

Flood Mitigation-Based Settlement Environment Management Strategy in Hudi Laran Region, Dili, Timor Leste

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Abstract

Geographically located hudilaran area the residential environment is in a flood-prone area because of its presence below the surface of the highway, so it requires a strategy of spatial arrangement based on disaster mitigation as an effort to safety and comfort the local community. Hudilaran area has become a flood subscription at the time of rain because the topography is flat and sunken then water runoff from the hill will drain the water to a lower place. The main causative factor of flooding is that the channels that receive water flow are damaged and covered by soil and irregular land use. In this study using a qualitative descriptive approach with data collection techniques through observations, interviews, questionnaires and documentation conducted directly by researchers, for the processing of data needed data obtained through the results of interviews with respondents. The results of the analysis are processed using qualitative analysis methods and displayed in the form of diagrams that will explain the results of interviews with respondents. Then processed data analysis results are done by summarizing the results of the interview and then displayed in the form of paragraphs. Based on the results of the analysis data, the conclusion is the main factor causing flooding, namely high rainfall and damage to channels to the main / primary drainage that cause flooding with an average water level intensity of 50-70 cm and a maximum height of 70-100cm. Community participation in cleaning the channels that have been built by the government is expected to suppress smaller flood disasters.

Keywords: Strategy, Structuring, Flood Disaster Mitigation, Residential Environment.

A. INTRODUCTION

The Municipality of Dili is the Capital of the Democratic Republic of Timor Leste (RDTL). Municipality of Dili has an area of 17,000 km² with a population of 137,879 people. Dili Municipality is divided into six sub-districts consisting of 48 villages and 243 hamlets. The six sub-districts are the western part of Dom Aleixo sub-district (10 villages), the eastern part of Cristo Rei sub-district (10 villages) and Metinaro (3 villages), the northern part of Atauro sub-district (5 villages), the southern part of Vera Cruz sub-district (11 villages), and the central part of Nain Feto District (9 villages). (Source; *Profil kota Dili*, 2015)

City of Dili as a business center city, politics and culture, a growing place with the rapid development of community settlements, prominent figures, hotels, offices and warehouses.

The research location chosen was in the Hudilaran area, Bairopite Village, Dom Aleixo District, Dili Municipality, Timor Leste.

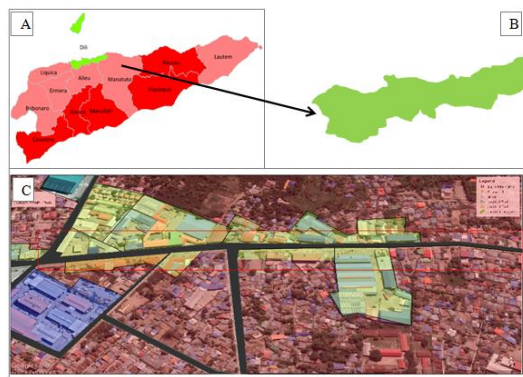


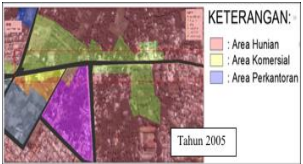
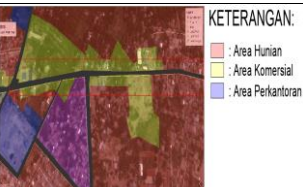
Figure 1. A. Timor Leste map, B. Dili municipality map, C. Research location map
Source: Profile Kotamadya Dili, & Google Earth Pro2020

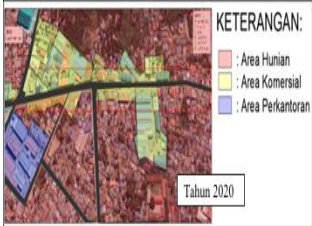
Flooding is a routine phenomenon during the rainy season that occurs in the Hudi Laran area, Bairopite Village, Dom Aleixo District, Dili Municipality, Timor Leste. The flooding that occurred in the Hudi Laran area was the result of heavy rainfall, and the small capacity of the current canal compared to the flow of water entering the area were several factors causing the flooding. The conversion of land functions in the Hudi Laran area from year to year is a threat to the balance of the garden ecosystem which is getting worse and the function of the banana garden and other plants is not running properly.

Flooding is an annual problem that occurs in the Hudi Laran area of Bairopite Village. In general, the causes of flooding in Hudi Laran, Bairo Pite Village, occurred due to two main factors, natural factors, namely flooding caused by the hilly topography 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.

Handling flood control by getting a more detailed picture of canal conditions so that water management in the Hudi Laran area can be optimally managed or controlled. This is the background of this research.

Table 1. Development of Land Use Change (Banana Garden Ecosystem and Other Plants).

