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Study of Morphometry to Debit Drainage Basin (DAS) Air Dingin Padang City

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Abstract. *Drainage Basin Air Dingin is which located in Padang city, part of pate upstream of there are areal protected forest. But the forest used by resident as areal plantation, mining, and activity of illegal logging. This matter menace the existence of function hidrologis needed by for society prosperity. High intensity rain that happened in Padang city cause the happening of floods at DAS Air Dingin. Floods thathappened in Padang besides caused high rain intensity, require to be by research about morphometry that is cause parameter the happening of floods. Morphometry drainage basin physical network (DAS) quantitatively related to DAS geomorphology that is related to form of DAS, river network, closeness of stream, ramp, usage of farm, high and gradient steepness of river. Form DAS will influence rain concentration to outlet. Make an index to closeness of stream depict closeness of river stream at one particular DAS. Speed of river stream influenced by storey, level steepness of river. Steepness storey, level is comparison of difference height of river downstream and upstream. Ever greater of steepness of river stream, excelsior speed of river stream that way on the contrary. High to lower speed of river stream influence occurrence of floods, more than anything else if when influenced by debit big. Usage of farm in glove its link to process of infiltration where if geology type which is impermeable, be difficult the happening of infiltration, this matter will enlarge value of run off. Research by descriptive qualitative that is about characteristic of DAS. Method the used is method survey with data collecting, in the form of rainfall data of year 2005 until year 2015 and Image of DEM IFSAR with resolution 5 meter, analyzed use Software ARGIS. Result of research got by DAS reside in at condition of floods gristle.*

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I. Preliminary

In line with going concern development process, needed by arrangement effort and guidance to activity's, with especial priority to re -create ecological balance of environment. Referring to problem of floods that happened in Padang city that from year 2000, with high rain intensity will happened floods. Bar of Air Dingin, not yet can overcome floods [6]. Like known that high rain intensity will cause the happening of floods. Cause of high rainfall intensity have done many its research. That floods not merely caused by rainfall but also caused by DAS morphometry [3] what consist of wide of DAS, form DAS, river network, closeness of stream, stream pattern, and Gradient steepness of river. For that influence of morphometry to DAS Air Dingin require to be done research.

(a). Figure floods area house (b). Figure floods area house **Figure 1:** (a), (b) Citizen Housing

II. Study Literature

2. 1. Parameter crisis of floods

According to [10], [13], [12], floods crisis parameters according to morphometri:

Table 1. Parameter Floods and category

Parameter	Classification	Category	Score
1. Maximal Daily Rain (mm/day)	<20	lower	1
Natural influence (35%)	21-40	Rather low	2
	41-75	middle	3
	76-150	Rather high	4
	➢ 150	High	5
2. Form of DAS	< 0,2	ellipse	1
	0,21 – 0,40	Rather ellipse	2
	0.41 – 0.60	middle	3
	0.61 – 0.80	roundish	4
	➢ 0.80	circular	5
3.Closeness of Drainage (km / km2)	< 0.25	Seldom	1
Natural Influence (5%)	0.26 – 8.50	Rather seldom	2
	8.51 – 16.75	middle	3
	16.76 – 25	Rather meeting	4
	➢ 25	meeting	5
4. Bevel (%)	➢ 25	Very steep	1
Natural Influence (5%)	15–25	steep	2
	8–15	precipitous	3
	3 -8	sloping	4
	0 – 3	Level off	5
5. Usage of farm	Cover forest	lower	1
Management (40%)	Forest production/plantation	Rather low	2
	Lawn/bush	middle	3
	Irrigated/non irrigated	Rather high	4
	Non irrigated/settlement	High	5
6. Gradien river	< 0.5	lower	1
Natural influence (10%)	0.5 – 1.0	Rather low	2
	1.1 – 1.5	middle	3
	1.6- 2.0	Rather high	4
	➢ 2.0	High	5
7. Form farm mountain	Hilly	lower	1
Natural influence	Rather hilly	Rather low	2
	Plain,terrace	middle	3
	Plain,terrace (bevel < 2%)	Rather high	4
	Plain of alluvial	High	5
8.High of pond (cm)	<23	lower	1
Natural influence	24- 47	Rather low	2
	48–71	middle	3
	72–95	Rather high	4
	➢ 96	High	5

