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DISASTER-PRONE SETTLEMENT ARRANGEMENT IN KAMPUNG BARU, SEMADAM SUBDISTRICT, SOUTHEAST ACEH REGENCY

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ABSTRACT

Semadam Subdistrict in Aceh Tenggara District is the area where flash floods occur most frequently. One of the villages that is threatened with disaster is Kampung Baru Village. Flash floods occur every year but the government's steps have not been carried out completely. Therefore, it is very important to conduct a study of social, economic, physical and environmental aspects to determine the level of disaster vulnerability as a basis for conducting comprehensive arrangement of riverbanks and settlements in order to minimize losses. This research is a descriptive type of research, using a qualitative approach in describing the vulnerability and arrangement of flash floods- prone settlements. As a result, disaster vulnerability was obtained in the high category, so the arrangement carried out included rivers and settlements at the same time. The river is structured by: construction of a reservoir at the head of a river, widening of the riverbed, and reconstruction of a bridge. Meanwhile, settlements are arranged by providing green open space and engineering the transportation system.

KEYWORDS: disaster vulnerability, flash floods, settlement arrangement.

1. INTRODUCTION

Southeast Aceh is a district in Aceh Province whose topography is dominated by mountains. Mountains and valleys form rivers that flow continuously. Gunung Leuser National Park (TNGL) and protected forest dominate the area of Southeast Aceh Regency. Other Use Areas or Area Penggunaan Lain (APL) only remain 13% which are covered by residential areas, agriculture, plantations, commercial, and so on. According to Minister of Forestry Regulation Number 50 of 2009 concerning Confirmation of the Status and Function of Forest Areas, APL is an area other than forest areas, both National Parks and Protected Forests. APL in Southeast Aceh is dominated by agricultural land and settlements.

The rivers are also a source of meeting the needs of clean water and sanitation of the community daily so that settlements tend to be built close together along these rivers for easy access. The number of riverside settlement buildings causes a large risk of damage when flash floods occur.

Flash floods disaster often hit Semadam sub-district. Most recently, on April 12, 2017 flash floods hit Semadam and Lawe Sigala- gala subdistricts with damage to 298 houses, 5 houses of worship and 2 fatalities.

The existence of settlements and all its elements on the riverbank is also considered important to be reviewed in order to mitigate future flash floods disasters with a focus on social, economy, physical and environmental aspects in order to know how big the vulnerability of flash flood disaster in the settlement. Afterwards, recommendations can be made to arrange settlements so that disasters can be prevented as early as possible in the future.

2. PROBLEMS

This research is expected to be able to answer questions related to flash floods disaster prone settlements in Semadam District, Southeast Aceh Regency. The questions are as follows:

1. What is the level of vulnerability of settlements in Kampung Baru Village, Semadam District, Southeast Aceh Regency, to flash floods disaster?
2. How is the arrangement of settlements in Kampung Baru Village that are safe from flash floods disaster?

This research focuses on the assessment of flash floods vulnerability, does not create disaster risk maps with risk, hazard and capacity analysts. The assessment was carried out to find out what steps were taken related to the arrangement of disaster response settlements in Kampung Baru Village, Semadam District, Southeast Aceh Regency. This research is expected to:

1. Analyzing the level of insecurity of flash floods disaster in Semadam Subdistrict.
2. Provide recommendations for structuring settlements in Semadam subdistrict that are safe from flash flood disasters.

3. THEORETICAL STUDIES

3.1 Disaster vulnerability

Disaster is an event or series of events that result in the victims of human suffering, property loss, environmental damage, facilities and infrastructure and can cause disruption to the life and livelihood of the community. (Sudibyakto, 2011). Disasters can be caused by natural and non-natural factors. Natural disasters are disasters caused by an event or series of events caused by natural phenomena that can result in environmental damage, material loss, or human casualties. (UGM Kamadhis Bulletin, 2007). In Law No. 23 of 2007 on Disaster Management explained that in calculating insecurity or disaster risk of an area we must know the hazard, vulnerability and capacity of an area based on the characteristics of physical condition and its formula:

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R = H x V / C (1)

Where:
R = Risk
H = Hazard
V = Vulnerability C = Capacity

Disaster risk is the potential loss caused by disasters in a certain region and period of time that can be in the form of death, injury, illness, life threatened, loss of security, displaced, damage or loss of property, and disruption of community activities, due to a combination of dangers, vulnerabilities, and capacity of the area concerned. Calculating disaster risk in a region based on hazard, vulnerability and capacity assessment in the region.

Hazard is an event that has the potential to cause accidents, injuries, loss of life or loss of property. Vulnerability is series of conditions that determine whether the danger (both natural hazards and artificial hazards) that occur will be able to cause disasters or not. (Regulation of the Head of the National Disaster Management Agency No. 2, 2012 concerning General Guidelines for Disaster Risk Assessment):
1. Social vulnerability: population density, gender, poverty rate, number of disabilities, age group ratio.
2. Economic vulnerability: productive land, Gross Regional Domestic Product (GDP).
3. Physical vulnerability: houses, public facilities, critical facilities.
4. Environmental vulnerability: protected forests, natural forests, shrubs and swamps.