Transfer of Land Functions from Year to Year	Information
<p>2005-2009</p>  <p>Map comparison of research locations in 2005 <i>Source: www.google.earth2016 processed by the author, 2016.</i></p>	<p>During the 2005-2009 period, the development of city and commercial service facilities was not rapid, most of which were still concentrated in the Municipality of Dili and along the main roads (protocol roads).</p>
<p>2009-2011</p>  <p>Map of research locations in 2009</p>	<p>The period 2009-2011, was the development stage of the Municipality of Dili towards the outskirts of the city to its sub-district areas.</p>

Source: www.googleearth.pro.com 2020 and processed by the author, 2021	
<p>2011-2020</p>  <p>KETERANGAN: ■ : Area Hunian ■ : Area Komersial ■ : Area Perkantoran</p> <p>Tahun 2020</p> <p>Map comparison of 2020 research locations Source: www.google.earth2016 processed by the author, 2021.</p>	<p>The development of this commercial and service area continues to grow, during 2011–2020 the development and spatial physical changes of the city became very visible along the Aimutin road in the Hudi Laran area. Currently, the condition of this area has been crowded with commercial buildings such as shops, restaurants, warehouses, workshops and hotels.</p>

From the description of the background above, researchers are trying to examine the causes of flooding in residential areas along the Aimutin road in the Hudi Laran area.

B. LITERATURE REVIEW

1. Settlement Environment Management Strategy

Hax and Majluf (in J. Salusu, 2006:100-101 states that strategy becomes a fundamental framework in the organization so that the organization has direction and goals and can adapt to a changing environment

2. Settlement Environment Arrangement

Spatial planning is a system of spatial planning processes, space utilization, and control of spatial use. Implementation of spatial planning is an activity that includes arrangement, guidance, implementation, and supervision of spatial planning (Law 26/2007 Article 1).

Environmental Management is an activity in residential areas that aims to build a healthy, orderly, harmonious and sustainable physical environment.

3. Physical Character

The geological conditions in an area are related to land use. Rainfall can affect land suitability and environmental carrying capacity, because this is closely related to soil conditions and erosion which will have an impact on land use activities. Class Value, Category and Rainfall Score. Details can be seen in the following table:

Table 2. Rainfall Categories and Scores

Class	(mm/day)	Category	Score
1	0-36,6	Vey Low	10
2	13,6 - 20,7	Low	20
3	20,7 -27,7	Medium	30
4	27,7 -34,8	High	40
5	> 34,8	Very High	50

Source: Special Handling of Peak Areas "Location Criteria & Technical Standards", Dept. Kimpraswil in Permen PU, 2007

Land use is human activity on and in relation to land, which is usually not directly visible from the image. According to Widiatmaka 2007:20) In land use there are terms such as use, *aguna* (not used), *wyaguna* (incorrect use) or *alpaguna*, and *tunaguna* (incorrect use).

4. Building Structure and Environmental Conditions

Building density is the number of buildings on a certain land area, expressed in buildings/Ha. The ideal medium building density is not less than 40 buildings/Ha as stipulated in Minister of Public Works Decree No. 378/KPTS/1987. Classification of building density based on KDB can be seen as follows:

Table 3. Classification of Building Density

Classification	Building Density
Very Low	< 10 buildings/ha
Low	11 – 40 buildings/ha
Medium	41 – 60 buildings/ha
High	61 – 80 buildings/ha
Very High	> 81 buildings /ha

Source: Decree of the Minister of Public Works No. 378/KPTS/1987

Building density is calculated from the ratio between the built-up area and the area: Building Density = Built-Up Land Area (M²): An Area (M²)

Flood disaster mitigation efforts are divided into two:

- a. Structural mitigation is an effort made to minimize disasters such as by constructing special funds to prevent floods and by making technical engineering of disaster-resistant buildings, as well as water-resistant building infrastructure.
- b. Non-structural mitigation is an effort made in addition to structural mitigation, such as regional planning. In this non-structural mitigation, we really expect from increasingly advanced technological developments.

Flood is defined as the inundation of a place due to the overflow of water that exceeds the capacity of water disposal in an area and causes physical, social and economic losses (Rahayu et al, 2009).

Factors that affect Flood:

- a. Physical factors that can cause flooding include: high rainfall, soil type, water infiltration or infiltration, and the topography of the earth's surface.
- b. Non-physical factors that can cause flooding include: human interference in exploiting natural resources, especially forests, construction activities that do not pay attention to negative environmental impacts, and human attitudes that do not properly dispose of waste.

Table 4. Factors that influence flood vulnerability

Factor	Flood Vulnerability Assessment Parameters
Vulnerability from Environmental Aspect	
Sea Tides	The movement of sea level in a vertical direction is due to the influence of the gravitational pull of the moon, sun and celestial bodies on the earth so that sea water rises inland

