Level Of Flood Disaster Vulnerability in Hudi Laran District, Dom Aleixo, Dili City, Timor-Leste

Alexandre Pereira[1a]

[a] *Departement of Civil Engineering, Faculty of Civil Engineering and Planning, Institut Teknologi Adhi Tama Surabaya, Indonesia*

Abstract. An area is said to be prone to flooding if the area has a high tendency or potential to experience floods. This can be seen from the topography of the area as well as infrastructure such as the provision of flood inundation disposal sites. Meanwhile, to determine the level of vulnerability to flooding can be determined based on the parameters that affect the occurrence of flooding. This study aims to determine the area's vulnerability to flooding in residential areas along the Aimutin road in Hudi Laran-Timor Leste. This research was conducted quantitatively using a survey method by distributing questionnaires to 37 research samples. The population in this study included the entire residential area along Jalan Aimutin in the Hudi Laran area, Biropite Village, Dom Aleixo District, Dili City, Timor-Leste and the subjects of the study were the community, using stratified random sampling techniques by Purposive and Accidental Sampling. The results of the study based on the calculation of the flood hazard level parameter score show the high category with inundation duration >48 hours, while the frequency of flood inundation in the area shows the medium category with a presentation of 75.8% or as many as 2-5 incidents in one year. Calculation of the area's vulnerability level to flooding shows that out of 37 research samples, 10 samples fall into the low vulnerability category, the remaining 18 research samples show moderate vulnerability and 9 other samples fall into the high vulnerability category.

Keywords: Regional Vulnerabilities, Floods, Settlements Along the Aimutin Road in the Hudi Laran-Timor Leste area

1. Introduction

Floods are natural disasters that cause natural events such as high rainfall which often cause both physical and material losses. [1] said that the causes of flooding and the duration of inundation are not only caused by overflowing river water, but by excess rainfall and fluctuations in sea level, especially coastal alluvial plains, geomorphological units such as swamp areas, back swamps, floodplains, river confluence with alluvial plains are places that are prone to flooding. Excess water that inundates an area that is usually dry occurs as a result of the capacity of the river not being able to accommodate the water flowing over it or excess local rainwater. Excess local rainwater which causes flooding can be caused by two things, namely the soil has been saturated and the water level in the river channel is still high to be high. The high surface runoff as a result of excess rain can be accommodated by the river body. As a result of excess water (flooding) as a result of overflowing river water or local rain, it will cause the formation of flood formations and on a wider scale are included in the class of formations of fluvial origin.

Appointed from a phenomenon that often occurs in settlements along the Aimutin road in the Hudi Laran area, Bairopite Village, Dom Aleixo District, Dili City, Timor-Leste in recent years. On April 4, 2021 it was recorded that there were at least 34 people died as a result of flash floods triggered by Tropical Cyclone Seroja and affected public facilities and 10,000 other residents [2]. Floods that occur in Hudi Laran, Bairo Pite Village, generally occur due to two main factors, natural factors, namely flooding caused by the topography of the hills in the southern part of Hudi Laran (Dom Aleixo District), and human factors, namely changes in land use which threaten the balance of the banana garden ecosystem. and other plants. This shows that there is a need for serious handling related to this disaster in order to minimize losses and casualties as a result of the disaster.

Flood is a natural disaster (natural hazard) which is very detrimental. Flood management can be distinguished physically (structural measures) and non-physical (non-structural measures). Physically, this includes making check dams, embankments, and dams, while non-physically in the form of mapping areas that are vulnerable, dangerous or at risk of flooding. The purpose of this study is to determine the level of vulnerability of the region to floods.

2. Methods

The research began with a literature study that aimed to determine the dangers of flooding that occurred, and then data collection planning was carried out in residential areas along Jalan Aimutin, Hudi Laran area, Biropite Village, Dom Aleixo District, Dili City, Timor-Leste. After obtaining approval from residents, the next step is data collection. The data used in this research are primary and secondary. Primary data was obtained using a questionnaire survey method by capturing the experiences of respondents who were affected by flooding and then analyzed. Meanwhile, secondary data included data obtained from journals. The type of research used is quantitative research. Quantitative research methods are research that is full of numeric nuances in data collection techniques in the field [3]. The variables in this research are flood hazards, including inundation height, inundation duration, inundation frequency, and residential vulnerability, namely house condition, inundation intensity, and perceived comfort of residence. Meanwhile, the sample in this study consisted of 37 people who live in flood-prone residential areas along Jalan Aimutin in the Hudi Laran area, using a stratified random sampling technique using purposeful and accidental sampling.

