Analysis of Farmland Potency to Improve Community Economy in Letbaun Village Semau Sub-district Kupang District East Nusa Tenggara Province

Sutirto, Yunus Fallo and Amy Wadu
Civil Engineering Lecturer, Kupang State Polytechnic, Kupang City, East Nusa Tenggara, Indonesia

Keywords: Farm Potency, Improving Community Economy,Water Needs Supply.

Abstract: Semau Island is a small island with a minimum population of 8000 people who come from the Helong tribe, one of the tribes in East Nusa Tenggara. The location of this island is in the waters west of Timor Island, west of Kupang City. Kupang City is the administrative center of East Nusa Tenggara Province. Letbaun Village, Semau District, Kupang Regency has productive land to be used as agricultural land. Constrained by the limited availability of water, so the land is not utilized so that it becomes a shrub field. The results of the analysis of the potential of agricultural land in this village are 900,126 hectares of the total area of 1,379,634 hectares or 65.24% of the total area. And to meet the water needs, a reservoir was built in Sub-watershed 10 at coordinates 123°24'23.41" East Longitude and 10°11'44.23" South Latitude with a water capacity of 442,230 m3/second every 10 years with a Chatment Area of 215,571 Ha. In this case, the provision of land by optimizing non-productive land into productive land will overcome the problem of food supply shortages.

1 INTRODUCTION

At present, one of the goverment targets is making Indonesia as food-self sufficiency country. Therefore it is planned various goverment program to achieve that goal, even in the remote regions is strived for improving like East Nusa Tenggara province (NTT).It has to be supported by some factors, among other are natural resources and human resources. Indonesia is very famous with the strategic location so that it has farmland which becomes the primary livelihood for the people. The dominant factor in improving the agriculture is the water supply, NTT region is one of the regions that always experiences the drought and the lack of water. To answer it therefore the water management is needed in order to fulfill the people need.The goverment attempts to build irrigation area in dry land or wet land which have potency to be improved into farmland that can fulfill the needs of the community. The limited water supply is one of the obstacles in improving the community welfare in Kupang District through agricultural sector which is the biggest income resource for the community in general in Kupang District or Central Kupang Sub-District, but the yields or agricultural product is still low.

Pesident Joko Widodo said that the problem in East Nusa Tenggara is only the water, the improvement of NTT depends on water supply. The people in East Nusa Tenggara region have various livelihoods, one of them is farming. The goverment tries to build the irrigation area in dry land or wet land that has potency to be improved into farmland that can fulfill the people needs (Juditha, 2016).

Semau island is a small island that populated about 8000 people who come from Helong tribe,one of the tribes in East Nusa Tenggara Province. The location of Semau island is in the Western waters of Timor island,it is in the west of Kupang city, Kupang city is the government centre of East Nusa Tenggara province. In Letbaun Village Semau Sub-District, there is productive land to be made into farmland.

According to the background and the problem above, it is required the Analysis Study of Land Usage as The Farmland to Improve The Community Economy in Letbaun Village Semau Sub-District Kupang District East Nusa Tenggara Province.

Sutirto, ., Fallo, Y. and Wadu, A.
Analysis of Farmland Potency to Improve Community Economy in Letbaun Village Semau Sub-district Kupang District East Nusa Tenggara Province.
DOI: 10.5220/0010961300003260
In *Proceedings of the 4th International Conference on Applied Science and Technology on Engineering Science (iCAST-ES 2021)*, pages 1158-1168
ISBN: 978-989-758-615-6; ISSN: 2975-8246

2 LITERATURE REVIEW

2.1 DAS (Watershed) Managemen

DAS management is a formulation process and activity implementation or a program that manipulated the natural resources and human resources in watershed to obtain the benefit of production and service without causing the damage of water and land resources. Included in the DAS management is linkages identification between land use, land and water, and the linkages between upstream areas and downstream areas of the DAS (Asdak,2004:5).

2.1.1 Spatial System based on Land and Water Conservation

Spatial system is a way to manage, to plan, to run and to control the region. In the sustainable spatial system, variables of economy, social and conservation of water and land resources become the unity.

Border requirement for spatial planning that based on land and water conservation is using the border of watershed (DAS).

2.1.2 Land Conservation

Land conservation is efforts to use, to maintain and to protect the land resource, or an effort to improve and to protect land resources. Generallyland conservation is to protect the land from the rainfall directly, to improve the capacity of land infiltration, to reduce the surface runoff, to improve land aggregate stability (Hardjowigeno, 1995).

Therefore, the thing that is very important in utilizing the land resources is the analysis of that land ability. Based on this land ability analysis, the direction of land usage can be known so that the land conservation can be one of the bases in spatial arrangement.

2.1.3 Water Conservation

Water conservation is the efforts in utilizing and protecting the water resources. Empowering water conservation principle in spatial planning is an effective way to maintain nature condition and environment equilibrium.

From the description above, it can be interpreted that water conservation is an effort to put the water into the soil in order to fill groundwater, both natural recharge and artificial recharge.

2.1.4 AGWA Model (Automated Geospatial Watershed Assessment) Tool

Kineros method is a part of AGWA extension which is a tool to analize the hidrology phenomenon for the research about watershed. This model is designed to stimulate the infiltration process, the depth of surface runoff and erosion that occurs in a DAS with relatively small scale that is ≤ 100 km2 (Agwa, 2000).

2.2 Philosophical Idea of Kineros Method

The idea of Kineros method is if a land gets rain with certain intensity, then the part of water that falls into land surface will be infiltrated into the land until the certain saturation limit, whereas the other part will overrun on the land surface or flooded. This condition depends on the land ability to absorb the water based on various factors that influence it, such as the slope of the land, the components of land structure and the soil physical properties (Bisri, 2017).

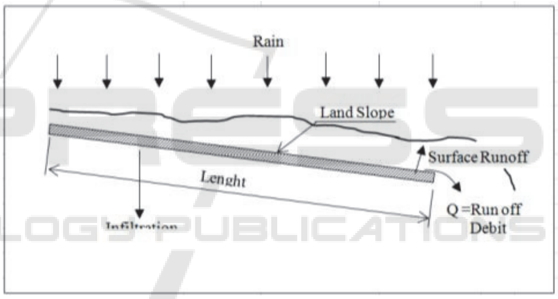


Figure 1: Basic Philosophy of Surface Water Runoff.