Capacity is the ability to respond to certain situations with available resources (physical, human, financial and others). This capacity can be the local wisdom of the community that is told through generations.

3.2 Flood and flash floods

Flood is a form of natural phenomenon that occurs due to high rainfall intensity where there is excess water that is not accommodated by a river system. (Santoso, 2019). According to Aprilia Findayani (2015), flooding is inundated land due to river overflows, which is caused by heavy rain or flooding due to shipments from other areas that are at higher altitudes.

There are various floods, namely extreme rain floods, shipment floods, upstream floods, tidal floods, and flash floods. Each type of flood has unique characteristics. Flash floods are short flood events in about 6 hours caused by heavy rains, a broken dam, a broken embankment. This flash flood is characterized by the rapid rise in river/channel water levels. In the process of flash floods, landslides are the first to occur which are triggered by rain, then flash floods are the next events as a continuation of landslides. (Figure 1). The economic impact of the flash floods disaster is the massive and rapid impact of damage and loss of property, especially for residential buildings (lost due to drifting and

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damage), infrastructure such as bridges and roads that require large costs for their rehabilitation. In addition, damage to infrastructure buildings can isolate a residential area, as a result, the costs for evacuation and delivery of aid are difficult and expensive. The loss of their livelihoods in the long term causes economic paralysis of the communities affected by the flash floods. (Seno Adi, 2013).

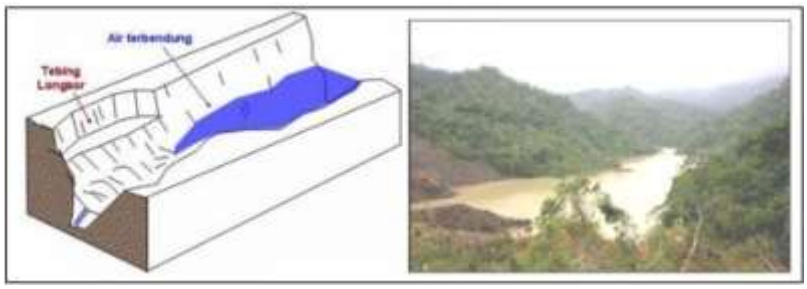

Figure 1: Landslide triggers river flooding (Adi, Seno 2013)

Flash floods are floods that occur in an area that has a low surface and occurs due to continuous rain. This flash flood has the nature of coming suddenly and usually occurs very quickly. This flash flood occurs because the water in the area is already at a saturation point, so this flood occurs so fast that it can no longer be absorbed by the soil layer. Because the water that flows can no longer be absorbed by the soil, as a result, the remaining water will be stagnated in the lower area. This flash flood is classified as a big flood and causes a lot of losses. This is because flash floods that come suddenly can drag anything if the current is strong. In addition, all objects that the flood passes through will suddenly be surrounded by water. Apart from causing large material losses, flash floods also cause many other losses. (Pelly, Dandi Arianto, 2013).

3.3 River arrangement

To reduce the threat and the aftermath of flash floods system disaster from several actions can be done (YPM and JICA, 2011) in the following ways:

1. Making flood dampers on heavy grooves to catch and temporarily store a portion of the volume of flood (detention storage) so that the discharge released downstream maximum equals the dominant discharge of downstream grooves.
2. Creating dew (reservoir basins) at possible locations for example by utilizing gullies as a large increase in volume
3. Reduce the speed of flash flood flow. The speed of this flow can be reduced especially in the transportation flow makes the flow there tiered by installing one or several (series) of ground sills to flatten the base slope. This action will reduce the threat of debris flow along with flash floods.

3.4 Settlement arrangement

There are many alternatives in the approach of planning residential areas, one of which is sustainable planning. Ervianto and Wulfram I (2019) stated that at the 1992 Earth-Level Conference in Rio de

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Janeiro, Brazil formulated the concept of sustainable development that includes three pillars that are interconnected and support each other, namely:

- Development that can improve the economic welfare of the community;
- Development that maintains the sustainability of people's social life;
- Development that maintains the quality of the community's environment through the governance of the implementation of development to improve the quality of life from generation to generation.

Sabarudin, Arief (2016) announced that the basic concept of sustainability is development that prepares improvements in social, economic and environmental aspects. The social aspect has relationships in people and values, social interactions, including social institutions that occur. The economic aspect gives attention to the allocation and distribution of scarce resources. While environmental aspects include contributions between economic and social and the effects of such contributions. (Figure 2)

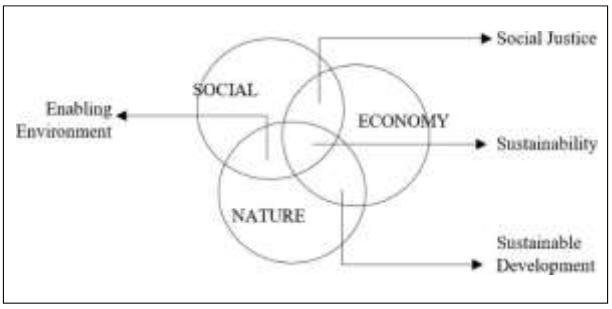

Figure 2, Concepts of sustainable development (Sabarudin, Arif, 2016)

Continuous design rule application can be done by:

1. Provision of green open space.

Every inch of land today is measured by economic benefits alone so that the provision of green open space in urban areas today becomes a rare item. On the other hand, housing demand is increasing as the population grows. The consequence is the depletion of green open space in residential areas resulting in higher energy consumption and emissions.

