the socio-economic characteristics of Mangunharjo and Mangkang Wetan Urban Villages have characteristics that are not much different which describe the level of community knowledge regarding disasters and mitigation efforts. From the socio-economic aspect of the local community, it shows that the proportion of the male and female population does not have a significant difference, most of them are elementary school graduates and have a livelihood as farmers, but the level of dependence on the two urban villages can be said to be low because they are dominated by people with older ages. productive. In this study, these various factors contribute to increasing community resilience in facing the impact of erosion on riverbanks (erosion) which causes landslides on riverbanks in the downstream Beringin sub watershed.

These various factors are supported by social interaction with the government through the Disaster Preparedness Group (KSB/ Kelompok Siaga Bencana), which is a form of cooperation that involves the government and the community directly. KSB includes 7 urban villages that are included in the Beringin watershed area, as well as Mangunharjo and Mangkang Wetan Urban Villages which are part of the KSB membership. These activities provide benefits including providing knowledge related to disaster and disaster preparedness prevention and management efforts both structural and non-structural, communication and coordination mechanisms become more systematic [32]. So that it can increase the

level of understanding, ability, and participation of the community in understanding vulnerability as a result of climate change.

3.3 River Cliff Landslides and Erosion of the Downstream Beringin Sub-Watershed

Riverbank landslides in Mangunharjo and Mangkang Wetan Urban Villages often occur on the banks of the downstream Beringin sub watershed, especially during high rainfall intensity. Based on disaster event data by BPBD in December 2020 there was a landslide on the riverbank of the downstream Beringin Sub-watershed which caused the embankment to burst. In addition, when viewed based on the results of spatial analysis through a geographic information approach with the overlay method on the factors that cause riverbank landslides including,

1. Soil type which is dominated by alluvial soil and composed of alluvial rock structure which has sensitive properties to erosion.
2. The intensity of rainfall in December 2020 is quite high, reaching 380.10 mm/month, causing an increase in the flow of the Banyan River watershed to reach 60-70 cm with a duration of 3 hours.
3. Land use in the area around the downstream Beringin sub watershed is dominated by settlements directly adjacent to riverbanks, rice fields and ponds.

The overlay results based on these factors described in figure 7 show that the location riverbank landslides are included in the moderate vulnerability classification.

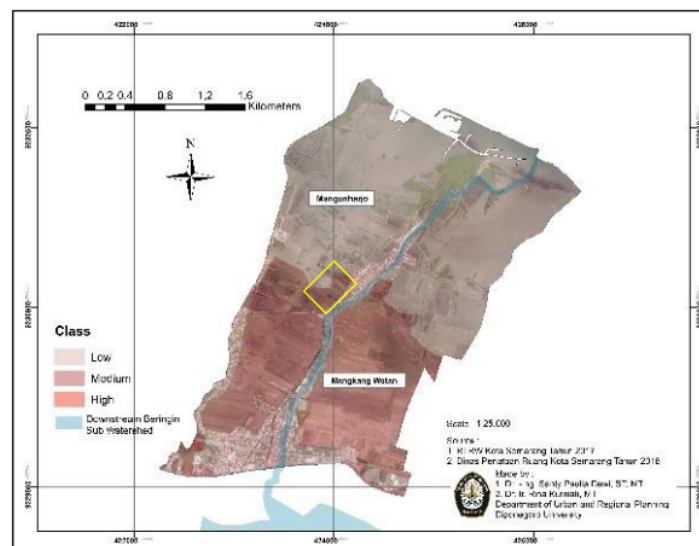


Figure 7. The Map of Landslide Classification (Researcher Analysis, 2021 based on RTRW Kota Semarang, 2017 & Dinas Penataan Ruang Kota Semarang, 2018)

The level of vulnerability to landslides is also influenced by the high runoff discharge which encourages erosion of riverbanks, which is caused not only by rainfall factors but changes in land use in upstream areas can also affect runoff discharge. The development of Semarang City is towards the hinterland, namely Ngaliyan and Mijen which are the upstream areas. Encouraging changes to land use, namely non-built land into built-up land, so that when there is high rainfall intensity some will become runoff when the soil is saturated. Based on the research of Sutopo et al., 2019 the runoff that occurred along with the Mangkang Wetan Urban Village ranged from 1,65 meters to 3,45 meters [33]. The runoff height is influenced by the amount of runoff discharge, based on the analysis of the rational method, the peak discharge height of the downstream Beringin sub watershed is obtained as follows,

Table 8. Peak Discharge Downstream Beringin Sub Watershed

Sub DAS	C	I (mm/hour)	A (ha)	Qp (m ³ /sec)
Downstream Beringin Sub Watershed	0,35	9,5	440,8	4,07

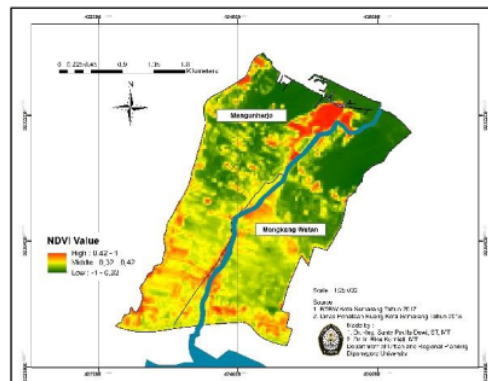
Researcher Analysis, 2021

Based on the analysis results, the peak flow of the downstream Beringin sub watershed reaches 4,07 m³/s, with a coefficient value of 0,35. This condition is influenced by the downstream Beringin sub watershed which is located on the coast which has a relatively flat slope, which is 0-2%, and the intensity of rainfall reaches 9,5 mm/hour.