Rainfall Intensity	The higher the intensity of rain, the more vulnerable to tidal floods
River geometry	Proximity distance from the river which is affected by the tides
Topography	The lower the topographic elevation, the more vulnerable to tidal floods
Type of Soil	Related to the indication of the soil's ability to support the process of infiltration of water into
Land Use	The higher the land cover, the more vulnerable to tidal floods
Land subsidence	Land subsidence due to building loads and reduced levels or amount of ground water
Vulnerability from a Physical Aspect	
Road	The lower the road availability and the worse the condition of the road, the more vulnerable it will be to tidal floods.
Residential density	The area of the built-up area of an area/the number of buildings over one area is expressed by buildings/ha
Vulnerability from Social Aspect	
Population density level	The higher the level of population density, the more vulnerable to tidal floods
Growth rate of Resident rate	The higher the rate of population growth, the more vulnerable to tidal floods
Percentage number of old-fives	The more the population aged + under five, the more vulnerable to tidal floods
Vulnerability from an Economic Aspect	
Percentage of households working in the sector prone to	The more workers who work in the agricultural sector, the more vulnerable they are to tidal floods
Percentage of households poor	The more poor households, the more vulnerable to tidal floods
Physical Capacity	
Distance to evacuation	The distance of the population to reach the place of refuge when a disaster occurs
Facility health	The number of health facilities in an area
Social Capacity	
Organizational existence	The level of existence of community organizations related to disaster management in the community
Community engagement in disaster management	The level of kinship of the population in the community as a disaster management effort
Community resource capacity	
Deep engagement disaster socialization	The level of community involvement in disaster discussion / socialization
Training engagement disaster	Engagement training disaster
Economic Capacity	
Average income	The income level of the community in one month
Ownership insurance	Life insurance ownership rate

Based on the theory obtained, it produces a literature review in research which becomes important variables both in abstract and concrete (real) form, namely: Strategy, Settlement Environmental Management, Flood Disaster Mitigation, Flood Management and Management Strategy.

C. METHOD

The research method uses a combination of qualitative and quantitative approaches to the phenomena that occur at the research location. Sugiyono (2005) states that the qualitative descriptive method is a method used to describe a research focused on the Strategy for Settlement Environmental Management Based on Flood Disaster Mitigation in the Municipality of Dili, Timor-Leste. To obtain data, this study also used questionnaires and field surveys.

According to Sugiarto (2000), in carrying out data collection in research can be taken from two types of data namely:

1. Primary Data

Primary data is the type of data collected through direct interviews with respondents by filling out a list of questions or questionnaires that are usually done by researchers.

2. Secondary Data

Secondary data is primary data obtained by other parties or primary data that has been processed by other parties.

In selecting the sample, the researcher uses a random or systematic random sampling method at the research location and directly determines the types of respondents to be studied in this study, determined according to the flood-prone areas that have been determined based on initial observations. Using qualitative and quantitative descriptive analysis methods, with a superimpose/overlay analysis approach with a Geographic Information System (GIS), namely to analyze the level of hazard, level of vulnerability, and level of risk in flood-prone areas.

Analysis of the level of vulnerability describes the assets exposed to floods including human life (social vulnerability), economic area, physical structure and ecological area.

1. **Social Vulnerability**, The parameters used are population density, sex ratio, disability ratio, poverty ratio and age group ratio.
2. **Economic Vulnerability**, The things that affect economic vulnerability are land use (cultivation areas).
3. **Physical Vulnerability**, The parameters used for physical vulnerability are housing (permanent, semi-permanent, and non-permanent), availability of public facilities and critical facilities.
4. **Ecological/Environmental Vulnerability**, The parameters used are land cover (protected forest, natural forest, mangroves and shrubs).

Analysis of the flood hazard level determines where flood events occur with a certain frequency and intensity. Analysis of the flood hazard level uses several flood indicators, where the flood indicators used in this study include: slope indicator, rainfall indicator, land coverage indicator, land system indicator and elevation indicator. Flood hazard is a function of rainfall, land cover, slope, land system and elevation.

After determining the hazard level analysis and vulnerability level analysis, a study will be obtained regarding the analysis of disaster risk levels by overlaying the two analyzes, and using three risk class classifications namely high, medium, and low by using the risk analysis formula.

Through the three analyzes above, it can easily lead researchers to answer the research formulation namely How is the strategy for structuring the settlement environment in Hudi Laran based on flood disaster mitigation.

Table 5. Data Requirements

Aspect	Data Type
Settlement Environmental Conditions (Physical Characteristics of the Environment)	<input type="checkbox"/> Topographical conditions/slope <input type="checkbox"/> Geological Conditions <input type="checkbox"/> Climatology (Rainfall) <input type="checkbox"/> Land Use
Building Structure and Environmental Conditions	<input type="checkbox"/> Building density <input type="checkbox"/> Distance between buildings
Infrastructure Condition	<input type="checkbox"/> Condition of drainage channels

D. RESULTS AND DISCUSSION

The research location is in the Hudi Laran Area Along Jalan Aimutin, one of the areas in Bairopite Village, Dom-Aleixo District, Dili Municipality, Timor Leste. The majority of the population in this village work as farmers who rely on the natural resources available in this area, especially in the agricultural and horticultural sectors. The research location can be seen in the following figure:

