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COMMUNITY PARTICIPATION IN DETERMINING RUNNOUT COEFFICIENT AS AN EFFORT TO REDUCE FLOOD VOLUME IN TEWAH VILLAGE

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ABSTRACT

The Rational method is one of the simple hydrological modeling to estimate the discharge of a watershed, and one of the important factors in the rational method is the runoff coefficient (C). The purpose of this study is to analyze the results of the Rational method discharge estimation using the runoff coefficient value that is tested and analyzed based on the parameters of community participation in the use of its land use. Analysis of the planned flood discharge using the Rational method, followed by analysis of the runoff coefficient value (C), analyzed using the SWOT analysis method, which is the basis for determining the parameters in simulating the runoff coefficient value (C) to reduce the magnitude of the planned flood discharge. The results of the study showed that the form of community participation in reducing the risk of flood disasters in the Tewah Village area, especially in areas affected by flooding, was to change 40% of the built-up area/community settlements and 10% of the forest area/open land area to be converted into parks, as an effort to carry out the greening process and utilize residents' yards as rainwater catchment areas which produced the lowest C runoff coefficient value, namely 0.26, so it is assumed to reduce the planned flood discharge value by around 8% of the 2023 discharge.

Keywords: Flood, Community Participation, Runoff Coefficient, SWOT Analysis, Tewah in Central Kalimantan.

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1. INTRODUCTION

Flooding is a problem that until now still requires special handling from various parties, both from the government and the community, because flooding is not a light problem. Flooding can occur due to several factors, namely internal factors, external factors and anthropogenic factors. Anthropogenic factors are factors caused by humans, where the habit of people closing off land that should be for preservation and conservation areas to maintain the balance of the local environment, is then taken over to be used as settlements and so on. Facts of the problem about flood for public moment this is ignorance or lack of education for public alone related roles in society in help and prevent the occurrence flood. Indifference and unawareness public will importance prevent flood still very minimal. This is resulting in the occurrence of increasingly flooded often in season rain. How should public follow recommendation or the rules that have been determined by the government local, as well as how public that alone in manage and maintain the utilization land in the area environment place his residence as from effort reduce possibility the occurrence flood. Rational Method is one of modeling hydrology simple often used for estimating peak discharge a DAS, and one of the factor important things that exist in method rational is coefficient runoff (C). In the study this factor anthropogenic taken from habit public close yard or change of use land that will be influence coefficient runoff in the area. This factor will be a free parameter that can controlled in subtraction potential the occurrence flood. The purpose of study this is for analyze and measure the large flood discharge of the Karungen River which has an impact on some areas in Tewah Subdistrict Gunung Mas Regency, analyzing results debit estimation method rational use mark coefficient calculated runoff based on participation parameters public in use of the rules his land and gave input to public local related role participation public in effort mitigation disaster flood.

2. METHODS AND MATERIALS

2.1. Research Location

The study area is Karungen River in Tewah Village, Gunung Mas Regency, with a watershed area of 21.85 km2. Karungen River is one of the tributaries of Kahayan River located in Tewah Village, Tewah District, Gunung Mas Regency, Central Kalimantan Province. With a river length of 7.6 km, a depth of 1-3 m, and a width of 2.5-5 m.

2.2. Population and Sample

The population in this study was the community in Tewah Village located in the Karungen River area which consists of several RTs, namely RT 11, RT 12, RT 13 and RT 14, totaling 470 heads of families (KK). (Source: Statistical data for the 2024 General Election List, Tewah Village, Tewah District, Gunung Mas Regency). From the population the writer take 10% of population so that amount sample his is 10% × 470 families = 47 families. So the total number sample taken rounded up become as many as 50 families in Tewah Subdistrict Regency Gunung Mas. Based on the affected area floods that settled around the Karungen River in the Tewah Subdistrict environment that is totaling 4 RT with sample as many as 50 families divided into 12-13 families in each RT whose territory often submerged flood.

2.3. Data Collection

1. Maps and topographic data.
2. Bulk data rain used at the location studies that is Station Meteorology Tjilik Riwut (Palangka Raya).

3. Questionnaires and interviews to public related use land yard as form from participation public in reduce flood volume.