2. Transportation network system.

Transportation is the largest contributor to its high emissions, which is around 54.5% (Sabaruddin, 2016). The approach of planning the transportation system must be more efficient, which is determined by mileage as a consequence of distance and obstacles. Both should be shortened. Emissions and energy consumption can be reduced if road resistance and length are shortened. Therefore, planning patterns with grid systems, cul-de-sacs, loops or cluster patterns can reduce obstacles. (Kwanda, Timoticin, 2000).

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4.2 Research time and place

The research was conducted from February to December of 2020. Geographically, Semadam subdistrict is located at 3023'08.24" - 3023'21,92" LU and 97053'45.82" - 97052'10,87" BT as shown in figure 4 below:

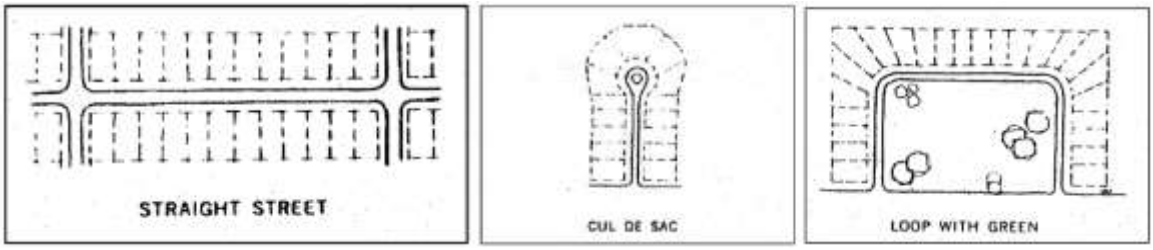

Figure 3: Grid Street pattern/straight street/gridiron, cul de sac and loop with green (Kwanda, Timoticin, 2000)

Figure 3 above shows the road placement patterns for settlements. The grid/straight street/gridiron pattern has the advantage of being a practical and efficient lot, but this pattern will cause a relatively high traffic frequency because it is a pass-through. This road pattern is the most efficient and economical in plot arrangement. For a cul-de-sac pattern, high privacy and low traffic can be achieved, but with this pattern irregular plots are created. Meanwhile the loop/cluster pattern also provides privacy, security and an economical deadlock form without the hassle of turning back. With this road pattern, several house grouping patterns can be planned.

4. METHODOLOGY

4.1 Research design

This research is a descriptive type of research, using qualitative approach in describing vulnerability and structuring of flash floods disaster prone settlements in Semadam District, Southeast Aceh Regency. The subject of the study is an individual and or group that the author is expected to tell what is known about something related to the phenomenon or case studied. Reviewed from the classification aspect based on the objectives, this research is applied research with the aim of solving the problem of losses due to the occurrence of flash floods disaster. Furthermore, this study recommends solutions for structuring residential areas that are safe from flash flood disasters.

Based on the method, this research is included in the survey research. Method in this form is research conducted to obtain the facts of the occurrence of a phenomenon by looking for a factual description. Phenomena are things that can be witnessed with five senses and can be explained and scientifically assessed such as natural phenomena and all events that cover them (Dictionary of Bahasa Indonesia, 2018).

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Figure 4. Map of Semadam District, Southeast Aceh Province, Aceh Province (https://petatematikindo.wordpress.com)

4.3 Scope of research

This research focuses on analyzing the vulnerability of flash floods disaster in Semadam Subdistrict, Southeast Aceh Regency. In disaster studies, vulnerability is a variable in calculating disaster risk among hazard variables and capacity variables. Disaster risk calculation is usually done to make a map of natural disaster insecurity. While this research, disaster studies are needed for data on the arrangement of residential areas. Therefore, the author only calculates vulnerabilities consisting of social vulnerabilities, vulnerabilities, economies, physical vulnerabilities and environmental vulnerabilities along with the elements included in them.

4.4 Data source determination

This research will be used purposive sampling technique that researchers have determined the place or informant to go.

1. Primary data taken directly in the field, in the form of conditions and location of impacts, the area of river cross-section, as well as a picture of infrastructure damage by past flash floods.
2. Secondary data related to the vulnerability of flash floods at research locations obtained from several related agencies, in the form of rain data, watershed maps and Land Use Maps, disaster-prone maps, etc. Then in their calculation of the vulnerability is specific to the research location in accordance with the instructions of Perka BNPB No.2, 2012 on General Guidelines for Disaster Risk Assessment. Other secondary data is the condition of settlements obtained from existing map products in relevant government agencies or if it is inadequate then the map is redesign by conducting a comprehensive survey.

4.5 Data collection

In qualitative research, data collection there are several methods carried out, namely:

1. Interview, which is the process of collecting information by question and answer while face-to-face or through a communication device with or without the guidelines.
2. Observation, which is the activity of obtaining information to get a real picture of an event or event.