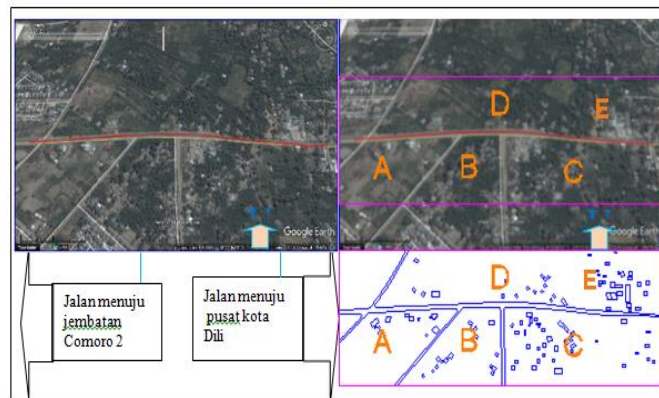


Figure 2. Research Location Map

Source: www.google.earth, 2020 (processed by the author, 2020)

From the picture above it can be explained that the research locations are locations in areas A, B, C, D and E along ± 810 meters. This location is the main access road for the southern part of the municipality of Dili which connects the eastern part to the city center and the western part to the Comoro Dua bridge. The position of the location on Jalan Aimutin in the Hudi Laran area is very strategic because it is located between commercial activities, offices, hotels and education.

Developments that occurred on Jalan Aimutin in the Hudi Laran area from 2005-2020 underwent very rapid changes. After observing and interviewing 50 respondents in the Hudi Laran area, Bairro Pite Village, Dom Aleixo District, the area that was affected by flooding was the Hudi Laran area because this area is flooded every year during heavy rains with a long duration, the flood height reaches an average - an average of 0 – 60 cm and a dry time of 1-4 hours.

The impact of flooding from a health and economic perspective is non-existent because floods do not occur for a long duration. The condition of the houses in general were not damaged, but electronic goods, furniture and public transportation were damaged, such as TVs, cabinets and motorbikes due to being submerged in the floods.

In addition, the drainage infrastructure system is not good, so it needs to be improved so that it can respond to the flow of water from the rainwater catchment area.

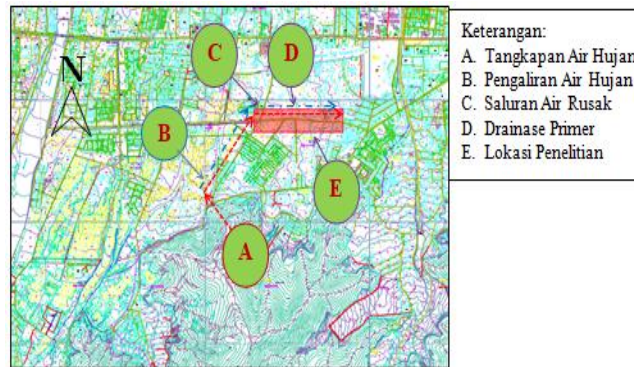


Figure 3. Rainwater Catchment Area

Source: Processed Results of Researchers

The Hudi Laran area is one of the flood-prone areas in the Municipality of Dili. This is due to the topographical conditions. For more details see the following picture:



Figure 4. Cutout photo (Section)

Source: Author Analysis Results, 2021

Section A

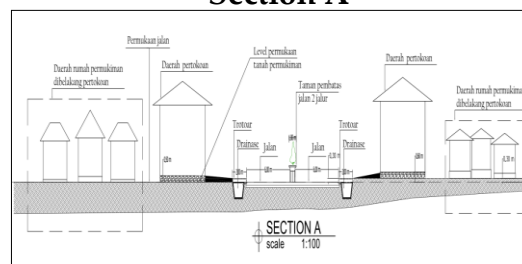


Figure 1.5. Cross Section A

Source: Author Analysis Results, 2021

In section A, it generally looks relatively flat because the southern part of the ground surface is 30 cm above road level and in the northern part the ground level is at road level.

Section B

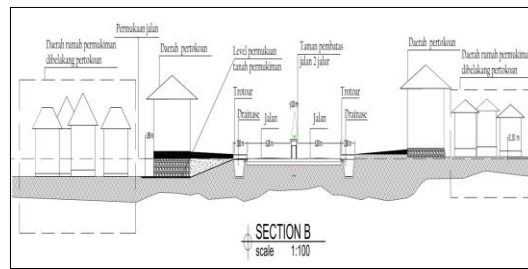


Figure 6. Cross section B

Source: Author Analysis Results, 2021

In section B: in this figure the cross section of the road is 202 m long so that the elevation of the ground surface from the southern part is higher than the road surface, which is 30 cm high. in the northern part it can be seen that the ground surface is below road level which is as high as - 1.89 m. So, the elevation difference from point 0 in the south to the lowest point in the north is as high as 2.19 m.