2.2. Congeniality

Morphometri DAS (Drainage basin)

[1], DAS morfometri represent quantitative size measure characteristic of DAS which related to aspect of geomorfologi area. This characteristic related to rainwater process which fall in DAS. The Parameter wide of DAS, form DAS, river network, closeness of stream, stream pattern, and gradien steepness of river.Drainage basin (DAS) left outspread area beside and and right the than a river stream, where all watercourse which there are on the right and is left of river have estuary into mains river. All rain that happened in a basin drainage, all its water will fill river which there are in DAS. On that account, DAS areal also represent rain capture area or referred as area catchment. All water emiting a stream of to pass river pull away river capture area (DAS) with or without reckoning gone through road;street before reaching limpasan (run off), [9]. Drainage basin (DAS) also can be defined as a area limited by natural topography, where all rainwater which fall in it will emit a stream of to a exit and river outlet at river, or represent set of hidrologi depicting and using set of fisik-biologi and set of economic social activity for the planning of and management of natural resources. [15]. Morphomeri Drainage basin (DAS)] term used to express situation of network groove river quantitatively. such situation for the analysis of river stream [7] for example covering:

2.2.1. Area of DAS

DAS represent place gathering of rain / presipitasi to a river system. Wide of stream area can be estimated [5] with measuring the the area map of topography. Border line between DAS is contour back / surface of earth able to dissociate and divide rainwater to each DAS. The border line determined pursuant to change of contour of map of tofografi while wide its DAS can be measured by means of planimeter, used map scale will influence correctness of calculation

2.2.2. Wide and long of DAS

Long of DAS [7] is equal to distance level off from river estuary up at pateupstream as long as mains river. While is wide of DAS is comparison between wide of DAS with mains river length.

2.2.3. Gradien River

Gradien of river [7] can be obtained with the following equation:

Gradien = Vertical Distance / Horizontal distance

Su= h85−h10 0.75 100

(1)

2.2.4. Closeness of drainage

Closeness of river [4] is a index number showing to the number of watercourse in a DAS. The Index obtained with the following equation:Dd = L/A (2)

2.2.5. Form Drainage basin

Pattern River determine form a DAS. Form DAS have important meaning in its link with river stream, that is having an effect on to speed of stream. According to [7], to determine form of DAS can know by determining assess its R. $Rc = 4\pi A/P^2$ (3)

Form of DAS influence rainwater concentration time emiting a stream of to go to outlet. Circular progressively form of DAS mean progressively shorten needed concentration time, so that floods fluctuation excelsior that happened. On the contrary ellipse progressively form of DAS, needed concentration time longer so that floods fluctuation progressively lower. Form of DAS quantitatively can be estimated by using long ratio value (' ratio' elongation / Re) and circularity (' ratio' circularity / Rc). Kinds of drainage basin form: DAS in form of plumage, DAS in form of radial, DAS in form of is parallel.

2.2.6. River network

[13], river network can influence the level of river stream debit conducted by its river children. This parameter can be measured quantitatively from ramification ratio that is comparison between amount of river path of ordo certain with river ordo one storey, level above him. This value indicate that ramification ratio excelsior mean the the river have many river children and fluctuation charge that happened ever greater also. River ordo is position ramification of river path in its sequence to river mains at one particular DAS. More and more amount of river order, progressively wide and long progressively also groove its river. River Ordo can be specified with method of Horton, Strahler, Shreve, and Scheidegger. But in general method of Strahler easier to be applied to be to be compared to the other method.