2.4. Data processing

1. Analysis rainfall rain maximum.
2. Analysis rainfall rain the plan being analyzed use a number of method distribution, namely Normal, Log Normal, Log Pearson Type III and Gumbel distributions.
3. Analysis intensity rain connected with events and duration rainfall rain, the formula used in count intensity rain is Formula Mononobe .
4. Runoff coefficient (C) analysis as factor in design discharge calculation.
5. Flood discharge analysis plan using the Rational Method.
6. SWOT analysis of the questionnaire with method analyze and sort things that influence fourth the factors. With thus, the results from analysis can to form strategic planning based on results analysis to factors strategic (strengths, weaknesses, opportunities, threats).
7. Determine simulation that affects the magnitude of the flood discharge plan (Q) of method selected with recurrence periods of 2, 5, 10, 25, 50 and 100 years.

3. RESULTS AND DISCUSSION

3.1. Determination of Regional Rainfall

Data used in this study is the annual maximum rainfall data from the Tjilik Riwut Meteorological Station (Palangka Raya) with 20 years of rainfall data collection, from the period 2004 to 2023, which can be... seen in **Table 1.**

Table 1. Maximum Daily Rainfall

No	Year	Maximum Rainfall (mm)
1	2004	131.2
2	2005	130
3	2006	130
4	2007	130
5	2008	195,9
6	2009	139
7	2010	195
8	2011	148
9	2012	155
10	2013	120
11	2014	119,8
12	2015	148,9
13	2016	200
14	2017	168
15	2018	100
16	2019	128
17	2020	185.7
18	2021	88.1
19	2022	110.4
20	2023	99

3.2. Rainfall Data Consistency Test

The results of testing the rainfall data were tested using The RAPS method can be seen from the description below this.

Sk** Max	= 1.63
Sk** Min	= -1.81
Q |Sk** Max|	= 1.63
R (Sk** Max - Sk** Min)	= 3.44
$Q/n^{0.5}$	= 0.29 < 1.22 (with 95% probability of table, data OK)
$R/n^{0.5}$	= 0.41 < 1.43 (with 95% probability of table, data OK)

From the results the above test shows that the rain data Station Meteorology Tjilik Riwut Palangka Raya has Q/n value$^{0.5}$ and $R/n^{0.5}$ more small from mark Q and R criticism. So that can concluded that the rainfall data rain the consistent and able used for calculation furthermore.

3.3. Suitability Test Distribution

Test of goodness of fit of the calculated distribution with the Chi Square Test method (deviation vertically) and the Smirnov Kolmogorov Test (horizontal deviation). Results full calculations can be seen at **Table 2.**

Table 2. Maximum Daily Rainfall

Rainfall Plan				
	Normal	**Gumball**	**Normal Log**	**Pearson Type III Log**
Square Test				
X^2 Calculate	3.50	1.50	1.00	7.00
X^2 Critical	5,991	5,991	5,991	5,991
Conclusion	REPRESENT	REPRESENT	REPRESENT	NOT REPRESENTING
Kolmogoroff test				
D Count	0.23	0.23	0.12	0.12
D Critical	0.29	0.29	0.29	0.29
Conclusion	REPRESENT	REPRESENT	REPRESENT	REPRESENT

Suitability test Chi Square Test Distribution it is said accepted / fulfilled condition except log pearson type III distribution, and Smirnov Kolmogorov Test all distribution can accepted / fulfilled condition.

3.4. Analysis Frequency and Probability

The purpose of rainfall frequency analysis is to determine the amount of rainfall or discharge with a certain return period based on the statistical properties of the available data to obtain the probability of the amount of rainfall/discharge in the future. There are 4 methods for analyzing the frequency distribution of rainfall data, namely Normal Distribution, Log Normal Distribution, Gumbel Distribution and Log Pearson Type III Distribution.

Table 3. Analysis Summary Rainfall Frequency

Analysis Distribution Frequency				
Tr (Tahun)	**Normal**	**Gumbel**	**Log Normal**	**Log Pearson Type III**
100	219	269	238	238
50	209	247	223	223
25	198	225	206	208
10	184	195	186	186
5	169	172	168	168
2	141	136	137	137

From the results of the frequency analysis above, the rainfall intensity was obtained for several return periods that are usually used for planning. That the results of the calculation of planned rainfall using the Gumbel method showed the planned rainfall with the largest results among other methods. For planning take rainfall Rain plan the largest, so that the design plan can anticipate Rain big in the future and represent statistics of the data analyzed. So that rainfall rain the next plan used for debit plan analysis is rainfall rain plan Gumbel Distribution.

3.5. Coefficient Overflow (C)

Analysis coefficient overflow obtained from ESRI Satellite Imagery where the oldest data that can be obtained and used is data from 2017 until 2023. For land use observations, satellite imagery data is used because the data obtained is closer to field conditions.