Section C

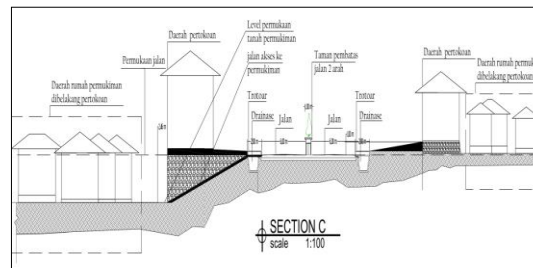


Figure 7. Cross Section C

Source: Author Analysis Results, 2021

In section C: in this figure the cross section of the road is 202 m long so that the elevation of the ground surface from the southern part is higher than the road surface, which is 30 cm high. in the northern part it can be seen that the ground level is below the road level which is -2.46 m high. So, the elevation difference from point 0 in the south to the lowest point in the north is as high as 2.76 m.

Section D

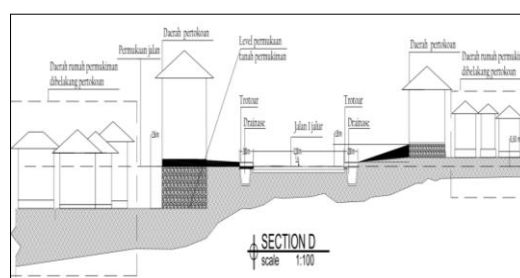


Figure 8. Cross section D

Source: Author Analysis Results, 2021

In section D: in this figure the cross section of the road is 202 m long so that the elevation of the ground surface from the southern part is higher than the road surface which is 60 cm high and in the northern part it can be seen that the ground

level is below the road level which is -2.54 m high. So, the elevation difference from point 0 in the south to the lowest point in the north is as high as 3.14 mm.

Section E

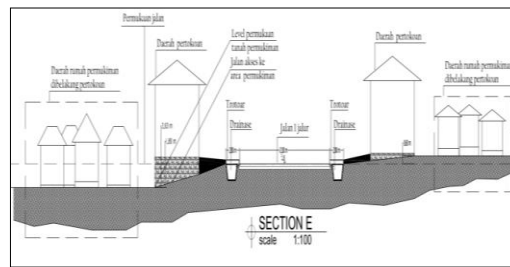


Figure 9. Cross Section E

Source: Author Analysis Results, 2021

In section E: in this figure the cross section of the road is 202 m long so that the elevation of the ground surface from the southern part is higher than the road surface, which is 60 cm high. in the northern part it can be seen that the ground surface is below road level which is as high as -2.63 m. So, the elevation difference from point 0 in the south to the lowest point in the north is as high as 3.23 m.

Section F

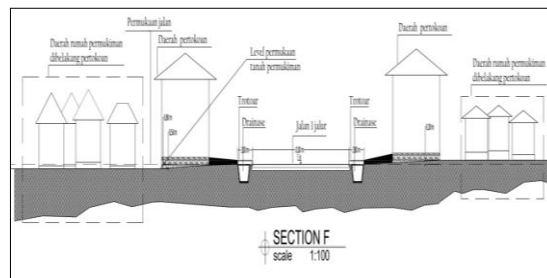


Figure 10. Cross Section F

Source: Author Analysis Results, 2021

In section F: in this figure the cross section of the road is 202 m long so that the elevation of the ground surface from the southern part is higher than the road surface, which is 30 cm high. in the northern part it can be seen that the ground surface is below the road level which is - 0.54 m high. So, the elevation difference from point 0 in the south to the lowest point in the north is as high as 0.84 m.

Section G

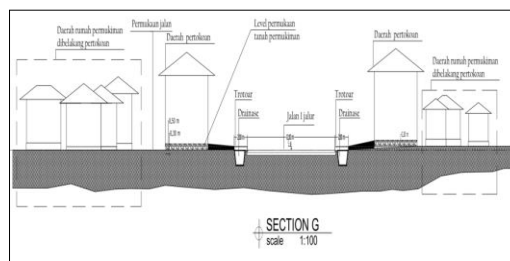


Figure 11. Crosscut G

Source: Author Analysis Results, 2021

In section G: in this figure the cross section of the road is 202 m long so that the elevation of the ground surface from the southern part is higher than the road surface, which is 30 cm high. in the northern part it can be seen that the ground surface is below road level which is as high as -0.30 m. So, the elevation difference from point 0 in the south to the lowest point in the north is as high as 0.60 m.

Section H

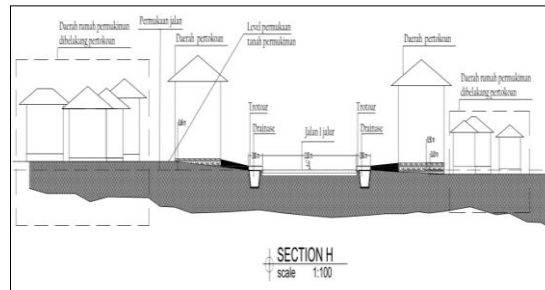


Figure 12. Cross Section H

Source: Author Analysis Results, 2021

In section H: in this figure the cross section of the road is 202 m long so that the elevation of the ground surface from the southern part is higher than the road surface, which is 0.46 m high. in the north it can be seen that the ground surface is below road level which is as high as - 0.43 m. So, the elevation difference from point 0 in the south to the lowest point in the north is as high as 0.89 m.