2.2.7. Daily rain maximum

Taken by rainfall data of year 2005 until year 2015

2.3 Classification Floods

Of floods crisis parameter got by floods classification based on score of divided variable like table 2, According to [10], [13], [12]:

Table 2. Classification Floods

Classification	Score
Very gristle	40 – 29,4
Gristle	29,3 – 18,7
Not gristle	18,6 – 8

III. Research Methodology

Research conducted by descriptive qualitative that is about characteristic of DAS based on morphologi at Air Dingindebit. As for method taken is method survey by collecting data. Data aggregate later will be analysed [2]. Research by using rainfall data of year 2005 up to year 2015. Rainfall calculated by Thiessen and get floods debit by using logarithm method of Pearson III [8]. Analysis of DAS relate at process use DEM and data operation of raster [12] to depict drainage basin and to get fitur like river, river network, diffusion area, hollow. A big DAS can include, cover entire all river system in DAS, possible there is small river stream, one to each, every watercourse in stream system

required data

1. Image of DEM IFSAR with resolution 5 metre. IFSAR with Single Use August 2011
2. Sofware ARGIS

Population is corps set of having same characteristic or assumed is same. This characteristic can be seen in the form of certain size measure [15]. Population can in the form of farm, which farm on the surface of earth very immeasurable. For that in this research of farm population better limit in the form of inclination of bevel, closeness of drainage, rainfall, farm form, use of farm, river gradien, ordo, form DAS, and is high of pond.

IV. Research Result

Pursuant to result of calculation of Order river class and length based on map of Image, hence obtained result of rivers order class length and amount region of DAS Bar of Air Dingin:

1. Wide of Bar of Air Dingin 130,70 km2
2. Long of River of Air Dingin 19,87 km
3. River gradien:

Su = (h85 - h10)/ (0,75 Lb)
Su = Inclination Of Especial Path River
h10 = Height of dot which lay in distance 0,10
Lb h85 = Height of dot which lay in distance 0,85
Lb Lb = Long of Especial Path River
h85= 90 m
h10=10 m
h85-h10 = 90-10 = 80 m or 0,08 km
Su = 0,08/ 19,87 = 0,0040261701 or 0, 40261701 % (< 0,5 % low)
(Score 1)

4.Bifurcation Ratio (Rb)

Orde	Nu	Nu/(Nu + 1)
1	72	0.99
2	42	0,98
3	15	0,94
4	15	0,94
∑	144	3,85

$$WRb = \frac{Rb\,u/u+1\,(Nu+Nu+1)}{(Nu)} \qquad WRb = 3,85 \times (144+143) \qquad WRb = \frac{1.093,47}{144} \qquad WRb = 1.093,47_{144} = 7,67$$

5.Circularity Ratio (Rc)

$Rc = \frac{4\pi A}{P^2}$

A = 130,70 Km2
P = circle DAS = 85,47 km

$2\pi r$= circle DAS

$r = \frac{85,47}{2\pi} = \frac{85,47}{6,28} = 13,60$ km

$Ac = \pi r$

$= 3,14 \times (13,60)^2 = 580,77$ km2

Rc $= \frac{A}{} = \frac{130,70}{} = 0,22$(Rather ellipse the including score 2)

6. Closeness Of drainage (Dd)
For total Length Mains river and watercourse of batang Air dingin151,48 Km
Closeness of drainage
Dd = L / A =151,48/130,70
Dd = 1.16 (can make sedimentation)
Closeness of drainage= 1,16 (closeness class category rather seldom, score 2)

7.. Frequency river order ratio (F)
Grand total of Ordo river = 144
Wide of DAS = 130,70 Km2
F = Grand total of ordo river/wide of DAS
$= \frac{144}{130,70} = 1,10$

8.Bevel
Of biggest bevel 25 - 45% broadly 96,05 km^2 (score 1, and 0 - 3% broadly 13,71km^2 (score 5).
Score bevel mean 3

Bevel	Area (KM^2)	Area (HA)
DAS Batang Aia Dingin		
0-3%	13,71	1371,16
3-8%	1,68	167,85
15-25%	3,51	351,13
25-45%	96,05	9606,88
>45%	15,72	1572,49

9. Use of farm

Table 3. Use of farm

DAS Arau	Use of farm	**Area (Km^2)**	**SCORE**
	Areal Airport	1,08	5
	Forest	114,56	2
	Garden	1,29	3
	Farm	0,15	3
	Empty farm	0,17	3
	Settlement	8,94	5
	Rice field	4,44	4
			Mean=3.57