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3. Document studies, namely the collection of a large number of facts and data stored in the form of documentation in the form of letters, notes, photo archives, meeting results, activity journals and so on.

5. RESULT AND DISCUSSION

5.1 Disaster Vulnerability

Ideally, the border of the river as far as 50 meters to the left-right of the river is a green area as an avalanche area of cliffs and ecological areas. While settlements and supporting facilities are built outside the area so that when flash floods occur material does not cause many casualties.

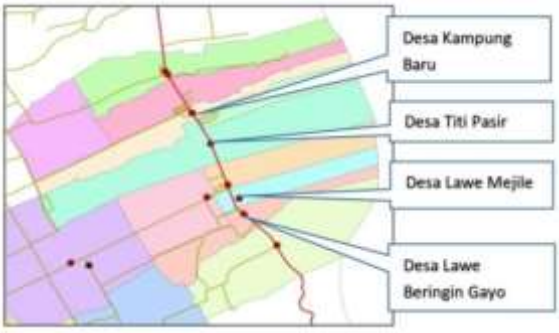

Figure 5 Locations performed vulnerability analysis and structuring (Author Analysis, 2020)

Figure 5 above shows the points of vulnerability study and arrangement of settlements in Semadam Subdistrict, focused on villages with small rivers that cut the Kutacane-Batas Sumut National Road because at this point the dense settlements are built so that they are the most at risk when flash floods occur. The points are located in Kampung Baru Village, Titi Pasir, Lawe Mejile and Lawe Beringin Gayo. The focus of this research is only in Kampung Baru Village considering that there has not been an adequate arrangement even though there are often flash floods. In Kampung Baru Village there is a river with order class III, the upstream is in the protected forest area of Bukit Barisan mountain and downstream meets Lawe Kinga river then to Kali Alas (figure 6).

Figure 6, The research location of Kampung Baru Village (maps.google.com, 2020)

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Figure 7, Flooding in Kampung Baru Village on March 28, 2019 (BPBD Aceh Tenggara, 2020)

Figure 7 shows the river was hit by flash floods on March 28, 2019 which caused 16 houses to be lightly damaged and dozens of other houses submerged in flood material. Flood material consists of mud, stone and wood that is stuck on a bridge on the Kutacane-Batas Sumut National road and overflows into the settlements.

5.2 Calculation of disaster vulnerability.

The calculation of disaster vulnerability is carried out in accordance with the Regulation of Perka BNPB No. 2, 2012 concerning General Guidelines for Disaster Risk Assessment consisting of social, economic, physical, and environmental vulnerabilities. The accumulation of vulnerability indexes will determine the steps of structuring settlements that are safe from disaster.

Social Vulnerability Index (IKS)

Indicators used in analyzing social vulnerability include population density, gender ratio, disability ratio, and age group ratio.

Figure 8, Land use map of Kampung Baru Village (Big Data Process, 2020)

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Kampung Baru Village area based on village map processed based on data from Geospatial Information Agency (BIG) in 2020 as shown in figure 8 above is 13,822 hectares or 0.13 Km2 The population of Kampung Baru Village based on BPS Aceh Tenggara data is 628 people with a male population of 307 people and 321 women. Thus, the population density is 4,536 people / km2, fall into the high category because it is above 4,000 people/km2. The gender group that is vulnerable to disasters is women so the ratio of female gender to the number of residents of Kampung Baru Village is 51.11% and fall into the high category because it is above 40%.

The poverty rate in Kampung Baru village refers to the poverty data of Southeast Aceh Regency based on BPS data in 2017 is 14.86% and fall into the low category because it is below 20%. For indicators of the ratio of people with disabilities in Kampung Baru Village based on data from the Social Service of Southeast Aceh amounted to 6 people. This means that compared to the population of 628 people, the result of 0.96% means that it fall into the low category because it is below 20%. The ratio of age groups most vulnerable to disasters is 0-14 years of age and over 60 years of age. Referring to sub-district level data based on BPS Aceh Tenggara data in 2020, the total population of Semadam sub-district is 12,140 people with an age range of 0 to 14 years and above 60 years amounting to 5,093 people. Thus, the ratio of vulnerable age is 41.95% and fall into the high category because it is above 40%. The above results are summarized in table 1 below:

Table 1 Results of social vulnerability index calculation

Parameters	*Results*	*Index Class*	*Score*
Population density (60%)	4,536 people/km2	High	1
Gender (10%)	51,11 %	High	1
Poverty (10%)	14,86 %	Low	0
People with disabilities (10%)	0,96 %	Low	0
Total age group (10%)	41,95 %	High	1