2.2.1 The Processing of Land Type Map and Land Texture Definition

Each one area of land texture polygon contains some different land components. These components are noted on the table that named Comp.dbf. then for each component has different land component in each depth and it is noted in the table that named Layer.dbf. The determination of land structure properties here is based on the data of land texture that obtained by using texture triangle as follows.

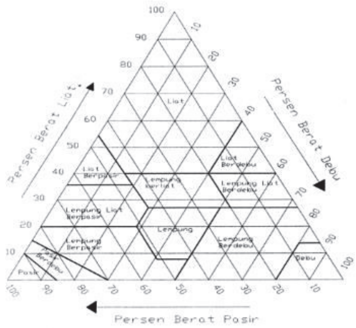


Figure 2: Triangle diagram of Land texture class.

2.2.2 Research Result – Previous Research

Herawati, 2010. The research result showed that the erosion danger level in Cisadane DAS covered very light to very heft with the precentage of land area in a row from very light to very heft55,85%;15,74%; 6,33%; 0,81%; and n 0,30%. The land with the very heft erosion danger level covered the area of 316 ha and the heft level covered the area of 851 ha. Tamansari was the Sub-district that had land area with the most serious erosion danger level,that was 87 ha. The others Sub-Districts which had serious erosion danger level were Tenjolaya, Caringain, Cijeruk, and Nanggung. This result research can be used as the basic data to make the better planning of DAS management.

Sulaiman et al, 2017. His research result showed that Kupang city had high ground water potency, it was proved from 49% of total area of Kupang City or about 8070.74 ha had high ground water potency. And only 561.85 Ha or about 3.42 % which had low ground water potency. Most of spread of ground water in Kupang city was influenced by the topography condition in Kupang city. The wavy relief made the spread of ground water in Kupang city was randomly scattered from the flat topography area to sloping area. Beside the topography condition, the spread of ground water in Kupang city was also influenced by the land usage in Kupang city, the kind of land usage would influence in surface flow and infiltration capacity that occured in some areas in Kupang city which had high ground water potency.

2.3 Research Method

2.3.1 Research Location

This research location was in Uitiuh Tuan Village South Semau Sub-District Kupang District. To reach the research location, it was traveled through cruise ship by speed boat or ferry then continued by motorcycle or car from Semau Port to Letbaun Village Semau Sub-District for at least 30 minutes with the distance of 60 Km.

Figure 3: Research Location.

2.3.2 The Necessary Data and Data Sources

1. The data of daily rainfall in 2011 until 2020 that sourced from Meteorology and Geophysics Agency Kupang. the data of rainfall from the Station observation result that located around DAS Semau
2. Watershed (DAS) map and river network in Timor island that sourced from BP DAS Benain Noelmina as the comparing tool in making DAS border.
3. RBI map with the scale of 1: 50.000 used to know the nature condition, elevation, and flow direction.
4. Remote sensing image of Lansat7 ETM Satellite+ and Lansat 8 (OLI) location in recording years of 2004, 2009, and 2020 that sourced from USGS (U.S. Geological Survey) used to identify the condition of land usage in DAS Noel Amabi.
5. Land usage map in 2020 Kupang District as the comparing tool, land usage map that obtained from processing Remote sensing image.
6. Land type map used to know the land type in DAS Semau and to determine land erodibility value.
7. Rain station map used to know the spread of rain gauge station. Beside that to know the area of rain station influence.

3 RESULT AND DISCUSSION

3.1 Hidrology Analysis

The research location located in DAS Uitao, there are three nearest rainfall stations that influenced to DAS Uitao region. Those stations are the nearest station in DAS Uitao region. Rainfall data used in that analysis consisted of daily rainfall with the observation period from 2011 until 2020.

The location of coordinate and elevation for each raifall station in research area are as follows

Table 1: Rainfall Stations of Research Area.

Name	Elevation	Coordinate(Geography)	
Rain Station	(m)	East Longitude	South Latitude
Tenau	418	1.233,912	-101,631
Manulai	20	1.234,476	-101,855
Batakte Station	380	1,234,340	-102,038

Whereas for spread map of rainfall station in DAS Uitao research area can be seen in figure 4

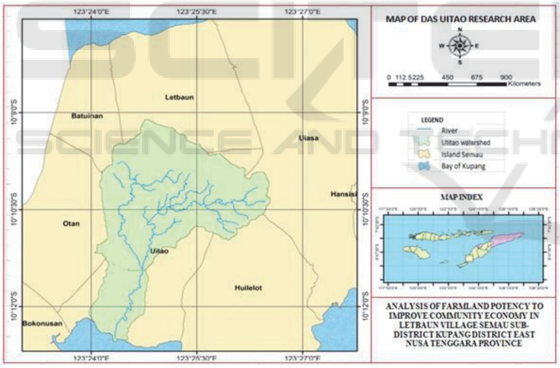


Figure 4: Map of DAS Uitao Rainfall Station Influence
Source: Analysis Result, 2021.

Table 2: Yearly maximum rainfall of study area (2011-2020).

		Maximum Rainfall		
No	Year	Batakte Station	Tenau Station	Manulai Station
		(mm)	(mm)	(mm)
1	2011	180.00	161.00	53.50
2	2012	159.00	102.00	72.00
3	2013	94.00	108.00	125.00
4	2014	74.00	80.00	154.00
5	2015	289.00	310.00	63.00
6	2016	98.00	90.00	275.00
7	2017	145.00	190.00	204.00
8	2018	171.00	210.00	130.00
9	2019	195.00	201.00	75.00
10	2020	125.00	183.00	140.00

Source: BMG Stasiun Klimatologi Lasiana Kupang,2021

Table 3: Total rainfall and rain day of study area 2011-2020.

		Total Rainfall and Monthly Rain Day					
		Batakte Station		Tenau Station		Manulai Station	
No	Year	Total Rainfall	Total Rain Day	Total Rainfall	Total Rain Day	Total Rainfall	Total Rain D
		(mm)	(day)	(mm)	(dayi)	(mm)	(day)
1	2	3	4	5	6	7	8
1	2011	1,383.00	76.00	1,412.30	91.00	1,276.30	84.
2	2012	1,715.30	69.00	1,346.00	71.00	1,009.80	68.
3	2013	1,317.20	70.00	1,483.30	69.00	1,350.50	82.
4	2014	1,065.50	67.00	387.50	42.00	1,331.50	74.
5	2015	1,999.00	92.00	4,241.00	62.00	1,222.00	58.
6	2016	914.00	60.00	1,950.30	79.00	2,055.00	55.
7	2017	2,015.00	71.00	2,445.00	67.00	1,047.50	35.
8	2018	1,635.50	82.00	1,951.00	99.00	1,277.60	56.
9	2019	1,737.00	60.00	2,288.00	112.00	1,006.50	50.
10	2020	1,555.00	89.00	1,662.00	81.00	1,179.00	79.