Table 4. Recapitulation of Coefficient Values Overflow C

No	Year	Coefficient C Value
1	2017	0.271
2	2018	0.280
3	2019	0.275
4	2020	0.275
5	2021	0.277
6	2022	0.282
7	2023	0.283

Based on usage ESRI satellite imagery of land 2017 to 2023 obtained mark coefficient increasing C runoff big on each year next.

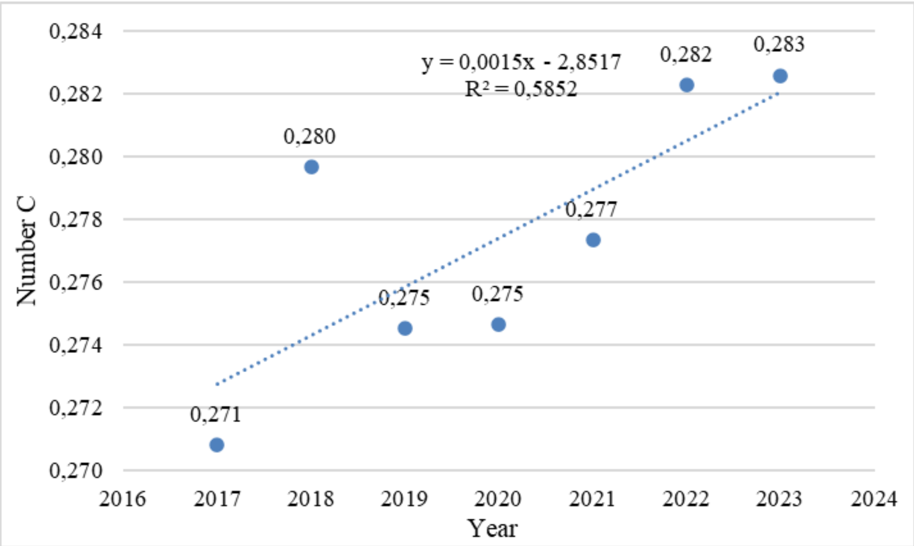

Figure 1. Coefficient Value Graph C. Overflow

If see results from chart recapitulation the value of C that trend data patterns that occur show improvement or increase in each the year with the R^2 value of 0.5852 indicates sufficient compatibility good between estimated trend line value with actual data.

3.6. Planned Debit (Q)

Table 5. Summary of Planned Discharge Calculation Results**.**

Period Repeat	Q (m³/ sec)						
	C (Satellite 2017)	C (Satellite 2018)	C (Satellite 2019)	C (Satellite 2020)	C (Satellite 2021)	C (Satellite 2022)	C (Satellite 2023)
2	33,8243	34,9273	34,2861	34,3039	34,6408	35,2556	35,2929
5	42,6621	44,0533	43,2446	43,2671	43,6919	44,4674	44,5145
10	48,5136	50,0956	49,1759	49,2014	49,6846	50,5665	50,6200
25	55,9068	57,7300	56,6701	56,6996	57,2563	58,2726	58,3343
50	61,3916	63,3936	62,2298	62,2621	62.8735	63.9895	64,0572
100	66,8359	69,0154	67,7483	67,7836	68,4492	69,6641	69,7378

Summary of the results of the planned discharge calculation using several different C values. Where the largest discharge result is the discharge from the ESRI satellite runoff coefficient in 2023, which is then made into as a reference in further calculation analysis.

3.7. SWOT Analysis

Based on the results of the SWOT analysis, it was obtained that the strength that can be taken is that the community is willing to comply with Regional Regulation No. 8 of 2014 concerning the Spatial Planning of Gunung Mas Regency and other regulations related to the management of residential spatial planning, and is willing if required to change the yard that was previously covered with cement or paving blocks into a garden for natural vegetation as an independent community effort, while the opportunities that can be taken are the existence of institutions or agencies that provide support in implementing policies in handling flooding and utilizing open land.

According to the Regulation of the Minister of Agrarian Affairs and Spatial Planning/Head of the National Land Agency of the Republic of Indonesia Number 14 of 2022 concerning the Provision and Utilization of Green Open Space (RTH) Article 1 Paragraph 17: Private Green Open Space hereinafter referred to as Private RTH is RTH owned by certain institutions or individuals whose use is for limited circles. And Article 3 Paragraph 3b: Private RTH is at least 10% (ten percent). Then a simulation was carried out by changing 10%, 20%, 30% and 40% of the built-up area/community settlement to be converted into a park, as an effort to carry out the greening process and utilize residents' yards as rainwater catchment areas.

