Study of Estimation Model for Maximum Flow Discharge with Rational Model (Case Study of Bantimurung Catchment Area in Maros Regency of South Sulawesi)

Ratna Musa, Muhammad Saleh Pallu, Lawalenna Samang, Mukhsan Putra

***Abstract*— Hydrology modelling has developed and this useful for water resources management basic data. This study intends to estimate the maximum flow discharge with using Rational Model. This study is the experimental study done in laboratory to get data as a model parameter. The rational model parameter is run off coefficient, soil type, slope, land cover, rain intensity, and Catchment Area. The result of this study indicates that applied rational model in the Bantimurung Catchment Area to predicate maximum flow discharge become under estimate amount of 6. 85 % if to be compared with result of the field measurement. However, this difference falls within acceptable range (5 to 10%). It can be concluded that, the discharge rate gathered from this experimental model is accurate and therefore is an acceptable method for the estimation of maximum discharge rate.**

***Index Term*— Hydrograph Model, Maximum Discharge, and Rational Model**

I. INTRODUCTION

One of the management planning program of catchment area is necessary known the first local hydrology condition . However, hydrology data in a large part of catchment area that will be planned their catchment Area management is not sufficient available yet, to solve this problem an approach to be needed by using appropriate modelling hydrology with the catchment area condition, the result of the modelling is expected can be applied in the catchment area that has resemblance of that condition. With appropriate hydrology modelling existance, then characteristic and evaluation of sub catchment area / catchment area can be easy conducted.

The hydrology models a large part has been developed in area temperate, and only few to be developed in tropics area, but actually the case that in tropics is also required hydrology model. The hydrology model developed in the temperate area is not guaranteed yet when it be applied in the tropic area due to besides climate different and it is also there are soil and cover vegetation different.

The useful of the hydrology data analysis result is more experienced at the present time, even it is always needed as a basic data for activity concerning water resources management of catchment area. In general there are 3 (three) stages in hydrology analysis that is started with measuring phenomenon hydrology, making correlation between examined variable, and making prediction (Sharp and Sawden, 1984). A regression analysis and correlation is often used to make a modelling hydrology . this modelling is tried as simple as possible in the sense of the modelling to be easy applied, without ignoring carefulness aspect, and modelling resulted is predictive.

After taking note of hydrology processes in a catchment area, it can be concluded that rain fall distribution become direct streamflow is besides affected by surface physical characters of catchment area, it is also affected by rain characters. In view of that rain occured in wet trophical climate area has a large enough variation in accordance with space and time, the study of correlation of rain and how their effect toward respond a catchment area is very needed, in view of measuring hydrology phenomenon in particular in areas that there is no their hydrology data recording either due to budget limitation or their human resources, it is needed a correlation

Muh.Saleh Pallu is serving in
Civil Engineering Department, Hasanuddin University, Makassar, South Sulawesi, Indonesia salehpallu@hotmail.com
Lawalenna Samang is serving in
Civil Engineering Department, Hasanuddin University, Makassar, South Sulawesi, Indonesia samang_@yahoo.com
Ratna Musa is serving in
Doctoral Student, Departement of Civil Engineering, Hasanuddin University
Jl. Perintis Kemerdekaan Km 10 Makassar, South Sulawesi - 90245, Indonesia; ratmus_tsipil@ymail.com
Mukhsan Putra is serving in
Civil Engineering Department, Hasanuddin University, Makassar, South Sulawesi, Indonesia mukhsan_p@yahoo.co.id

model between variable, so that the existance a model, then the directly hydrology phenomenon measurement can be reduced.

In preparation of model is required a complete and accurate data, so the result of the model can be applied in area having resemblance of condition of biophysical or their economical social. In this study will be examined only on empirical model forming one of part from deterministic model. This model in general presenting correlation between two hydrology factors or more based on observation result in laboratory or in the field. The empirical model has usually shape of mathematics equation based on information obtained from the research result.

The objective of this study is to predict maximum flow discharge with rational model on Bantimurung catchment area.

II. BOOK REVIEW

Empiric Model is the model that has been developed based on observation. This model is simple, either in structure or in their application. This model uses simple equations, with certain input will be obtained related output. The well known model is "rational model ", introduced by Mulvaney, 1837.