Source : BMG Stasiun Klimatologi Lasiana Kupang, 2021.

3.2 Regional Average Rainfall

The determination of regional average rainfall uses Polygon Thiessen method. The description of Polygon Thiessen done by inserting each coordinate into the table to obtain rain station spread map. Then made the Polygon Thiessen by activating extension spatial analyst with border of influence area is Rain Station map of Uitao DAS by producing DAS Uitao Polygon Theissen map (Figure.5). The Influence area of Polygon Thiessen with Thiessen coefficient of each Rain Station in research area of DAS Uitao is presented in Table 4.

Table 4: The Area of Influence Spread to Rain Station in DAS Uitao.

		Elevation	Coordinate (Geography)		Rain Station	Thiessen
No.	Rain	(m)	Tgeography		Influence Area	Coefficient
	Name	(m)	East Longitude	South Latitude	(Ha)	(C)
1	Tenau Station	418	1.233,912	-101,631	526.057	0.381
2	Manulai Station	20	1.234,476	-101,855	41.053	0.298
3	Batakte Station	380	1,234,340	-102,038	442.615	0.321
	Total				1009.725	1.000

Source : Calculation Result, 2021

From the data of Yearly Maximum Rainfall of Research Area (2010-2019) Table 6. Multiplied by precentage of Thiessen coefficient. The calculation result of Software ArcView GIS Software obtained the value of Regional Average Maximum Rainfall,it can be seen on the table below:

From the calculation result of Average Yearly Maximum Rainfall of Research Area with the influence of Thiessen Coefficient obtained the yearly average rainfall and it has been sorted, it is presented on the table below:

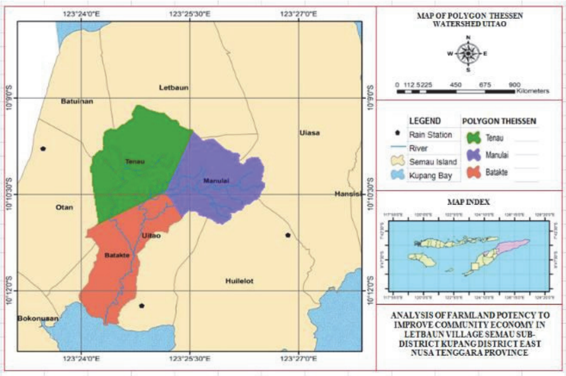


Figure 5: Polygon Theissen Map Source: Analysis Result, 2021.

Table 5: Average Rainfall after sorted.

No	Year	Average Rainfall
1	2014	100.101
2	2013	108.567
3	2012	111.363
4	1011	135.099
5	2020	151.587
6	2019	161.570
7	2018	173.672
8	2016	147.634
9	2017	179.726
10	2015	229.740

Source : Calculation Result, 2021

3.3 Planning Rainfall Analysis

Planning rainfall is the biggest rainfall that is possible to occur in an area with certain chance. The analysis of planning rainfall is a procedure to predict the frequency of raining in the past and in the future. With the analysis of rainfall frequency, it can be known rain distribution type that can represent the spread of daily rain data so that it can be determined the planning rain with various repeated period (Suripin, 2018).

3.4 Statistic Parameter

By calculating the statistic parameter such as average value, deviation standard, variation coefficient, and skewness coefficient from the available data and followed by statistic test, then the suitable rain probability distribution can be determined

Table 6: The Determination of Statistic Parameter of Research Area.

No	Year	Xi (mm)	(Xi-X)	$(Xi-?)^2$	$(Xi-?)^3$	$(Xi-?)^?$
1	2014	100.10	-49.8	2,480.52	-123541.88	6,152,981.62
2	2013	108.57	-41.34	1,708.88	-70,642.66	2,920,267.91
3	2012	111.36	-38.54	1,485.56	-57,257.88	2,206,888.14
4	1011	135.10	-14.81	219.23	-3,245.96	48,060.75
5	2020	151.59	1.68	2.83	4.75	7.99
6	2019	161.57	11.66	136.05	1586.86	18,509.15
7	2018	173.67	23.77	564.81	13423.11	319,010.07
8	2016	147.63	-2.27	5.16	-11.73	26.65
9	2017	179.73	29.82	889.22	26516.53	790,719.26
10	2015	229.74	79.83	637.43	508814.02	40,620,621.80
	Total	1,499.06	0.00	13,865.69	295.646,19	53.077.098,35
X		149,906				
iation Standard		39,251				
Cs		0,679				
Ck		4,437				

Source : Calculation Result, 2021

The calculation step on Table 11 to determine the type of that probability distribution is as follows:

1. Determine Average Value

$$X = \frac{\sum_{i=1}^{n} Xi}{n}$$

$$x = \frac{1.499,06}{10}$$

X = 149,906

2. Determine Deviation Standard Value (Sd)

$$Sd = \sqrt{\frac{\sum_{i=1}^{n}(Xi - X)^2}{n-1}}$$

$$Sd = \sqrt{\frac{13.865,69}{10-1}}$$

Sd = 39,251

3. Determine Skewness Coefficient Value (Cs)

$$Cs = \frac{n\ x\ \sum_{i=1}^{n}(Xi - X)^3}{(n-1)(n-2)Sd^3}$$

$$Cs = \frac{10\ x\ 295.646,19}{9\ x\ 8\ x\ 39,251^3}$$

$$Cs = 0,679$$

4. Determine Kurtosis Coefficient Value (Ck)

$$Ck = \frac{n^2 \sum_{i=1}^{n}(Xi - X)^4}{(n-1)(n-2)(n-3)Sd^4}$$

$$Ck = \frac{10^2\ x\ 53.077.093,35}{9\ x\ 8\ x\ 7\ x\ 32,036^4}$$

$$Ck = 4,437$$

3.5 Distribution Type Election

In Statistic knowledge, it is known some types of frequency distribution and four types of distribution that widely used in hidrology field that are Normal Distribution, Log-Normal distribution, Gumbel Distribution and Log-Person Type III Distribution

(Suripin, 2018).

Table 7: Distribution Type Election of Research Area.