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Flood Danger Level

The level of flood hazard in all residential areas along the Aimutin road in the Hudi Laran area is using a scoring method including inundation height, inundation duration, and inundation frequency. While the flood hazard parameters are grouped into three categories, namely low, medium and high with a score range of 1-3. Score 1 is a category of low hazard level, score 2 is a medium category and score 3 is a category of high flood hazard level.

Table 1. Classification of Flood Inundation Height (*Source:* Saadatus Safaah, 2017)

No.	Height(cm)	Classification	Score
1	<20cm	Low	1
2	20-50 cm	Currently	2
3	>50cm	Tall	3

Flood inundation duration parameters are grouped into three categories, namely low, medium and high with a score range of 1-3. Score 1 is a category of low hazard level, score 2 is a medium category and score 3 is a category of high flood hazard level.

Table 2. Old Classification of Flood Inundation

No.	Inundation Length (Hours)	Classification	Score
1	<12 hours	Low	1
2	12-24 hours	Currently	2
3	>24 hours	Tall	3

The classification of the frequency of flood inundation consists of three categories namely, low, medium and high with a score range of 1-3.

Table 3. Classification of Flood Inundation Frequency

No.	Flood Inundation Frequency	Classification	Score
1	0-3 events	Low	1
2	4-6 events	Currently	2
3	>6 occurrences	Tall	3

Regional Vulnerability

To determine the level of vulnerability of the area to flooding in residential areas along the Aimutin road in the Hudi Laran area, Biropite Village, Dom Aleixo District, Dili City, Timor-Leste, the data analysis technique uses the scoring method. Indicator variables include the condition of the house, the intensity of the inundation and the perceived comfort of the place to live. The score for each indicator is 1-3, where the higher the score, the higher or greater the vulnerability, but before that the first step is to determine the maximum score, minimum score, range, many classes, class length and the lower end value of the class interval.

Table 4. House Condition Variable Indicators and Scores

No.	Indicator	Variable	Score
1	Home Status	One's own	1
		Loan	2
		Rent	3
2	Building Use	Residence	1
		Place of business	2
		Residence and business	3
3	House Building Age	0-5 years	1
		5-15 years	2
		>15 years	3
4	Wall Type	Wood	1
		Mixture	2
		Wall	3
5	Floor Type	Land	1
		Cement	2
		ceramics	3

After classifying the level of regional vulnerability to flooding in residential areas along the Aimutin road in the Hudi Laran area, plotting was then carried out based on the study area and grouping each sample the same.

Table 5. Classification of Regional Vulnerability Levels (*Source: Primary data processed in 2023)*

Classification	Category	Score
1	Tall	17-21
2	Currently	12-16
3	Low	7-11

2. Result

Analysis of Flood Danger Level

Analysis of the flood hazard level in residential areas along the Aimutin road in the Hudi Laran area, using three hazard parameters including inundation height, inundation duration and inundation frequency [4]

a) Flood Period

Based on a study of 37 research samples in residential areas along the Aimutin road in the Hudi Laran area, they were in the high category for the duration of flood inundation with a duration of >48 hours.

Table 6. Percentage of Flood Period (*Source: Primary data processed in 2023*)

No.	Old Puddle	Score	Number of Samples	Percentage (%)
1	>48 hours	3	37	100%
2	24-48 hours	2	-	-
3	<24 hours	1	-	-
	Total		**37**	**100%**

b) Flood Height

The high percentage of flood inundation in residential areas along the Aimutin road in the Hudi Laran area, shows that the 37 research samples showed an inundation height of >50 cm (high category).

Table 7. High Percentage of Flood Inundation (*Source: Primary data processed in 2023*)

No.	Inundation Height	Score	Number of Samples	Percentage (%)
1	<20cm	1	-	-
2	20-50cm	2	-	-
3	>50cm	3	37	100%
	Total		**37**	**100%**

c) Flood inundation frequency

The frequency of flood inundation in residential areas along the Aimutin road in the Hudi Laran area shows from 37 research samples 75.8% or 2-5 times the frequency of flood inundation in one year of occurrence.

Table 8. High Percentage of Flood Inundation (*Source: Primary data processed in 2023*)

No.	Inundation Frequency	Score	Number of Samples	Percentage (%)
1	0-1 times	1	-	-
2	2-5 times	2	28	75.67%
3	6-10 times	3	9	24.32%
	Total		**37**	**100%**

Regional Vulnerability Level To Flood

Table 9. shows the results of research related to the Indicator variable the level of vulnerability of the region to flooding that there are 25 houses used as residences, the remaining 9 houses are used as residences and businesses and 3 other houses are used as places of business.