In determining river discharge based on rain is necessary observed correlation between rain and river flow. Amount of flow in the river is necessary decided especially amount of rain, period of rain time, the large of river flow and catchment area characteristics.

III. STUDY METHODOLOGY

A. Location and Area

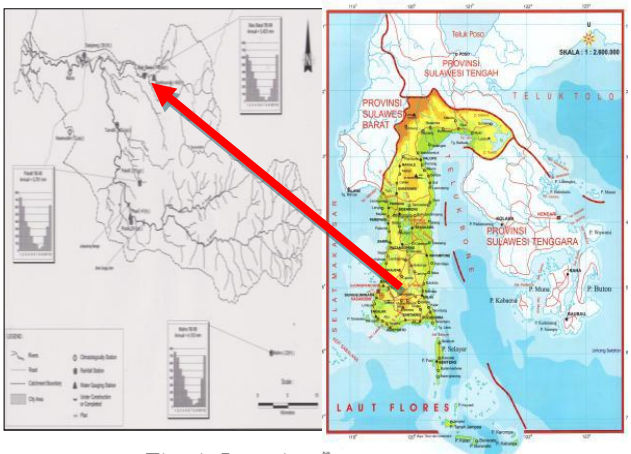

Fig. 1. Location and Area Bantimurung

Geographycal Bantimurung catchment area is located in position 05° 01' 14,55'' of South Latitude and 119° 40' 32,3 " of East Longitude with area of 20.26 Km^2 with elevation between 100 to 500 m above Sea Mean Level. This catchment area includes National Park area is under Control of Forestry Service and Tourist Service of Maros Regency. The condition of Bantimurung Catchment Area is located in Bulusaraung mountain line with stony mountain condition that too steep and there ara some kinds of the best butterflay in the world, so that it is necessary kept their conservation.

The shape of the Bantimurung catchment area is more like bird fur with outlet dimension in Bantimurung Station (Automatic Water Level Record). The length of Bantimurung River from upstream to location of AWLR (outlet) is 6.22 km with average of river slope is 0.0523, depth is 7.0 meter and the average of wide is 14 meter

B. Data Process and Analysis

Maximum discharge estimation with Rational model namely

The rational formulation is the oldest one and well known between the formulation empirics. The fist time this formulation is applied in Irlandia by Mulvaney in 1837. This rational idea can be stated in algebra with rational formulation as follows :

$$Q = 0{,}278\ C.I.\ A \qquad \text{.....(1)}$$

Where:

I = maximum rain intensity during the same time with the concentration time in mm/hour.

A = the catchment area large in km2

C = run off coefficient, undimension

a) Run off coefficient based on their stream flow factors as : soil type, slope, condition of forest cover and flood, rain intensity during time of concentration and the large of catchment area. This coefficient is based on condition of the catchment area as shown in Table I

Table I
Calculation for Run off Coefficient

No	Catchment Area Condition	Run off Coefficient
1	Mountainous and steep	0.75-0.90
2	Tertiary Mountainous	0,70-0.60
3	River with soil and forest in their upper and under parts	0.50-0,75
4	Irrigated ground soil	0,45-0.60
5	Rice field when irrigated	0,70-0.80
6	Mountainous river	0,75-0.85
7	Plain river	0,45-0.75

b) Rain intensity (I) obtained from equation :

$$I = \frac{R24}{24}\left(\frac{24}{Tc}\right)^{2/3} \qquad \text{.....(2)}$$

$$Tc = \frac{(0{,}869 \times L)^{0{,}385}}{H} \quad \text{.....(3)}$$

I = Rain intensity during time of concentration (mm/hour)
R = a day rain (mm)
Tc = time of concentration (hour)
H = The difference in height between the highest with the lowest points in the catchment area (m)

c) Large of Catchment Area (A) km^2

Fig. 2. Model Catchment Area Bantimurung at Laboratory

IV. STUDY METHODOLOGY

Flow Pick Discharge Estimation Model with Rational Model

The amount of run off coefficient (C) is based on the catchment condition as shown in Table II.