No	Distribution Type	Requirement	Calculation Result	Description
		Cs = 0	Cs = 0,679	
1	Normal	Ck = 0	Ck = 4,437	Ineligible
		Cs = 1,14	Cs = 0,679	
2	Gumbel	Ck = 5,4	Ck = 4,437	Ineligible
		Cs = 0,688	Cs = 0,679	
3	Log Normal	Ck = 3,14	Ck = 4,437	Ineligible
4	Log Pearson Type III	Besides the value	Cs = 0,679	Eligible

Source : Analysis Result, 2021

Table 8: The calculation of Deviation Standard and Skewness Coefficient (Cs) of Research Area.

No	Year	Rainfall Xi (mm)	Log Xi	Log Xi - Log X	$(\text{Log Xi - Log X})^2$	$(\text{Log Xi - Log X})^3$
1	2014	100.101	2.000	-0.162	0.026	-0.004
2	2013	108.567	2.036	-0.217	0.016	-0.002
3	2012	111.363	2.047	-0.136	0.013	-0.002
4	1011	135.099	2.131	-0.032	0.001	0.000
5	2020	151.587	2.181	0.018	0.000	0.000
6	2019	161.570	2.208	0.046	0.002	0.000
7	2018	173.672	2.240	0.077	0.006	0.000
8	2016	147.634	2.169	0.006	0.000	0.000
9	2017	179.726	2.255	0.092	0.008	-0.001
10	2015	229.740	2.361	0.199	0.099	-0.008
	Total	1,499.059	21.628	0.000	0.113	0.001
	Log X			2,163		
	S Log X			0.112		
	Cs			0.100		

Source : Analysis Result, 2021

Table 9: The Calculation of Planning Rain with various repetition.

No	Tr (Year)	Deviation Stand Log X	(S.Log X)	Skewness (Cs)	Chance (%)	K	Planning Rainfall Log X	X (mm)
1	2	3	4	5	6	7	8	9
1	1.01	2.163	0.112	0.1	99	-2.252	1.91	81.319
2	2	2.163	0.112	0.1	50	-0.03	2.159	144.334
3	5	2.163	0.112	0.1	20	0.84	2.257	180.688
4	10	2.163	0.112	0.1	10	1.29	2.307	202.951
5	25	2.163	0.112	0.1	4	1.79	2.363	230.920
6	50	2.163	0.112	0.1	2	2.11	2.399	250.811
7	100	2.163	0.112	0.1	1	2.4	2.432	270.314
8	1000	2.163	0.112	0.1	0.1	3.24	2.526	335.788

Source : Analysis Result, 2021

Information
[1) = Number
[2] = Repeat
[3] = (S.Log Xi)/n
[4] = $((\text{S.Log Xi})/n))//(n-1)^{0,5}$
[5] = $(\text{n.S.(Log Xi-}\overline{\text{LogX}})^3/(\text{n-1(n-2)(LogX)})^3$
[6] = (1/Tr)*100
[7] = Table of Pearson III. log distribution properties factor table Based on Cs Value and Opportunity or Repeat Time
[8] = $\overline{\text{Log}}\text{X} + \text{K.}\overline{\text{S.}}\text{Log X}$
[9] = Antilogue of X

3.6 Distribution Suitability Test

Distribution suitability test means to know whether the selected distribution can be used or not, for the available data series. In this study, to the requirement of distribution suitability test analysis used two statistic methods, that are Chi Square test and Smirnov Kolmogorov test.

3.7 Chi Square Test

Chi Square test means to determine whether the selected chance distribution equation can represent analyzed sample data statistic distribution. The decision of this test uses parameter.

Table 10: Interpolation of G Value.

No.	Pr (%)	G
1	80	-0,830
2	75	-0,697
3	50	-0,032
4	25	0,695

Source : Calculation Result, 2021.

Table 11: Recapitulation of Rainfall for each Research Area.

No	Pr (%)	Log X	Deviation Standard (Log X)	Skewness (Cs)	G Tabel	Rainfall (mm)
1	25	2.153	0.112	0.100	0.695	170.15
2	50	2.153	0.112	0.100	-0.032	141.58
3	75	2.153	0.112	0.100	-0.697	118.84
4	80	2.153	0.112	0.100	-0.830	114.83

Source : Calculation Result, 2021

Table 12: Calculation of *Chi-Square* Test.

No	Class	Class (%)	Class (mm)	Frequency Theoretical (Ea)	Frequency Observation (Oi)
1	I	0 - 25	0 - 118,62	2	3
2	II	25 - 50	118,62 - 122,13	2	0
3	III	50 - 75	122,13 - 141,58	2	2
4	IV	75 - 80	141,58 - 165,59	2	3
5	V	80 ~	165,59 ~	2	2
				Total	10

Source : Calculation Result, 2021

Table13: Calculation of Chi-Square Test.

No	A	X^2_{Teble}	X^2_{Count}	Information	
1	1%	13.277	3	$X^2_{Count} < X^2_{Teble}$	Distribution is acceptable
2	5%	14.860	3	$X^2_{Count} < X^2_{Teble}$	Distribution is acceptable

Source : Calculation Result, 2021

The calculation of K value is presented in the Table completely as follows:

Table 14: Interpolation of Pr Value.

No	K	Pr	Pr (%) (Pr/100)
1	-1,606	94,462	0,945
2	-1,235	88,955	0.890
3	-1,119	80.000	0,800
4	-0.235	57,696	0,577
5	-0.291	37,955	0,380
6	0,583	28,871	0,289
7	0,913	17,485	0,175
8	0,170	43,091	0,431
9	1,070	14,898	0,149
10	2,192	-0.823	-0.008

Source : Calculation Result, 2021

Table 15: Calculation of *Smirnov Kolmogorof Test.*

No	Year	Planning Rainfall	Log Xi	Pe	K	Pr	Pt	(Pt-Pe)
1	2	3	4	5	6	7	8	9
1	2014	100.101	2.000	0,091	-1,606	0,945	0,055	-0.036
2	2013	108.567	2.036	0,182	-1,235	0.89	0,110	-0.071
3	2012	111.363	2.047	0,273	-1,119	0,800	0,200	-0.073
4	1011	135.099	2.131	0,364	-0.235	0,577	0,423	0.059
5	2020	151.587	2.181	0,455	-0.291	0,380	0,620	0.166
6	2019	161.570	2.208	0,545	0,583	0,289	0,711	0.166
7	2018	173.672	2.240	0,636	0,913	0,175	0,825	0.189
8	2016	147.634	2.169	0,727	0,170	0,431	0,569	0.158
9	2017	179.726	2.255	0,818	1,070	0,149	0,851	0.033
10	2015	229.740	2.361	0,909	2,192	-0.008	1,008	0.099
		Jumlah	21.627					
		Log X	2.153					
		S Log X	0.095				D Max	0.1989
		Cs	0.1					