3.8. Discussion

With the results of the analysis and calculation of the planned rainfall at the research location on the Karungen River with a return period of 2 years of 136 mm; 5 years of 172 mm; 10 years of 195 mm; 25 years of 225 mm; 50 years of 247 mm; and 100 years of 269 mm. the maximum flood discharge value that has been calculated using the Rational method, it can be seen that the planned flood discharge for the return period Q2 is 35.2929 m³/second; Q5 is 44.5145 m³/second; Q10 is 50.6200 m³/second; Q25 is 58.3343 m³/second; Q50 is 64.0572 m³/second and Q100 is 69.7378 m³/second.

The processed questionnaire with SWOT analysis and analysis land use changes from 2017 to 2023, then the ideal simulation to produce a C value is to change 40% of the built-up area/community settlements and 10% of the forest area/open land area to be converted into parks, as an effort to carry out the greening process and utilize residents' yards as rainwater catchment areas which produce the lowest C value, namely 0.26.

Table 6. Summary of Planned Discharge Calculation Results.

Period Repeat	Q (m³/ sec)		
	C (Satellite 2017)	C (Satellite 2023)	C (Simulation)
2	33,8243	35,2929	32,4732
5	42,6621	44,5145	40,9580
10	48,5136	50,6200	46,5757
25	55,9068	58,3343	53,6737
50	61,3916	64,0572	58,9394
100	66,8359	69,7378	64,1662

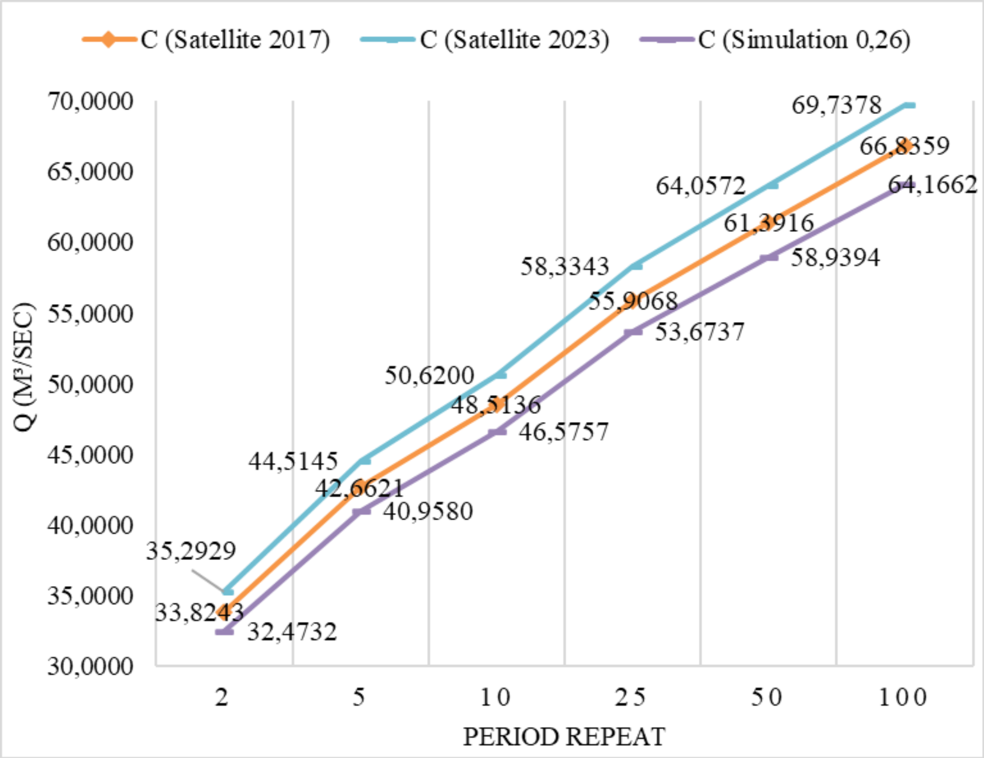

Figure 2. Planned Discharge Graph.

Need be noticed with results C value in 2023 (0.283) which can categorized low However still happen flooding in the area, due to condition the river that experienced shallowing / sedimentation and the presence of activity mining illegal on the Karungen River and rainfall rain at the location the of course enough tall so that with the C value of 0.283 remains the same happen flooding in the Karungen River area.