Table II
Run off Table Coeficient Calculation Bantimurung Catchment Area

No	Land use type,Treatment, soil condtion	Area (ha)	Percentage (%)	C	C weighted
1	Uprigth stone mountain/medium forest	1900	93,84	0,825	0,774
2	Stony land	10	0,49	0,300	0,0015
3	Grassy sorjoun land	5	0,25	0,125	0,0003
4	Pavement road	10	0,49	0,325	0,0016
5	House, stall, school,mousque,etc.	10	0,49	0,325	0,0016
6	Rice cultivation	90	4,44	0,300	0,0133
		2025	100		0,7923

From the result of calculation for flow pick discharge predicted in Bantimurung Catchment Area on maximum rain is 123 mm and maximum water level = 7,35 m on 01 February 2009 its value is 223,75 m^3/second to be compared with the actual value obtained from result of hydrology observation (Automatic Water Level Record) the value is 209,40 m^3/second, so there is deviation of 14,35 m^3/second (6,85 %). This indicates that rational method applied in Bantimurung Catchment Area become **under estimate** in predicting flow pick discharge

V. CONCLUSION

(1) Rational method become under estimate of 14,53 m^3/second (6,85%) in predicting pick flow discharge in Bantimurung Catchment Area to be compared with the actual value obtained from result of hydrology observation (Automatic Water Level Record), this is based on the result of calculation for predicted maximum discharge (Qp-rational) in the maximum rain time = 123,00 mm.
(2) It is suggested that study is carried out anymore in other location having various different catchment area large

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Ratna Musa, She is a Doctoral Student, Departement of Civil Engineering, Hasanuddin University, Makassar, South Sulawesi, Indonesia, Post Code : 90245, Telp: +62 411 583646, Email : ratmus_tsipil@ymail.com Now, She is a Doctor Candidate in Civil Engineering, School of Engineering, Hasanuddin University, Jalan Perintis Kemerdekaan Km 10 Makassar 90245, South Sulawesi, Indonesia. Telp : +62 411 583646. She was born in Barru, South Sulawesi, Indonesia on 27th December 1958. Her education level at elementary school and junior / middle high school were experienced in Barru, South Sulawesi, senior high school were experienced in Makassar, South Sulawesi. She graduated from Civil Engineering (Ir) at Hasanuddin University, Makassar, South Sulawesi, Indonesia in 1984. She recieved her Master Of Engineering (MT) in Water Resources Department from Yogyakarta University Gadjah Mada (UGM), Yogyakarta, Indonesia from September 1992 until March 1995. She is lecture in University Muslim Indonesia, Makassar, South Sulawesi, Indonesia since October 1985 until now.

H.Muh.Saleh Pallu,Prof.Dr.Ir.M.Eng.; His current address is in Civil Engineering Department, School of Engineering, Hasanuddin University, Jalan Perintis Kemerdekaan Km. 10 Makassar 90245 , South Sulawesi, Indonesia. Telp. +62 411 584639, Fax: +62 411 586015. Email : salehpallu@hotmail.com

His academic experience is :

- Doctor of Civil Engineering , University of Kyushu , Japan, 1994.
- Master of Civil Engineering , University of Kyushu, Japan,1991.
- Bachelor of Science,Civil Engineering, Hasanuddin University , Makassar, Indonesia 1981.

H.Lawalenna Samang, Prof.Dr.Ir.M.S,M.Eng.; His current address is in Civil Engineering Department, School of Engineering, Hasanuddin University, Jalan Perintis Kemerdekaan Km. 10 Makassar 90245, South Sulawesi, Indonesia. Telp, +62 411 587636, Fax: +62 411 580505. Email: samang_l@yahoo.com

His academic experience is :

- Doctor of Civil Engineering, University of Saga, Japan,1997.
- Master of Civil Engineering, University of Saga, Japan,1994.
- Master of Civil Engineering, Hasanuddin University, Makassar, Indonesia,1988.
- Bachelor of Science, Civil Engineering, Hasanuddin University, Makassar,Indonesia 1984.

Mukhsan Putra.Dr.ST,M.Eng.; His current address is in Civil Engineering Department, School of Engineering, Hasanuddin University, Jalan Perintis Kemerdekaan Km. 10 Makassar 90245, South Sulawesi, Indonesia. Telp. +62 411 584639, Fax : +62 411 586015. E-mail : mukhsan@yahoo.co.id