Source : Calculation Result, 2021

Table 16: The Decision of *Smirnov Kolmogorof Test.*

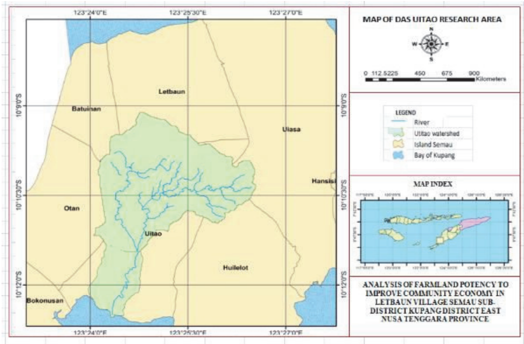
C	Δcritical	ΔMax	Description
0,2	0,32	0,189	Accepted
0,1	0,37	0,189	Accepted
0,05	0,41	0,189	Accepted
0,01	0,49	0,189	Accepted

Source : Calculation Result, 2021

3.8 The Drawing of DAS Uitao Map

The drawing of DAS Uitao border map by using the assistance of ArcView GIS software and ArcSWAT extension.This drawing generates DEM (Digital Elevation Model) which is taken from topography map that has the shape of contour line that modified into cell shape (grid). The use of digital surface model in surface runoff analysis process which presents the earth relief surface will give accuracy in identifying the land slope, flow accumulation, flow line lenght and flow area detemination.

The drawing of water catchment area is done after generating DEM is over, in this case is DAS Uitao drawing. This drawing aimed to find Sub DAS from DAS Uitao and its attribute and generating synthetic river network. The computer will translate the basins or mound by using DEM. The result of DAS Uitao drawing can be seen in Figure 6 and Sub DAS can be seen in figure 7 whereas its attribute data is presented on table 17.



Source: Analysis Result, 2021

Figure 6: Research Area Watershed Map.

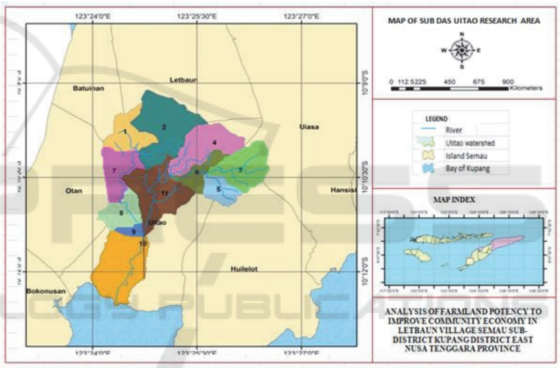


Figure 7: Map of DAS Uitao Research Area Source: Analysis Result, 2021.

Table 17: DATA of Sub-DAS Attribute, the Result of Making DAS Border by using DEM.

Subbasin	Area Subbasin (ha)	StremReach Slope Lenght (LEN1) (m)	Subbasin Slope (SL01) (%)	StreamReach Slope (SLL) (%)	StreamReach Width (WID1) (m)	StreamReach Depth (DEP1) (m)	Elevation Subbasin Controid (ELEV) (m)
1	2	3	4	5	6	7	8
1	98.125	1.967,635	3.466	91,436	1.2754	0.1290	51.9484
2	234.438	3.132,412	3.209	91,436	2.1508	0.1828	64.0555
3	138.688	2.646,168	20.434	15,239	1.5697	0.1482	116.3659
4	157.000	3.117,767	8.183	60,957	1.6909	0.1557	91.9773
5	61.750	1.484,772	25.522	15,239	0.9660	0.1072	115.6407
6	63.500	2.098,681	17.675	18,287	0.9823	0.1084	85.5157
7	104.438	3.277,082	2.058	91,436	1.3240	0.1323	3.7135
8	83.000	1.489,949	1.317	121,914	1.1536	0.1207	29.6032
9	19.375	851,777	3.307	91,436	0.4819	0.0674	24.1000
10	215.571	400,000	1.494	121,914	0.0844	0.0211	12.0000
11	203.750	4.297,056	4.728	91,436	1.9772	0.1728	37.8644
Total	1379.634						

Source : Analysis Result, 2021

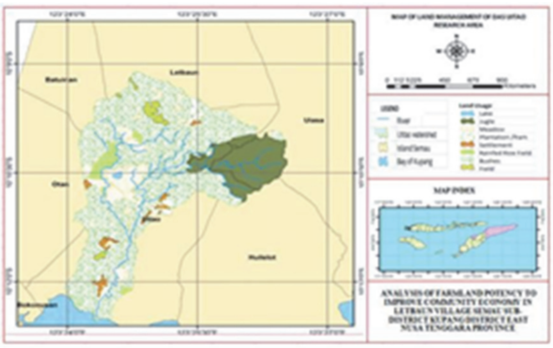
Runoff Debit Analysis of Rational Method The

Determination of Runoff Coefficient (C) The big coeffricient value of runoff/flow (C) shows the quantity of surface runoff that occurs in the land is big, in other words the water management condition and land usage in that land is damaged.

Table 18: Runoff Coefficient in Existing Land Usage in DAS Uitao.