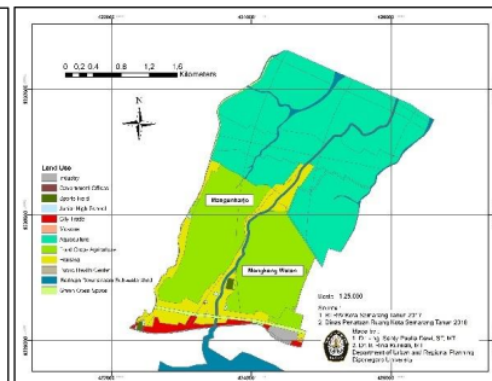
3.4 Condition of Vegetation on the banks of the Downstream Beringin Sub-Watershed

Riverbank landslides in the downstream Beringin sub watershed in Mangunharjo and Mangkang Wetan Urban Villages were influenced by various factors, both natural and human activities driven by the erosion of riverbanks caused by runoff. These conditions encourage damage to the environment and infrastructure. Efforts are needed to overcome these conditions, one of which is the vegetation approach, but these efforts cannot be separated from the existing vegetation conditions in the Mangunharjo and Mangkang Wetan Urban Village, based on research [34] the condition of the riverbanks is planted with various kinds of plants.

Vegetation conditions are also seen based on the analysis of the NDVI density level described in Figure 8, which shows that most of them are in the range of values of 0,32 – 0,45, thus showing the vegetation density condition is dominated by medium density. Vegetation density is influenced by the characteristics of the land cover if seen in Figure 9, the existing conditions are mostly used as settlements, agricultural land, and ponds.

**Figure 8.** The Map of NDVI

(Researcher Analysis, 2021 based on RTRW Kota Semarang, 2017 & Dinas Penataan Ruang Kota Semarang, 2018)

**Figure 9.** The Map of Land Use

The efforts of the vegetative approach are also inseparable from the social and economic influence of the community, in its implementation, it can be encouraged by the existence of KSB in Mangunharjo and Mangkang Wetan Urban Villages. The existence of KSB helps the community in preparedness efforts to prevent and overcome riverbank landslides. Based on research [30] the level of community preparedness is dominated by productive ages, namely 18-40 years. KSB preparedness actions begin with community understanding of disasters through the development of outreach programs, so that they can help understand the community, most of whom are elementary school

graduates and work as farmers. Thus, the implementation can be coordinated and systematic well, so it is hoped that the community will be ready when a disaster will occur.

Judging from the existing condition of land use, which is dominated by settlements that grow directly adjacent to riverbanks, the availability of land is limited. Thus, in the vegetative approach, the community can only use the available land optimally. Based on research Maridi, 2011 the vegetation approach applied in the Keduang watershed by planting ground cover crops such as vetiver, setaria grass, kolonjono grass, blembem grass around the Keduang watershed effectively reduces erosion and surface water flow [35]. The selection of these types of plants can be a recommendation that is applied by the community in efforts to overcome and prevent riverbank landslides by planting cover crops on the banks of the downstream Beringin sub watershed which has limited land availability. Thus, it will effectively give effects including [36], (1) vegetation can catch and cut raindrops before hitting directly on the ground, (2) plant roots help increase stability through soil strengthening, (3) cover crops can increase roughness thereby reducing flow velocity and transporting sediment particles, (4) plants assist in water transpiration so that it compacts the soil layer, (5) plant biological activities have a positive impact on soil porosity. Thus, the vegetative approach in its implementation can be carried out independently

21 4. Conclusion

Based on the results of research on the influence of climate change which directly affects the weather cycle felt by the people of Mangunharjo and Mangkang Wetan Urban Villages, especially in the area around the downstream Beringin sub watershed, namely high rainfall intensity causing overflow floods that cause landslides on the riverbanks of the downstream Beringin sub watershed. Based on the results of the study by overlaying the factors that affect landslides including the level of slope, soil type, rainfall, land use and geological structure, it is identified that the riverbank area of the downstream Beringin sub watershed is included in the classification of moderate landslide susceptibility. In addition, riverbank landslides in the downstream Beringin sub watershed are also influenced by cliff erosion (erosion) and vegetation density. Based on the analysis of the rational method, the river discharge reached 4.07 m³/second, while the level of vegetation density on the banks of the downstream Beringin sub watershed based on spatial analysis with the NDVI method obtained a value of 0,32 – 0,42 so that it can be categorized as a medium vegetation density level. This is influenced by the use of land around the banks of the downstream Beringin sub watershed which is used as settlements, agricultural land, and ponds. These various factors affect the level of environmental vulnerability. So that the community and government carry out various mitigation efforts, one of which is through a vegetative approach.

Mitigation efforts through a vegetative approach cannot be separated from the limited availability of land on the banks of the downstream Beringin sub watershed caused by the community's residence growing up to the banks of the downstream Beringin sub watershed. In addition, the influence of the socio-economic characteristics of the people of Mangunharjo and Mangkang Wetan Urban Villages is based on the level of education of the local community, most of whom are elementary school graduates and have a livelihood as farmers. While the level of dependence can be said to be low because it is dominated by people of productive age. These various factors are supported by the existence of a Disaster Preparedness Group (KSB/ Kelompok Siaga Bencana) which provides benefits including knowledge related to disasters and preparedness efforts for prevention and disaster management both structural and non-structural, communication and coordination mechanisms become more systematic. So, that the community will be able to reduce the level of vulnerability and increase resilience in preventing and overcoming the occurrence of erosion that causes riverbank landslides in the downstream Beringin sub watershed.

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