Then with the Equation of Social Vulnerability Index (IKS), the result is obtained by 0.56 with the following calculation details:

$$IKS = 0.6\ x \left(\frac{\log\left(\frac{population\ density}{0.001}\right)}{\log\left(\frac{100}{0.01}\right)} \right) + (0.1\ x\ sex\ ratio) + (0.1\ x\ property\ ratio) + (0.1\ x\ disability\ ratio) + (0.1\ x\ tothe\ age\ group) \quad .....(2)$$

$$IKS = 0.6\ x \left(\frac{\log\left(\frac{1}{0.001}\right)}{\log\left(\frac{100}{0.01}\right)} \right) + (0.1\ x\ 1) + (0.1\ x\ 0) + (0.1\ x\ 0) + (0.1\ x\ 1) = \mathbf{0,56}$$

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A value of 0.56 means that social vulnerability is in the moderate index class because it is in the range of numbers from 0.34 to 0.66

Economic Vulnerability Index (IKE)

Economic vulnerability is derived from elements of productive land and Gross Regional Domestic Product (GDP). Productive land in Kampung Baru Village in accordance with the village map of the Geospatial Information Agency (BIG) in 2020 consists of 0.843 hectares of rice fields, 9,297 hectares of garden land or with a total productive land area of 10.14 hectares. According to BPS data of Aceh Province in 2013 the amount of rice fields in Southeast Aceh is 23,130 hectares with the number of rice harvests per year reaching 105,564 tons, meaning the average yield per hectare is 4.56 tons. The price of grain in Southeast Aceh based on interviews with rice refinery owners in Kuning I Village is IDR5,000 per kilogram. In kampung baru which only has 0.843 hectares of rice fields only produce 3,847 kg of grain and total income from rice fields amounting to IDR19,237,000. In one year there are 2 harvests which means the total value of rice fields is IDR38,474,000.

Another productive land in Kampung Baru is a cornfield with an area of 9,297 hectares. The amount of maize produced in Southeast Aceh is 2,762 tons or with a land area of 0.7 hectares per farm or about 3,495 tons per hectare. (Husainah. Et al, 2014). The current price of maize per ton based on interviews with farmers in Southeast Aceh is IDR3,100 per kilogram or IDR3,100,000 per ton. In Kampung Baru with land of 9,297 hectares with a yield of 3,495 tons per hectare produces 86,434 tons of corn with a value of IDR267,946,000. In a year corn can be harvested up to three times. Its mean, total value of productive land for corn plantations is IDR 803,808,000. The total value of productive land from rice fields and cornfields is IDR838,712,000.

Gross Regional Domestic Product (GDP) in 2019 of Southeast Aceh based on BPS data of Aceh Province is IDR 3,199,062. The total number of families in Kampung Baru Village is 154 families. Thus, the GDP of Kampung Baru Village is IDR492,655,548 in the high category because it is above 200 million Rupiah. Calculation of Economic Vulnerability Index (IKE) of Kampung Baru Village is explained in table 2 below.

Table 2 Results of calculation of economic vulnerability ndeks

Parameters	*Results*	*Index Class*	*Score*
Productive land (60%)	IDR838.712.000	High	1
GDP (40%)	IDR492.655.548	High	1

The Economic Vulnerability Index (IKE) score is then included in the equation:

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IKE = (0.6 x productive land) + (0.4 x GDP) ...*(3)*
IKE = (0.6 x 1) = (0.4 x 1) = **1.00**

With a value of 1.00 means the economic vulnerability of Kampung Baru Village is in the high index class because it is in the range of 0.67-1.00.

Physical Vulnerability Index (IKF)
Physical vulnerability is obtained from the data of house types (permanent, semi-permanent and non-permanent), public facilities in the region as well as the number of critical facilities whose respective values are converted into Rupiah. Based on interviews with the head of Kampung Baru village and field observations there are 129 houses inhabited by 154 family heads. Houses are generally semi-permanent and wooden construction with an estimated average price per unit of IDR 80,000,000 then the total value of house buildings is IDR 10,320,000,000. Thus, the physical vulnerability of house buildings falls into the high category above IDR 800.000.000 in accordance with PERKA BNPB No. 2 Year 2012.

Furthermore, there are other physical indicators that are public facilities. In Kampung Baru Village in accordance with the field observations there is a Mosque building measuring 12 x 12 meters. The unit price of a simple permanent building in Southeast Aceh based on data from the Office of Public Works and Spatial Planning of Southeast Aceh is IDR 4.300.000 per meter area. The value of the mosque building becomes IDR 619.200.000. The school building with dimensions of classrooms 8 x 7 meters x 6 rooms has a total area of 336 square meters. The total value is IDR 1,512,000,000. Village Office with the title of 6 x 7 meters, the area becomes 42 square meters, the price reaches IDR 189.000.000. The total value of public facilities is IDR 2,320,200,000. Thus, the vulnerability value of public facilities also fall into the high category because it is above one billion rupiah.

So, it is with critical facilities. In Kampung Baru Village there is a 270-meter country road and a 5 meter of long bridge, 7 meters wide. Local office's data shows that the unit price of asphalt road width of 7 meters is IDR 4.5 billion per kilometer or IDR 4.500.000 per meter of long. With a length of 270 meters the total price of critical facilities of the highway is IDR 1,215,000,000. As for the unit price of the bridge for a size of 5 x 7 meters worth IDR 1.300.000.000. Thus, the critical facilities in Kampung Baru Village are worth a total of IDR 2,515,000,000 and are in the vulnerable category because the total value exceeds one billion Rupiah.