Sub Sub DAS	Land Usage	Area (ha)	Runoff Coefficient C)	Average RunoffCoefficient
	Meadow	10.8929	0.200	
1	Bushes	84.9673	0.010	0.034
	Rainfed Rice field	1.4434	0.150	
	Farm	0.8213	0.020	
	Bushes	190.9824	0.010	
	Meadow	17.3568	0.200	
2	Plantation/farm	8.8219	0.020	0.026
	Field	15.6944	0.020	
	Rainfed Rice field	1.5819	0.150	
	Bushes	5.3534	0.010	
3	Jungle	132.2407	0.030	0.031
	Meadow	1.0934	0.200	
	Bushes	132.2926	0.010	
4	Plantation	5.2532	0.020	
	Meadow	3.0872	0.200	0.021
	Jungle	15.2375	0.030	
	Settlement	1.1295	0.700	
5	Bushes	35.4504	0.010	0.019
	Jungle	26.2996	0.030	
6	Bushes	32.3945	0.010	0.020
	Jungle	31.1055	0.030	
	Meadow	20.1485	0.200	
7	Bushes	56.5264	0.010	0.095
	Rainfed Rice field	25.7082	0.150	
	Settlement	2.0545	0.700	
8	Meadow	17.615	0.200	0.050
	Bushes	65.385	0.010	
	Bushes	182.3029	0.010	
9	Settlement	1.0399	0.700	0.014
	Meadow	0.1049	0.200	
	Bushes	181.5992	0.010	
	Settlement	9.7486	0.700	
10	Meadow	16.0342	0.200	0.058
	Field	3.4027	0.020	
	Rainfed rice field	2.7872	0.150	
	Bushes	136.1688	0.010	
	Meadow	50.8111	0.200	
11	Settlement	6.1475	0.700	0.079
	Rainfed Rice field	0.0544	0.150	
	Plantation	7.768	0.020	
	Lake	2.5736	0.000	

Source : Analysis Result, 2021



Source : Analysis Result, 2021

Figure 8: Map of Land Management of DAS Uitao Research Area.

3.9 Determination Concentration Time (Tc) and Rain Intensity (I)

Below is the calculation example of Concentration time (Tc) and Rain Intensity (I) in Sub-DAS 1

The data :

Land slope (Sloland) = 3,466 Slope lenght (L) = 1.967,61 m, River slope (Sloriver) = 0,100

River lenght (S) = 268,57 m. manning special number (n) = 0,025

R_{24} repetition 2 years = 144,34 mm

R_{24} repetition 5 years = 180,688 mm

R_{24} repetition 10 years = 202,951 mm

R_{24} repetition 25 years = 230,920 mm

R_{24} repetition 50 years = 250,811 mm

The Calculation Analysis is as folows:

1. Calculating To (*Overland flow time*)

$$To = [\frac{2}{3} x 3,28 x L x \frac{n}{\sqrt{S}} x \frac{1}{60}]$$

$$To = [\frac{2}{3} x 3,28 x 1.967,61\ x \frac{0,025}{\sqrt{0,100}} x \frac{1}{60}]$$

To = 0,963 hours

2. Calculating v (flow speed)

$v = 4,918(S)^{1/2}$

$v = 4,918\ (0,100)^{1/2} = 1,555$ m/dt

3. Calculating Td (*Drain flow time*)

$$Td = \frac{1}{3.600v} = \frac{1}{3.600x1,555}$$

Td = 0,351 jam

4. Calculating Tc (Concentration time)

Tc = To + Td

Tc = 0,963 + 0,351

Tc = 1,314 hours

Table 19: Concentration Time Calculation (Tc).

Sub Sub DAS	Land Slope (Slo.Land)	River Slope (Slo.River)	Slope Lenght (L)	River Lenght (S)	Special Number Manning (n)	Overland Flow Time	Flow Speed(V)	Drain Flow Time (Td)	Concentration Time (Tc)
1	2	3	4	5	6	7	8	9	10
1	3,466	0,100	1.967,61	268,57	0,025	0,963	1,555	0,351	1,314
2	3,209	0,688	3.967,61	1.817,09	0,025	1,593	4,079	0,213	1,806
3	20,434	1,916	2.646,17	130,50	0,025	0,533	6,807	0,108	0,806
4	8,183	2,776	3.117,77	1.682,63	0,025	0,933	8,195	0,106	1,099
5	25,522	0,100	1.484,77	138,39	0,025	0,268	1,555	0,265	0,533
6	17,625	2,053	2.098,68	121,75	0,025	0,455	7,047	0,083	0,538
7	2,058	0,514	3.277,08	1.996,02	0,025	2,081	3,524	0,258	2,340
8	1,317	0,245	1.489,95	919,97	0,025	1,183	2,432	0,170	1,353
9	3,307	2,929	851,78	426,78	0,025	0,427	8,417	0,028	0,455
10	1,494	0,100	400,00	425,00	0,025	0,298	1,555	0,072	0,370
11	4,728	0,646	4.297,06	387,03	0,025	1,801	3,953	0,302	2,103

Source : Calculation result, 2021

Rain intensity calculation of Mononobe method a). $I = \frac{R_{24}}{24}\left(\frac{24}{Tc}\right)^{2/3}$, with R_{24} for repetition 2 th = 144,34 mm

$I = \frac{144,34}{24}\left(\frac{24}{1,314}\right)^{2/3}$ = 40,902 mm/hour

b). $I = \frac{R_{24}}{24}\left(\frac{24}{Tc}\right)^{2/3}$, with R_{24} for repetition 5 th = 180,688 mm

$I = \frac{180,688}{24}\left(\frac{24}{1,314}\right)^{2/3}$ = 49,472 mm/hour

c) $I = \frac{R_{24}}{24}\left(\frac{24}{Tc}\right)^{2/3}$, with R_{24} for repetition 10 th = 202,951 mm

$I = \frac{202,951}{24}\left(\frac{24}{1,314}\right)^{2/3}$ = 54,587 mm/hour

d) $I = \frac{R_{24}}{24}\left(\frac{24}{Tc}\right)^{2/3}$, with R_{24} for repetition 25 th = 230,920 mm

$I = \frac{230,920}{24}\left(\frac{24}{1,314}\right)^{2/3}$ = 60,893 mm/ hour

e). $I = \frac{R_{24}}{24}\left(\frac{24}{Tc}\right)^{2/3}$, with R_{24} for repetition 50 th = 250,811 mm

$I = \frac{250,811}{24}\left(\frac{24}{1,314}\right)^{2/3}$ = 65,307 mm/hour

The quantity of Rain intensity (I) added to attribute data of Sub- DAS Uitao map. Then the calculation result can be seen on Table 20 as follows:

Table 20: Rainfall Intensity Calculation (I).