4. CONCLUSION

An analysis of the design rainfall calculation has been conducted at the research location on the Karungen River in Tewah Village, Gunung Mas Regency, Central Kalimantan Province, namely the design rainfall with a 2-year return period of 136 mm, can cause flooding with a Q2 return period of 35.2929 m³/second. With the results of quite large rainfall, it can cause flooding almost every year.

The form of community participation in reducing the risk of flooding in the Tewah Sub-district area, especially in areas affected by flooding, is to change yards into parks and utilize open land for natural vegetation because it is assumed that changing around 40% of yards into parks can reduce the percentage of built-up area on land cover which is a parameter in determining the runoff coefficient (C) value to be smaller (0.26) compared to 2023 (0.28).

The planned flood discharge value is increasing by around 2.1% from 2017 to 2023, due to the increasing area of built-up areas and the decreasing area of forests and open land areas such as people's yards which are converted into closed land by a layer of cement mixture and paving blocks. By simulating the reduced C value by implementing the greening process and utilizing residents' yards as parks/rainwater catchment areas, it can reduce the planned flood discharge by 8%.

REFERENCE

[1] Anura, HK (2019). Community Participation in Reducing the Risk of Flood Disaster in Bugis Environment, Menggala Urban Village, Menggala District, Tulang Bawang Regency.

[2] Asdak, C. 2004. Hydrology and Watershed Management. Yogyakarta: Gadjah Mada University Press.

[3] Babay, SS, Tungka, AE, & Moniaga, IL 2021. Community Participation In Flood Disaster Mitigation In North Bolaang Mongondow Regency. Fractal: Journal of Architecture, City and Science, 6 (2).

[4] Geospatial Information Agency of the Republic of Indonesia, 2015-2019. Digital Topographic Map of Indonesia. Bogor, West Java. Accessed from: http://tanahair.indonesia.go.id/portal-web/.

[5] Human Resources Development Agency, Central Work Unit for Education and Training of Roads, Housing, Settlements and Regional Infrastructure Development. 2021. Attachment A Technical Training Example of Hydrology and Hydraulic Calculations. Ministry of Public Works and Public Housing, Bandung. 29 Pages.

[6] Buchhorn, M., Smets, B., Bertels, L., Roo, B.D., Lesiv, M., Tsendbazar, N.-E., Herold, M., & Fritz, S. (2020). Copernicus Global Land Service: Land Cover 100m: collection 3: epoch 2019: Globe (Version V3.0.1) [Data set]. Zenodo

[7] Lestari, Utami Sylvia. 2016. Empirical Method Study for Calculating Flood Discharge of Negara River in Sungai Pandan Sub-district (Alabio). Poros Teknik Journal, 8 (2), pp.55-103.

[8] Masuku, R., & Lasaiba, M. A. (2022). Community Participation in Flood Disaster Mitigation in Kahena Hamlet RT 007/017 Batu Merah Village, Sirimau District, Ambon City. Unpatti Geography Education Journal, 1(1), 1-11.

[9] Nafarin, A., Adyatma, S., Arisanty, D., & Riadi, S. (2017). Community-Based Flood Disaster Management Model in Hulu Sungai Tengah Regency, South Kalimantan Province.

[10] Novitasari. 2012. Study of Water Resources Management (Case Study of Martapura Watershed Upstream, Riam Kanan Sub-watershed). Technical Info, 13 (1).

[11] Novitasari., Holdani Kurdi. 2022. Flood Mitigation in Banjar Regency, South Kalimantan, Indonesia in 2021: Between Hydro-meteorological factors and Anthropogenic factors. IOP Conf. Ser.: Earth Environ. Sci, 999 012010.

[12] Samaawa, A., & Hadi, MP (2016). Peak Discharge Estimation Based on Several Methods of Determining Runoff Coefficient in Kedung Gong Sub-DAS, Kulonprogo Regency, Yogyakarta. Indonesian Earth Journal, 5(1).

[13] Sasmita, FS (2019). Identification of Flood Causes in the Cicaheum Area of Bandung City–West Java (Case Study: Cipamokolan River).

[14] Susilo, Hadi. Hydrological Engineering Course Module: Calculation of Designed Flood Discharge Based on Rainfall. Mercu Buana University.

[15] Triadmodjo, Bambang. 2008. Applied Hydrology. Beta Offset. Yogyakarta.

[16] WATI, A. (2018). Flood Disaster Mitigation Based on Community Participation in Babat Village. Thesis, Brawijaya University.

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