Based on the results of the cross section of the A-H point above, it can be explained that the land contour (topography) at the study site has a different elevation height, for more details it can be seen in the following table:

Table 6. Matrix of Cross Sections of Points A-H

Variable	North	South	Conclusion
Cross Section A	Ground level is level with road level.	The ground level is above road level as high as 30 cm	In section A it shows that the road elevation on the south and north sides is relatively flat so that the impact of flooding has no effect In section B it shows that the road elevation on the south and north sides is clearly visible, especially the northern part is below the road surface so that the impact of flooding is very influential so a better handling system is needed.
Cross Section B	The ground level is below road level - 1.89 m.	The ground level is above road level as high as 30 cm	
Cross Section C	The ground level is below road level - 2.46 m.	The elevation of the ground surface from the southern part is higher than the road surface, which is 30 cm high.	
Cross Section D	The ground surface is below road level, which is - 2.54 m.	The ground level elevation of the southern part is higher than the road level, which is 60 cm high	
Cross Section E	The ground level is below road level - 2.63 m.	The ground level elevation of the southern part is higher than the road level, which is 60 cm high.	
Cross Section F	Elevation from point 0 in the south to the lowest point in the north is as high as - 0.54 m.	the elevation of the ground surface of the southern part is higher than the road surface, which is as high as 30 cm	

Cross Section G	The ground level is below road level - 0.30 m.	Sectional G: in this figure the cross section of the road is 202 m long so that the elevation of the ground surface from the southern part is higher than the road surface which is 30 cm high	
Cross Section H	The ground surface is below road level, which is as high as - 0.43 m	The ground level elevation of the southern part is higher than the road surface, which is 0.46 m high.	

Source: Author Analysis Results, 2021

Questionnaire Results

Respondents in this study were conducted on people who live in the Hudilaran location, Bairopite Village. The number of respondents in this study was limited by researchers and determined the number of respondents, namely 30 to 50 respondents. From the results of the distribution of questionnaires given to respondents in these locations and interviews, 50 respondents were obtained.

To find out about the quantification of research data that has been done, it can be seen in the tabulated results table in [Appendix 1-6].

Through the questionnaires that have been distributed to respondents it can be explained that based on the objectives and targets of the questionnaire itself, namely Description of Flood Phenomena, Community Responses to Floods, Geographical Factors, Settlement Environmental Management, Flood Mitigation and Environmental Management Strategies.

To find out about the public's opinion regarding the description of the Flood Phenomenon that occurred at the research location, see the following table:

Table 7. Tabulation of Questionnaire Results and Percentage Description of Flood Phenomena

No	Question	SA	A	Df	D	SD
1	The Hudi Laran area floods during heavy rains	18	27	1	4	0
2	Overflowing water from the southern slope causes flooding in Hudi Laran during heavy rains	12	24	6	8	0
3	Heavy rainfall caused the Hudi Laran area to flood	20	30	0	0	0
4	Garbage is always disposed of in its place	6	29	2	13	0
5	Garbage piles up in the drains after the rains	0	29	0	21	0
6	The maximum height of flood waters is an average of 70-100cm	0	3	16	31	0
7	The average height of flood waters is 50-70cm	0	12	10	28	0
8	The average height of flood waters is 30-50cm	5	17	9	24	0
9	The minimum height of the flood water puddles is an average of 0-30cm	3	15	2	30	0
10	Duration/Dry period of flood on average < 2 hours	0	9	11	30	0
11	Duration/Dry period of flood on average < 2-4 hours	10	26	0	14	0
12	Duration/Dry period of flood on average 4-6 hours	0	5	5	40	0
13	Duration/Dry period of flood on average 6-8 hours	0	1	7	42	0
Total		69	227	69	285	0
Percentage		11%	35%	11%	44%	0%

Source: Author Analysis Results, 2021

From the results of the tabulation above, it can be explained that respondents' answers about the description of the flood phenomenon at the research location which had the highest percentage were Disagree (D), namely 285 answers with a

percentage of 44%, who answered Agree (A), as many as 227 answers, with a percentage of 35 %, who answered Strongly Agree (SA) and Doubtful (Df), as many as 69 answers with a percentage of 11% and no one answered Strongly Disagree (SD).