Sub -	Concentration	R24	R24	R24	R24	R24	Rainfall Intensity				
Sub	Time(Tc)	(2 Years)	(5 Years)	(10 Years)	(25 Years)	(50 Years)	(2 Years)	(5 Years)	(10 Years	(25 Years)	(50 Years)
DAS	(Hour)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm/jam)	(mm/jam)	(mm/jam)	(mm/jam)	(mm/jam)
1	2	3	4	5	6	7	8	9	10	11	12
1	0,351	141.427	171.06	188.747	210.553	225.813	40.902	49.472	54.587	60.893	65.307
2	0,213	141.427	171.06	188.747	210.553	225.813	33.085	40.017	44.155	49.256	52.826
3	0,108	141.427	171.06	188.747	210.553	225.813	66.008	79.838	88.003	98.271	105.393
4	0,106	141.427	171.06	188.747	210.553	225.813	46.095	55.754	61.518	68.625	73.599
5	0,265	141.427	171.06	188.747	210.553	225.813	74.681	90.329	99.668	111.183	119.241
6	0,083	141.427	171.06	188.747	210.553	225.813	74.198	89.744	99.023	110.463	118.46
7	0,258	141.427	171.06	188.747	210.553	225.813	27.198	33.674	37.156	41.449	44.453
8	0,170	141.427	171.06	188.747	210.553	225.813	40.116	48.521	53.538	59.723	64.052
9	0,028	141.427	171.06	188.747	210.553	225.813	83.008	100.401	110.782	123.58	132.537
10	0,072	141.427	171.06	188.747	210.553	225.813	95.332	115.306	127.229	141.928	152.214
11	0,302	141.427	171.06	188.747	210.553	225.813	29.898	36.163	39.902	44.512	47.738

Source : Calculation result, 2021

3.10 The Determination of Runoff Debit and the Drawing of Runoff Debit Spread Map

The formula used based on the equation of runoff debit of Rational Method is as follows:
Q = 0,278.C.I.A
Its calculation example is as follows:
In Sub DAS 1 with the data:
1. Land area for Sub DAS 1= 98,125 Ha
2. Runoff Coefficient (C) = 0,034
3. Rainfall Intensity (I) :

2 years = 40,902 mm/hour
5 years = 49,472 mm/hour
10 years = 54,587 mm/hour
25 years = 60,893 mm/hour
50 years = 65,307 mm/hour

The calculation of surface runoff debit (Q_2, Q_5, Q_{10}, Q_{25}, Q_{50}) in Sub DAS 1 location is as follows:

Q = 0,278.C.I.A

Q_2 = 0,278 x 0,034 x 40,902 x 98,125 = 37,395 m^3/second

Q_5 = 0,278 x 0,034 x 49,472 x 98,125 = 45,230 m^3/second

Q_{10} = 0,278 x 0,034 x 54,587 x 98,125 = 49,907 m^3/second

Q_{25} = 0,278 x 0,034 x 60,893 x 98,125 = 55,673 m^3/second

Q_{50} = 0,278 x 0,034 x 65,307 x 98,125 = 59,708 m^3/second

Its calculation recapitulation result can be seen on Table 21 and Runoff Debit Graphic (Q) of DAS Uitao is presented in Figure 9. And its drawing result for Runoff Debit with 10 years repetition can be seen in the figure below:

Table 21: Calculation of Runoff Debit of DAS Uitao.

Sub Sub	Q	Q	Q	Q	Q
DAS	(2 Years)	(5 Years)	(10 Years)	(25 Years)	(50 Years)
	(m^3/second)	(m^3/second)	(m^3/Second)	(m^3/Second)	(m^3/second)
1	2	3	4	5	6
1	37.395	45.230	49.907	55.673	59.708
2	56.186	67.959	74.985	83.649	89.711
3	77.795	94.095	103.824	115.819	124.213
4	42.201	51.043	56.321	62.827	67.381
5	24.358	29.462	32.508	36.364	38.892
6	26.196	31.685	34.961	39.000	41.827
7	76.791	92.880	102.484	114.324	122.610
8	46.282	55.979	61.767	68.903	73.897
9	6.259	7.571	8.354	9.319	9.994
10	331.361	400.790	442.23	493.321	529.075
11	133,787	161.819	178.551	199.179	213.614
Total	858.610	1.038.513	1.145.892	1.278.277	1.370.921

Source : Calculation result, 2021

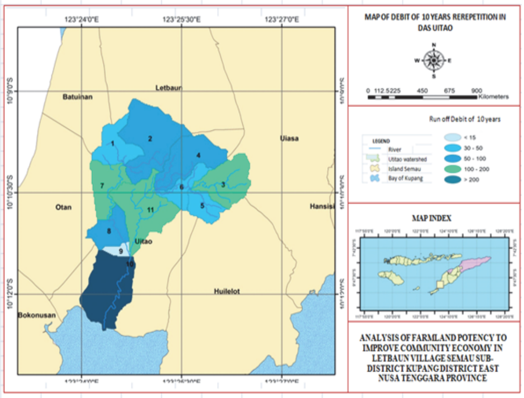


Figure 9: Map of Runoff Debit of 10 years repetition in DAS Uitao.

3.11 The Factors of Slope Lenght (L) and Slope Slant (S) and the Drawing of Slope Slant Map of DAS Uitao

The factors of Slope Lenght (L) and Slope slant (S) influence the quantity of erosion that occurred. The slant influences the speed and volume of surface runoff. Basically if the slope is getting steeper, so the precentage of slope slant is bigger, therefore the surface runoff rate is getting faster. The average of slope lenght quantity in DAS Uitao can be seen through the measurement on digital contour map with the assistance of ArcView software and measure facilities. The slope slant can be known from Sub DAS map attribute data that has been made by DEM method.

$L = (\frac{Lo}{22,1})^m$

With :

L = value of Slope Lenght factor

Lo = Slope lenght (obtained from result attribute of making DAS border /subbasin through software).

Data on Sub DAS 1 :

Lo = 1.967,615 m from Analysis measurement

then ;

$L = (\frac{1.967,615}{22,1})^{0,5} = 9,436\%$

The slant influences speed and volume of surface runoff.

= 9,436%

Slope slant factor (S) can be calculated

$$S = \frac{(0,43 + 0,30s + 0,04s^2)}{6,61}$$

$$S = \frac{(0,43 + 0,30 \times 3,466 + 0,04 \times 3,466^2)}{6,61} = 0,295$$

3.12 The Potency of Land Usage as the Farmland in Letbaun Village

In Letbaun Village Semau Sub-District, there is DAS Uitao that influenced the Letbaun village itself and it has productive land to be processed as farmland.