Table 9. Home Use Percentage (*Source: Primary data processed in 2023*)

No.	Home Use	Number of Samples	Percentage (%)
1	Residence	25	67.56%
2	Place of business	3	8.10%
3	Residence and Business	9	24.32%
	Total	**37**	**100%**

Based on the results of research in residential areas along Jalan Aimutin in the Hudi Laran area, it is known that of the 37 research samples, there were 91.89% or 34 houses owned by the owner and the remaining 8.10% or 3 houses were rented.

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Table 10. Percentage of House Building Status (*Source: Primary data processed in 2023*)

No.	House Building Status	Number of Samples	Percentage (%)
1	One's own	34	91.89%
2	Rent	3	8.10%
3	Loan	-	-
	Total	**37**	**100%**

The results of the calculations in table 11 below show that there are 4 houses with dirt floors. While 51.35% indicated the percentage of houses with tile floors and 37.83% indicated houses with cement floors.

Table 11. Floor Type Percentage (*Source: Primary data processed in 2023*)

No.	Floor Type	Number of Samples	Percentage (%)
1	Land	4	10.81%
2	Cement	14	37.83%
3	ceramics	19	51.35%
	Total	**37**	**100%**

The results of the research on the age indicators of house buildings at research sites in residential areas along the Aimutin road in the Hudi Laran area show that 13.51% of the houses are 0-5 years old, 29.72% of the houses are 5-15 years old and there are 56.75 % of houses aged >15 years.

Table 12. Percentage of House Building Age (*Source: Primary data processed in 2023*)

No.	House Building Age	Number of Samples	Percentage (%)
1	0-5 years	5	13.51%
2	5-15 years	11	29.72%
3	>15 years	21	56.75%
	Total	**37**	**100%**

Based on research on indicators of the type of wall of houses in residential areas along the Aimutin road in the Hudi Laran area, it showed the same presentation of wood and mixed wall types, namely 16.21% each or 6 samples each and the remaining 64, 86%.

Table 13. Wall Type Percentage (*Source: Primary data processed in 2023*)

No.	Wall Type	Number of Samples	Percentage (%)
1	Wood	6	16.21%
2	Mixture	6	16.21%
3	Wall	24	64.86%
	Total	**37**	**100%**

The intensity of flood inundation in residential areas along the Aimutin road in the Hudi Laran area shows that an inundation duration of >4 days with an inundation height of 100 cm is included in the high category with a presentation of 51.35%.

Table 14. Percentage of Flood Inundation Intensity (*Source: Primary data processed in 2023*)

Inundation Height	Old Puddle			Percentage (%)
	1-2 days	3-4 days	5-6 days	
50cm	-	13	-	35,13
50-100cm	-	5	-	13.51 %
>100cm	-	-	19	51.35%

The results of the research on the perception of the comfort of the residence of people who live in residential areas along the Aimutin road in the Hudi Laran area show that 56.75% of respondents think that they are uncomfortable living in this flood-prone area.

Table 15. Perceptions of Perceived Comfort in People's Residences (*Source: Primary data processed in 2023*)

No.	∑ Subject	Percentage (%)	Level
1	1	2.70%	Very comfortable
2	15	40.54%	Comfortable
3	22	56.75%	Uncomfortable
		Total 35	

The research results on the level of flood hazard and the level of vulnerability in residential areas along the Aimutin road in the Hudi Laran area, using purposive random sampling techniques and accidental sampling.

Several factors influenced the number of houses inundated by floods along the Aimutin road in the Hudi Laran area as follows:

a. The research was conducted at a location at a low altitude of ±5 meters above sea level at an elevation of 0-50 meters.

b. Most people in flood-prone areas build houses with high foundations with the aim of preventing floods from entering the house.

From the results of research on 37 samples in residential areas along the Aimutin road in the Hudi Laran area and scoring analysis, it was concluded from each respondent regarding the level of flood hazard that the variable indicator of flood hazard level at an elevation of 0 to 50 meters is included in the high category with an inundation duration of <48 hours. The low altitude of the area during the rainy season causes water to inundate this location due to limited drainage channels while the incoming water discharge is greater than the outgoing water discharge. The height of the flood inundation that inundated the study site was included in the high category, namely >50 cm. The frequency of flood inundation is included in the moderate category, there are 2-5 incidents within one year.