To find out about the community's opinion regarding the community's response to the flooding that occurred at the research location, see the following table:

Table 8. Tabulation of Questionnaire Results and Percentage of Community Response to Floods

No	Question	SA	A	df	D	SD
1	During a flood, people flee	8	8	11	23	0
2	During the flood, people stay at home	8	25	8	9	0
3	When it rains heavily, people are always on alert	6	24	1	19	0
4	Important documents and valuables have been secured during heavy rain	13	22	4	11	0
5	Each house makes a diversion channel around the house to reduce flood water stagnation	0	28	12	10	0
6	Property is damaged; electronics, household furniture	8	28	0	14	0
7	House condition due to flooding {damaged}	0	15	0	35	0
8	Condition of the house due to flooding {damaged livable}	0	35	2	13	0
9	The condition of the house due to flooding {damaged not liveable}	0	4	8	38	0
Total		43	189	46	172	0
Percentage		10%	42%	10%	38%	0%

Source: Author Analysis Results 2021

From the results of the tabulation above, it can be explained that respondents' answers regarding the description of the flood phenomenon at the research location which have the highest percentage are Agree (S), namely 189 answers with a percentage of 42%, those who answered Disagree (D), as many as 172 answers, with a percentage of 38%, who answered Strongly Agree (SA) and Doubtful (Df), as many as 43 answers with a percentage of 10% and no one answered Strongly Disagree (SD).

To find out about public opinion regarding geographical factors occurring at the research location, see the following table:

Table 9. Tabulation of Questionnaire Results and Percentage of Responses to Geographical Factors

No	Question	SA	A	Df	D	SD
1	The northern region is the lowest plains	10	30	4	6	0
2	Hudi Laran is a former horticultural plantation	10	35	1	4	0
3	The Hudi Laran area is prone to flooding	5	30	5	10	0
4	Floods contaminate well water	13	22	4	11	0
5	The Hudi Laran area is a swamp land	5	36	7	2	0
6	Floods have a negative impact on health	5	0	3	42	0
7	Floods hinder/hinder work activities	0	7	1	42	0
8	The impact of flooding damage housing and the environment	0	10	2	38	0
9	The impact of flooding brings inconvenience to the occupants of the house	5	36	5	4	0
Total		59	206	28	165	0
Percentage		13%	46%	6%	37%	0%

Source: Author Analysis Results 2021

From the results of the tabulation above, it can be explained that respondents' answers about the description of the flood phenomenon at the research location which have the highest percentage are Agree (S), namely 206 answers with a

percentage of 46%, those who answered Disagree (TS), as many as 165 answers, with a percentage of 37 %, who answered Strongly Agree (SS) as many as 59 answers with a percentage of 13% and those who answered Doubtful (RR) as many as 28 answers with a percentage of 6% and no one answered Strongly Disagree (STS).

To find out about the community's opinion regarding the arrangement of the settlement environment that occurs at the research location, it can be seen in the following table:

Table 10. Tabulation of Questionnaire Results and Percentage of Settlement Environmental Management

No	Question	SA	A	Df	D	SD
1	The location is suitable for settlement	10	30	4	6	0
2	Garbage disposal facilities are indispensable	11	35	1	3	0
3	Flood diversion drainage facilities prepared	5	30	5	10	0
4	Clean water facilities are well available	0	34	6	10	0
5	Achievement access to affordable settlements	5	34	9	2	0
6	Provision of dirty water facilities are fulfilled	0	5	3	42	0
7	Provision of electricity network is fulfilled	0	6	1	43	0
Total		31	174	29	110	0
Percentage		9%	50%	8%	33%	0%

Source: Author Analysis Results, 2021

From the results of the tabulation above, it can be explained that respondents' answers about the description of the flood phenomenon at the research location which have the highest percentage are Agree (S), namely 174 answers with a percentage of 50%, those who answered Disagree (TS), as many as 110 answers, with a percentage of 33 %, who answered Strongly Agree (SS) as many as 31 answers with a percentage of 9% and those who answered Doubtful (RR) as many as 29 answers with a percentage of 8% and no one answered Strongly Disagree (STS).

To find out about the community's opinion regarding flood mitigation at the research location, it can be seen in the following table:

Table 11. Tabulation of Questionnaire Results and Flood Mitigation Percentage

No	Question	SA	A	Df	D	SD
1	The community cleans up trash and mud in the canal to reduce flooding	10	29	4	7	0
2	Public awareness of disposing of waste in its place	0	36	4	10	0
3	The community makes flood diversion channels to prevent water from entering the house or building	10	25	5	10	0
4	The community raises the floor of the house according to the level of the surface water	7	38	0	5	0
5	The community prepares maps of evacuation routes during floods	5	35	8	2	0
6	The government made repairs to the damaged flood water diversion channel	0	40	4	6	0
7	The government socializes about flood-prone areas	5	25	5	15	0
8	The government prohibits construction in flood-prone areas	8	29	5	8	0
Total		45	267	35	63	0
Percentage		11%	64%	9%	16%	0%

Source: Author Analysis Results 2021

From the results of the tabulation above, it can be explained that respondents' answers regarding the description of the flood phenomenon at the research location which had the highest percentage were Agree (S), namely 267 answers with a percentage of 64%, those who answered Disagree (TS), as many as 63 answers, with a percentage of 16 %, who answered Strongly Agree (SS) as many as 45 answers with

a percentage of 11% and those who answered Doubtful (RR) as many as 35 answers with a percentage of 9% and no one answered Strongly Disagree (STS).