The usage of ideal farmland is in the lowland area with the slope slant < 10%, the steep land is not ideal to use as farmland. Based on calculation from each Sub DAS Uitao with each slope slant, there are some some Sub DAS with the slope slant < 10% which is ideal for farmland, the area is= 900,126 Ha from total area of DAS = 1379,634 Ha. The land potency for farmland in accodance with Sub DAS is below :

Sub DAS 1 Slope Slant 2,831 %
Extensive Area = 98,125 Ha

Sub DAS 2 Slope Slant 3,301 %
Extensive Area = 234.438 Ha

Sub DAS 4 Slope Slant 8,183 %
Extensive Area = 157,000 Ha

Sub DAS 7 Slope Slant 2,058 %
Extensive Area = 104.438 Ha

Sub DAS 8 Slope Slant 1,317 %
Extensive Area = 83.000 Ha

Sub DAS 9 Slope Slant 3,307 %
Extensive Area = 19.375 Ha

Sub DAS 11 Slope Slant 4,728 %
Extensive Area = 203.750 Ha

3.13 Reservoir Location for Agricultural Water Supply

To support the problem of limited water supply , it is required the usage of water resourse in that location to control the excess water in the rainy season and it becomes the source of irrigation water in dry season. In Sub- DAS 10 based on the calculation result of fairly big surface runoff debit and Land slope > dari 10 % is planned to build Reservoir (Retention basin) to fulfill the water need supply in the land of 900,126 Ha. The covered land (catchment area) is 215,571 Ha.

The location of the Reservoir (Retention Basin) building is at coordinates 123°24'23.41" East Longitude and 10°11'44.23" South Latitude with a water capacity of 442,230 m3/second every 10 years, 493,321 m3/second a Chatment Area of 215,571 Ha. The map image is presented in Figure 10.

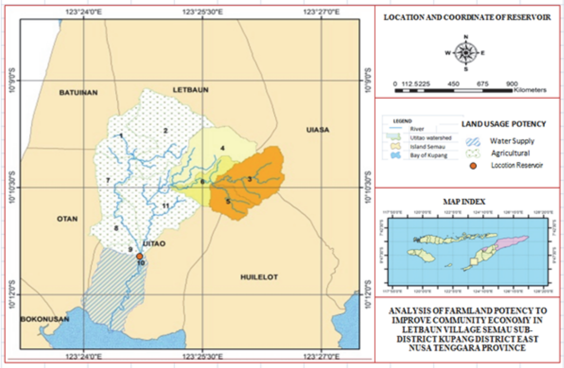


Figure 10: The Map of Land Usage Potency and Location and Coordinate of Reservoir.

4 CONCLUSIONS

The farmland potency in Letbaun Village Semau Sub-District Kupang District of area = 900,126 Ha from the total area of =1.379,634 Ha, it means 65,24 % from total region. And to fulfill the need of water in reservoir building(retention basin) in Sub DAS 10 in coordinate of 123°24'23.41" East Longitude and 10°11'44.23" South Latitude with the covered area (catchment area) of 215,571 Ha. In the DAS which has land slope > of 10 % is made the construction of water path that made parallel to the contour line with the distance of 10 - 20 m and the width size of 0,50, the depth of 0,50m to minimize surface runoff debit.

REFERENCES

Aronoff. 1989. Geographic Information System – A Management Perspective. Ottawa: WDL Publications.

Asdak, Chay. 2004. Hidrologi Dan Pengelolaan Daerah Aliran Sungai. Yogyakarta: Gajah Mada University Press.

ESRI (Environmental System Research Institute, Inc). 1996. ArcView GIS, The Geographic Information System for Everyone. New York: ESRI. Dampit, Kabupaten Malang". Skripsi tidak diterbitkan. Malang: Jurusan Pengairan FT Unibraw, 2003.

Marwan, Achmad. 2003. "Implementasi Sistem Informasi Geografis Dalam Penentuan Batas Genangan Bendungan Genteng Kecamatan Dampit, Kabupaten Malang". Skripsi tidak diterbitkan. Malang: Jurusan Pengairan FT Unibraw, 2003.

Prahasta, Eddy. 2001. Konsep-Konsep Dasar Sistem Informasi Geografis. Bandung: CV Informatika.

Prahasta, Eddy. 2005. Sistem Informasi Geografis. Bandung: CV Informatika.

Soemarto, CD. 1999. Hidrologi Teknik Edisi Kedua.
Jakarta: Erlangga.

Sulaiman dkk, 2017 Pemetaan Potensi Air Tanah Menggunakan Penginderaan Jauh dan Sistem Informasi Geografis. Prosiding Seminar Nasional seri 7"Menuju Masyarakat Madani dan Lestari" Yogyakarta, 22 November 2017, e-ISBN: 978-602-450-211-9, p-ISBN:
978-602-450-210-2.

Ervina Rouska, dkk, 2017 Tingkat Bahaya Erosi dan Faktor Kemanan Lereng Pada Jalan Banda Aceh – Calang, Journal Teknik Sipil Usyiah Kuala, Vol Vol 6 N. 2 (2017) .

Utomo, Wani Hadi. 1994. Erosi Dan Konservasi Tanah.
Malang: IKIP Malang.

Tuti Herawati, 2010. Analisis Spasial Tingkat Bahaya Erosi Di Wilayah DAS Cisadana Kabupaten Bogor. Journal Penelitian Hutan dan Konservasi Alam Volume 2.

Juditha, C. (2016). Peace Journalism in News Tolikara Religion Conflict in Tempo. co-Jurnalisme Damai Dalam Berita Konflik Agama Tolikara Di Tempo. co. *Jurnal Penelitian Komunikasi dan Opini Publik*, *20*(2).

Hardjowigeno, S. (1995). Kesesuaian Lahan untuk Pengembangan Pertanian, Daerah Rekreasi dan Bangunan. *Lembaga Pengabdian Kepada Masyarakat. IPB. Bogor*, *200*.

Agwa, H. E. (2000). Arbuscular mycorrhizal fungi (glomales) in Egypt. I. A field survey of Arbuscular mycorrhizal fungi associated with medicinal plants and effect of inoculation on growth of some plants. *African Journal of Mycology and Biotechnology*, *8*(3), 1-12.

Bisri, M., Limantara, L. M., Prasetyorini, L., & Chasanawati, D. (2017). Application of the Kineros model for predicting the effect of land use on the surface run-off Case study in Brantas sub-watershed, Klojen District, Malang City, East Java Province of Indonesia. *Journal of Water and Land Development*.

Suripin, S., Sangkawati, S. S., Pranoto, S. A., Sutarto, E., Hary, B., & Dwi, K. (2018). Reducing stormwater runoff from parking lot with permeable pavement. In *E3S Web of Conferences* (Vol. 73, p. 05016). EDP Sciences.