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Table 3 Result of Physical Vulnerability Index

Parameter	*Hasil*	*Index Class*	*Skor*
Houses	IDR 10.320.000.000	High	1
Public facilities	IDR 2.320.200.000	High	1
Critical facilities	IDR 2.515,000.000	High	1

The Physical Vulnerability Index (IKF) score is then entered into the equation:

IKF = (0.4 x houses) + (0.3 x public facilities) + (0.3 x critical facilities) ....*(4)*
IKF = (0.4 x 1) + (0.3 x 1) + (0.3 x 1) = 1.00

So, the physical vulnerability of Kampung Baru Village is in the high index class because it is in the range of 0.67-1.00.

Environmental Vulnerability Index (IKL)
There are five indicators used to determine environmental vulnerability, namely protected forest with a weight of 10%, natural forest with a weight of 30%, mangrove forest with a weight of 10%, shrubs with a weight of 10% and swamps with a weight of 20%. In Kampung Baru Village based on processed village map from Geospatial Information Agency (BIG) data in 2020 there is only one indicator variable, namely shrubs with an area of 0.179 hectares. Based on PERKA BNPB No. 2, 2012 this area fall into the low category because it is below 10 hectares. The overall Environmental Vulnerability Index (IKL) is included in the following table 4.

Table 4 Environmental vulnerability index calculation results

Parameters	*Results*	*Index Class*	*Score*
Protected forest	0 hectares	Low	0
Natural forests	0 hectares	Low	0
Mangrove forest	0 hectares	Low	0
Shrubs	0.179 hectares	Low	0
Swamp	0 hectares	Low	0

The Environmental Vulnerability Index (IKL) score is then entered into the equation:

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$$IKL = (0.3\ x\ protected\ forest) + (0.3\ x\ natural\ forest) + (0.1\ x\ mangrove\ forest) + (0.1\ x\ shrubs) + (0.2\ x\ swamp) \quad ....(5)$$

IKL = (0.3 x 0) + (0.3 x 0) + (0.1 x 0) + (0.1 x 0) + (0.2 x 0) = **0,00**

Environmental vulnerability in Kampung Baru Village is in the low index class because the value is in the range of 0.00-0.33.

5.3 Disaster vulnerability summary

Vulnerability means a condition in which the community has an inability to deal with disasters that have the potential to cause harm. The Disaster Vulnerability Index (IKB) is obtained from the merger of Social Vulnerability Index (IKS), Economic Vulnerability Index (IKE), Physical Vulnerability Index (IKF), and Environmental Vulnerability Index (IKL). In Kampung Baru Village, Semadam sub-district, in accordance with the calculation of each vulnerability index, the following results are obtained:

- Social Vulnerability Index (IKS) = 0.56
- Physical Vulnerability Index (IKF) = 1.00
- Economic Vulnerability Index (IKE) = 1.00
- Environmental Vulnerability Index (IKL) = 0.00

Therefore, the Disaster Vulnerability Index in Kampung Baru Village using the weight of each vulnerability index is obtained by using the following equation:

IKB = (IKS x 40%) + (IKF x 25%) + (IKE x 25%) + (IKL x 10%)
IKB = (0,56 x 40%) + (1,00 x 25%) + (1,00 x 25%) + (0,00 x 10%)

A low vulnerability has a score of 0.00 to 0.33, medium vulnerability has a score of 0.34 to 0.66, and high vulnerability has a score of 0.67 to 1.00. Thus, the Disaster Vulnerability Index in Kampung Baru Village is 0.724 and fall into a high category in accordance with BNPB Regulation of the Head of the National Disaster Management Agency Number 2, 2012.

5.4 Disaster-prone settlement arrangements

Based on the results of the calculation of high disaster vulnerability, the arrangement in Kampung Baru Village, Semadam sub- district must be carried out in an integrated manner in rivers and settlements. Given the limited land, the settlements are not fully relocated but are carried out in some areas.

5.4.1 River arrangement

Construction of river dew

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The construction of small river dew is regulated in circular letter of the Minister of Public Works and Public Housing No. 07/SE/M/2018 concerning Guidelines for The Construction of Small Dew and Its Water Reservoir Buildings in the Village.

Figure 9, Location of the small river dew development plan (personal processed from maps.google.com, 2020)

Small dew is a water conservation building in the form of ponds or basins to accommodate runoff water and other water sources to meet various water needs with a landfill volume of 500-3,000 m3, and a depth from the bottom to the top of the embankment a maximum of 3 m. Dew in addition to being used as a water source of the community will also serve as a flash flood material storage. Flash flood material consisting of mud, stone, and soil will be accommodated in the dew. Or if the volume exceeds the ability of dew then the speed of flash floods will be significantly reduced.

In Kampung Baru Village, a small dew is built upstream of the river with a distance of 650 meters from the bridge that crosses the Kutacane-Batas Sumut National Road or about 300 meters from the community settlements. (Figure 9).