To find out about the community's opinion regarding the environmental management strategy at the research location, it can be seen in the following table;

Table 12. Tabulation of Questionnaire Results and Percentage of environmental management strategies

No	Question	SA	A	Df	D	SD
1	The government socializes the benefits of rainwater infiltration	10	30	0	10	0
2	The government stipulates a ban on building in flood-prone areas	5	20	7	18	0
3	The government gives sanctions to people who violate regulations in settlement construction	10	25	0	15	0
4	The government has prepared a garbage facility or TPS in Hudi Laran	10	30	5	5	0
5	The government gives building permits (IMB) for all people	7	28	8	7	0
6	The government and the community routinely clean the canals	5	35	5	5	0
Total		47	168	25	60	0
Percentage		16%	56%	8%	20%	0%

Source: Author Analysis Results 2021

From the results of the tabulation above, it can be explained that respondents' answers about the description of the flood phenomenon at the research location which have the highest percentage are Agree (S), namely 168 answers with a percentage of 56%, those who answered Disagree (TS), as many as 60 answers, with a percentage of 20 %, who answered Strongly Agree (SS) as many as 47 answers with a percentage of 16% and those who answered Doubtful (RR) as many as 25 answers with a percentage of 8% and no one answered Strongly Disagree (STS).

E. CONCLUSION

Based on the results of the research and analysis, it was concluded that the flooding that occurred in the Hudi Laran area was caused by rainfall, the damage to the drainage connecting the main drainage so that the drainage was covered with soil caused the flow of water to overflow out of the canal and seep into lower areas such as the research location where where Hudi Laran's location is geographically at a lower elevation so it is very easily affected by flooding or standing water. There are no rules or regulations to regulate land use in the settlement environment of Hudi Laran so that developments that occur in the area cause building density. Settlement development that occurred in the Hudi Laran area from 2005 to 2020 underwent very rapid changes but the developments that were built were not well organized so that access roads, canals and infiltration wells in the environment did not yet exist.

As a result of the conclusions above, the strategies put forward to respond to the research objective of "Finding Optimal Settlement Environmental Management Strategies Based on Flood Disaster Mitigation" namely:

1. Repair damaged channels so they can drain water properly when it rains
2. Geographically, the Hudi Laran area is in the lowest area, so a foundation elevation of at least 1 meter is required. The front part of the house is raised as a barrier to water entering the building.
3. To avoid longer standing water during floods, infiltration wells are made in that area so that the dry period will be faster.

4. In order to avoid cases of water from the main road entering lower areas, as was the case in Hudi Laran, it is necessary to construct a rump elevation that is as high as the sidewalk and the drainage inlet is enlarged so that the volume of water that comes can be channeled into the canal so that the water level will not exceed sidewalk height.
5. Every building that will be built in the area requires an IMB letter so that it is directed according to the development of the city which is arranged in accordance with applicable government regulations. This is to reduce population density in a certain area such as Hudi Laran area.

REFERENCES

1. David, F. R. (2017). *Manajemen Strategik Suatu Pendekatan Keunggulan Bersaing*. Jakarta: Salemba Empat.
2. Immadudina, A. (2011). *Zonasi Risiko Bencana Banjir Akibat Sea Level Rise*. Surabaya: Institut Teknologi Sepuluh Nopember.
3. Iskandar, D., & Sugandi, D. (2015). Flood mitigation efforts in the Capital Region of Jakarta. *International Journal of Conservation Science*, 6(4), 685–696
4. Peraturan Kepala Badan Nasional Penanggulangan Bencana Nomor 2 Tahun 2012 Tentang Pedoman Umum Pengkajian Risiko Bencana
5. Peraturan Menteri Dalam Negeri Nomor 32 Tahun 2010 Tentang Pedoman Pemberian Izin Mendirikan Bangunan.
6. Peraturan Menteri Agraria dan Tata Ruang/ Kepala Badan Pertanahan Nasional Nomor 17 tahun 2017 Tentang Pedoman Audit Tata Ruang Metode Penilaian Persyaratan di Dalam Izin Pemanfaatan Ruang.
7. Peraturan Pemerintah Nomor 21 Tahun 2008 tentang Penyelenggaraan Penanggulangan Bencana
8. Rosyidie, A. (2013). Banjir: Fakta dan Dampaknya, Serta Pengaruh dari Perubahan Guna Lahan. *Journal of Regional and City Planning*, 24 (3), 241–249.
9. Undang-Undang Nomor 26 Tahun 2007 tentang Penataan Ruang dan Penyelenggaraan Penataan Ruang.
10. Sadyohutomo. (2013). *Penggunaan Lahan Perkotaan*. Surabaya: Universitas PGRI Adi Buana.
11. Undang-Undang Nomor 1 tahun 2011 tentang Perumahan dan Kawasan Permukiman
12. Undang-Undang Nomor 26 tahun 2007 tentang Konsep Penataan Ruang
13. Wisner, B., Blaikie, P., Cannon, T., & Davis, I. (2014). *At risk: natural hazards, people's vulnerability and disasters*. London: Routledge.