The indicators in calculating the score on the vulnerability level of the area in settlements along the Aimutin road in the Hudi Laran area consist of variable indicators of house conditions, intensity of inundation, perceptions of the comfort of living quarters indicating that there are three types of vulnerability, namely low vulnerability, medium vulnerability and high vulnerability.

The results of the analysis can be obtained from the final value of each respondent which is shown in table 16 below.

Table 16. Calculation of Area Vulnerability Value at an Elevation of 0.5 m to 50 m

NO	Respondent Code	Home Conditions			Intense. puddle			Persp. Level	Total	Category
1	**ER1**	1	1	3	1	2	1	2	1	Low
2	**ER2**	1	1	1	2	1	1	3	3	Low
3	**ER3**	1	1	1	3	2	2	2	1	Low
4	**ER4**	1	1	3	1	2	1	2	1	Low
5	**ER5**	1	2	2	1	2	1	2	1	Low
6	**ER6**	1	2	2	1	1	1	2	1	Low
7	**ER7**	1	1	2	1	2	1	2	1	Low
8	**ER8**	1	2	1	1	2	1	2	1	Low
9	**ER9**	1	2	3	1	1	1	2	1	Low
10	**ER10**	1	2	2	1	2	1	2	1	Low
11	**ES1**	1	1	3	3	2	1	2	1	Currently
12	**ES2**	1	1	3	3	3	1	2	1	Currently
13	**ES3**	1	1	3	3	3	1	2	1	Currently
14	**ES4**	1	1	2	3	3	1	3	1	Currently
15	**ES5**	1	1	3	2	2	2	2	1	Currently
16	**ES6**	1	1	2	3	3	1	2	1	Currently
17	**ES7**	1	1	2	3	3	1	2	1	Currently
18	**ES8**	1	1	3	3	2	1	2	1	Currently
19	**ES9**	1	3	1	3	2	1	3	1	Currently
20	**ES10**	1	1	2	1	1	3	3	1	Currently
21	**ES11**	1	3	2	3	3	2	2	1	Currently
22	**ES12**	3	2	2	2	3	1	2	1	Currently
23	**ES13**	1	1	2	3	3	1	3	1	Currently
24	**ES14**	1	3	2	3	3	1	3	1	Currently
25	**ES15**	1	3	1	3	1	1	2	1	Currently
26	**ES16**	3	2	3	1	1	1	3	1	Currently
27	**ES17**	1	1	3	2	2	1	2	1	Currently
28	**ES18**	1	3	3	3	2	2	2	1	Currently
29	**ET1**	1	3	3	3	2	2	3	1	Tall
30	**ET2**	1	1	3	3	3	3	3	1	Tall
31	**ET3**	1	3	2	3	3	2	3	1	Tall
32	**ET4**	1	3	3	3	3	2	3	1	Tall
33	**ET5**	1	3	3	3	3	2	3	1	Tall
34	**ET6**	1	3	3	3	2	2	3	1	Tall
35	**ET7**	1	3	2	3	2	3	3	1	Tall
36	**ET8**	1	1	3	3	3	3	3	1	Tall
37	**ET9**	1	3	3	3	3	2	3	1	Tall
37	**ET9**	1	3	3	3	3	2	3	1	Tall

Information :

E :elevation

R :Low vulnerability rate

S :Moderate vulnerability level

Q :High vulnerability rate

Table 16. Calculation of the area's vulnerability to flooding shows that out of 37 research samples, 10 samples were included in the low vulnerability category, the remaining 18 research samples showed moderate vulnerability and 9 other samples included in the high vulnerability category. The houses that are included in the high vulnerability category are the houses that have a very large impact risk of loss in the event of a flood. Conversely, if the lower the level of vulnerability of the settlement, the lower the possibility of the impact of the risk of loss that will be experienced by residents in the event of a flood disaster.

3. Conclusion

From the results of the discussion that has been carried out regarding the flood hazard that occurs in settlements along the Aimutin road in the Hudi Laran area, it can be concluded that there are 3 categories of vulnerability, namely high, medium and low categories. The inundation that occurred was included in the high category with an inundation duration of >48 hours, while the frequency of inundation in the area was in the moderate category with a presentation of 75.8% or 2-5 incidents in one year. In addition, based on the results of the sum of the scores on the condition of the house, the intensity of the inundation and the perception of the comfort of the community's residence, out of 37 research samples, there were 5 houses that were in the low vulnerability category and the remaining 29 houses were in the medium vulnerability category and 3 other houses were in the high vulnerability category. high susceptibility.

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