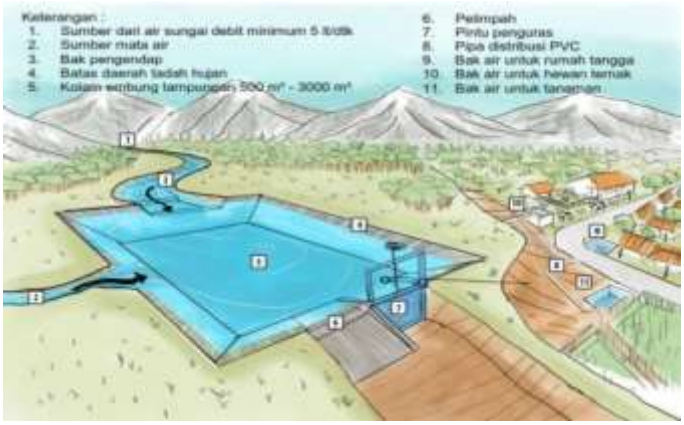

Figure 9, components of a small river dew (SE MenPU No. 07, 2018)

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Small dew consists of various components as shown in figure 9. The main components are water sources, damping tubs, rainfed limits, 500-3000 m3 connecting tubs, drain doors, water distribution pipes, and water tubs for households, animals and plants. The existence of river dew is expected to accommodate water for the needs of clean water communities and as a material reservoir when flash floods occur. Dew can also slow down flooding, giving people time to save themselves and property.

Normalization, expansion of the river cross-section.
Kampung Baru River is not widened but dredged as deep as 1.5 meters and made retaining walls. Dredging is carried out from dew to bridges with a total length of 650 meters. Dredging caused the water level to drop by 1.5 meters so that the flood cross-section became larger than the original.

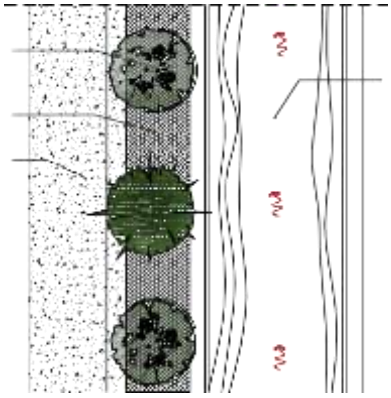

Figure 10, Plan of river arrangement of Kampung Baru Village (author analysis, 2020)

The left-right part of the river that is still filled is used as an open space for porous pavement and vegetation. In the pavement placed also the trees of the brewing and lighting facilities and signs related to the disaster. (figure 10). Village road is an existing road built with village funds. The average width is 2 meters. The arrangement is done by creating a closed drainage that equates its elevation with the existing road surface to increase the width of the cross-section of the road to 3 meters and is feasible to pass by four-wheeled vehicles.

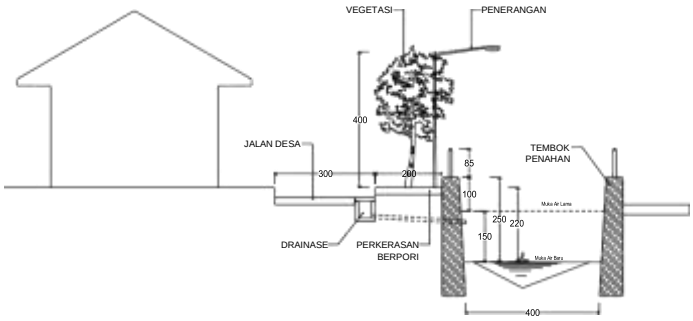

Figure 11 Plan worth the river Kampung Baru village after structuring (author analysis, 2020)

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With the normalization of the river is expected to be fulfilled cross-section of the river ideal to minimize the risk of disaster. The retaining wall is designed with a sturdy structure with a height of 2.5 meters from the water surface with a foundation of 1 meter. The retaining wall is the safety of the river trough from the grind that caused the landslide.

Bridge construction.

Figure 12 shows the bridge at the meeting point of the river and the state road Kutacane-Batas Sumut reconstructed to fit the cross-section with previous river normalization efforts. Handrail bridges are ideally a conventional form consisting of concrete poles and galvanized pipes. From making bridge walls, this type of handrail is ideal for bridges located in rivers prone to flash floods because it can secure bridges and not block flood material if large-scale flooding is abundant.

Due to the elevation of the bridge building, ramp also went up and the road became a mound. Therefore, to minimize the shock moment of the bridge and jumping vehicles, ramp is made along 10 meters with a slope of 5 degrees.