10.Rainfall:
Of Station record rainfall : Batu Busuk, Kasang, Gunung Sarik, daily rainfall maximum is 240 mm, including score 5
11.Form farm
Farm form is form surface of earth representing floods determinant. Farm form which level off will be more be big floods crisis compared to hilly farm have, precipitous bevel :

Table 4. Form farm Air Dingin

No	Form farm	Area (km^2)	Score
1	Plain of aluvial	13,71	0,52
2	Terrace (bevel< 3%)	3,13	0,10
3	Lava and fan	4,86	0,07
4	Mountain	15,71	0,12
5	Hilly	93,27	0,71
	Total		1,52

12.High of pond
R = rainfall = 250,88 mm> 150 mm , score 5
Wide area catchment (A) = 130,70 km2
Inclination of River = S = 0,09
Speed of stream (V) = 6,46 km / hour
Concentration time (t) = 3,07 hour
Rain intensity (I) = 81,69 mm / hour

River Bar debit of Arau by using rational formula: Q = 0,278 C I A
From analysis: debit of Air dingin Q = 2077,72m3 / second
wide mean 43 m, Bar depth of water of Air dingin = 2.02 m
Characteristic downstream in form of trapezium of A = (b + h) h x1/2
Angle inclination of river = 45^0. P = circle wetly = b + 2hV2 R = A / P S =
inclination of bar mean of Air dingin = 0,05

Table 5. Parameter of Morphometri floods

No	Parameter	Score	Total
1	Gradien =0, 4% (low area)	1	
2	Rc = 0,22 (form of DAS) rather ellips	2	
3	Closeness of drainage (Dd = 1,16) rather seldom	2	
4	Bevel	3	23,09
5	Usage of farm (middle)	3,57	Gristle floods
6	Rainfall (high)	5	Sedimentation
7	Form farm (rather low)	1,52	
8	High of pond (High)	5	

V. Conclusion

Fromeight eight parameters of morphologi cause of floods concluded that DAS Air Dingin floods gristle and sedimentation gristle.

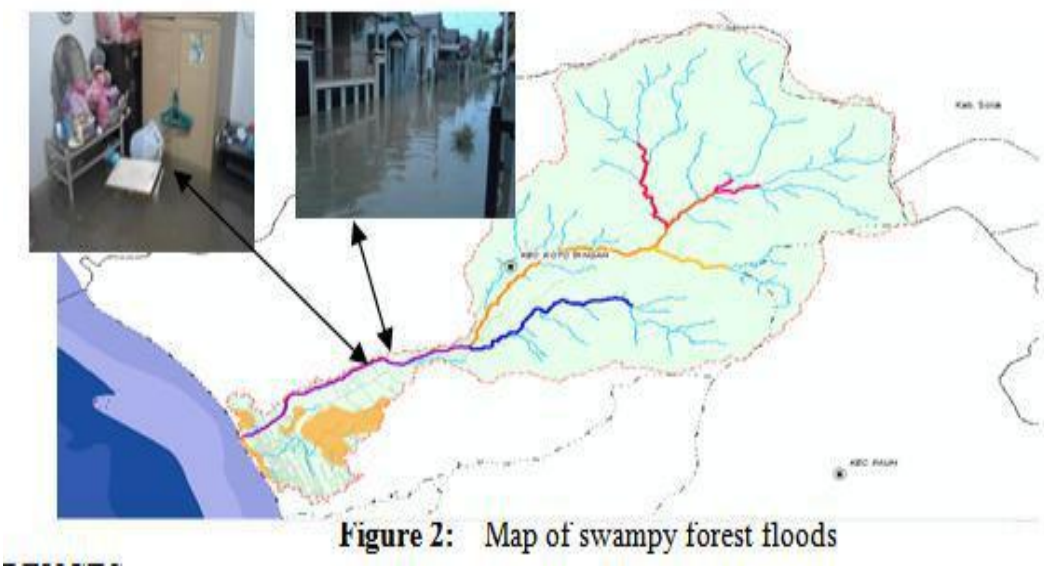

Figure 2: Map of swampy forest floods

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