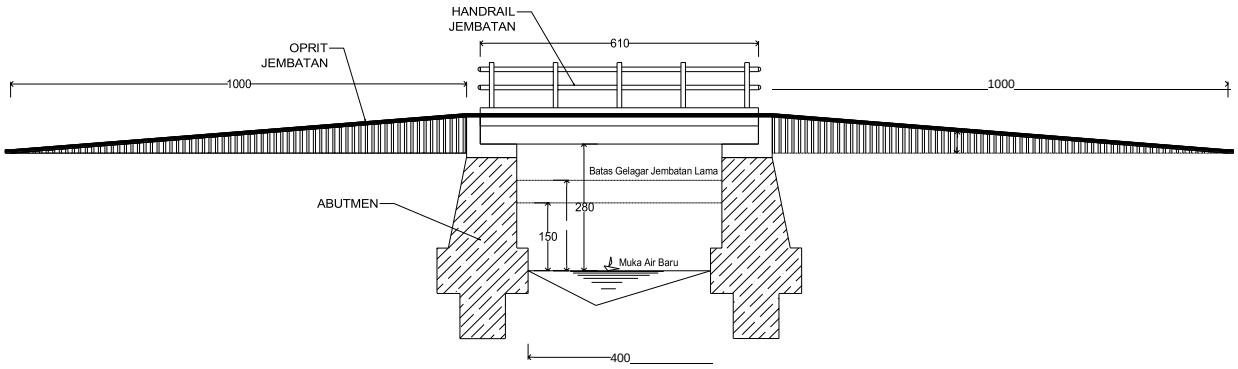

Figure 12, Reconstruction of Kampung Baru Village bridge (author analysis, 2020)

5.4.2 Settlement arrangement

Provision of Green Open Space

Green Open Space in Kampung Baru Village depends on how much border space is available. It is located along the residential road between the bridge and a small dew. A normalized 400-meter river track is then provided with open space on the side of the river leading to the settlement. There are 13 existing houses in the river-worthy area freed up land. Practically no more buildings directly adjacent to the river. All potential land area between the river and village road is used as Green Open Space with all its benefits (social, economic and ecological). That is, between the river and the settlement is connected by green open space. (Figure 13).

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Figure 13 Provision of RTH Kampung Baru Village (author analysis, 2020)

The winding river is not straightened but left to turn around in accordance with the initial conditions whose function is to slow the flow of material in the event of flooding. The cross-section of the river is expanded by deepening it at a certain point. Open space is not typical from end to end, the width varies according to the conditions of the existing river flow.

Transportation engineering

In Kampung Baru Village, there are 3 neighborhood roads for 129 residential houses. In order to get a more disaster response residential environment, a new road is created that connects the three existing roads. Its function is to facilitate access between residents and as a short route for the evacuation of banjir bandang disaster. The new road as shown in figure 14 is about 100 meters long with a width of 4 meters each.

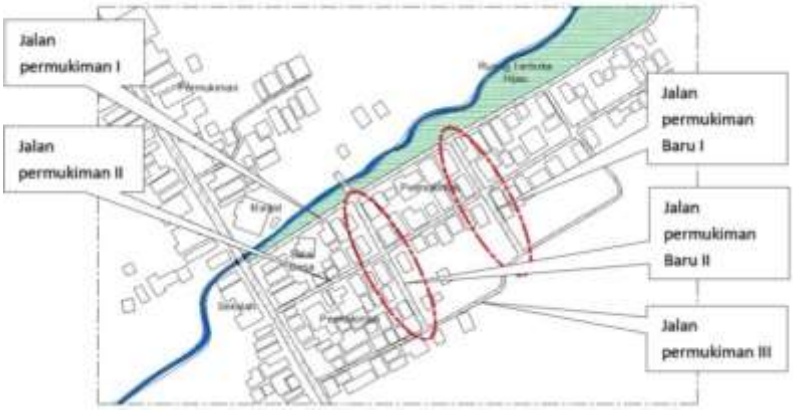

Figure 14 Environmental engineering of Kampung Baru Village (author analysis, 2020)

Road engineering eventually formed a grid/straight street/gridiron pattern that had the advantage of a practical and efficient parcel shape, but this pattern would cause relatively high traffic frequency because it was a translucent road. This road pattern is most economically efficient in the arrangement of the capling.

6. CONCLUSIONS

Based on the results of research and discussion on disaster vulnerability in Kampung Baru Village, Semadam District, Southeast Aceh Regency, the following conclusions are obtained:

• The villages that have repeatedly caused flash floods in Semadam sub-district are Kampung Baru Village, Titi Pasir Village, Lawe Mejile Village and Lawe Beringin Gayo Village. In these villages there is a river that cuts the national road Kutacane- Batas Sumut and there are bridges that block the material of flash floods and then overflow towards the settlements and cause massive damage. Only Kampung Baru village has not done adequate arrangement, both river arrangement and settlement arrangement.
• In Kampung Baru Village, disaster vulnerability analysis is carried out as the basis for structuring settlements that are safe from disasters. As a result, the Social Vulnerability Index (IKS) is at 0.56, the Index, Economic Vulnerability (IKS) is at 1.00, the Physical Vulnerability Index (IKF) is obtained at 1.00 and the Environmental Vulnerability Index (IKL) is 0.00.
• Overall Disaster Vulnerability Index in Kampung Baru Village, Semadam sub-district is 0.724 and fall into a high category because it is in the range of 0.67 to 1.00 in accordance with BNPB Regulation of the Head of the National Disaster Management Agency Number 2 Year 2012 on General Guidelines for Disaster Risk Assessment.
• Arrangements are made on rivers and settlements. On the river, small dew construction, normalization of cross-sectional widening of the river, and reconstruction of bridges. In the settlements carried out green open space providers, and transportation engineering by adding 2 roads that cut existing roads.

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