HYDROGRAPH PERFORMANCE OF BENDUNG WATERSHEED IN PALEMBANG CITY

by Achmad Syarifudin

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Achmad Syarifudin[1)], Amirudin Syarif[2)]

[1)]*Civil Engineering Faculty, Bina Darma University, Jl. Jend. A. Yani No. 3 Palembang, Indonesia*
E-mail: syarifachmad6080@yahoo.co.id
[2)]*Vocational Faculty, Bina Darma University, Jl. Jend. A. Yani No. 3 Palembang, Indonesia*
E-mail: amirudin_syarif@gmail.com

Abstract. During the rainy season, floods has become routine events in several cities in Indonesia. Various reasons to trigger the occurrence of flooding, among other drainage network system capacity is decreased, increasing water flow, or a combination of both. The capacity of the drainage channel has been calculated based on the design criteria to accommodate the flow of water occurs so that the area is not experiencing inundation or flooding. The reduced system capacity due to, among others, many precipitates, physical damage or their network systems and illegal buildings on the system network. While the cause of the discharge increases, among others, high rainfall out of habit, changes in land-use, environmental damage to the watershed in a region.

Cases like mentioned above also occur in Bendung watersheed, so it is necessary to study the drainage network system performance evaluation based on the concept of sustainable drainage based on community participation. Good and bad, high and low of the drainage network system performance is large determined by community participation in management, especially with the lack or absence of funds from Palembang city government for the management of drainage network system. Drainage system performance can be evaluated from the technical aspects as well as non-technical. One technical aspect is the frequency analysis to look at the picture unit hydrograph. Analytical results from this study may be that the maximum flow of 25 m^3 per sec at peak hours at the time of 4.8 hours and then slowly starting to go down at a time to 24 hours.

Keywords: inter relation, drainage network system, unit hydrograph

I. INTRODUCTION

The flood disaster became a regular phenomenon in the rainy season which is spread in different watersheds in most region of Indonesia. Total incidence of flooding in the rainy season over the last 3 years as well as the increasing number of human casualties and loss of property and facilities from public / social, transport infrastructure and infrastructure for agriculture / irrigation.. In addition to the problem of precipitation as factors, the incidence of disasters cannot to be separating from environmental damages to ecosystems that occur in the watershed and poor management of water resources. Their land damage may lead to increased surface runoff coefficient greater. The area upstream watershed is an area of a particle will be increasingly vulnerable to drought, precisely the opposite downstream areas prone to flooding. Flooding is a flow that causing economic losses or even cause loss of life. [2]

Flow can occur because of the outburst in the area in the right or left of the river due to river channel does not have enough capacity for the flow rates through. Flooding is not only experience by urban area located in the lowlands, even experienced area located in the highlands. Flooding or inundation in a region occurs when the system that serves to accommodate the inundation was not able to accommodate the discharge flow, it is the result of three possibility occur : the capacity of the system to decrease the flow rate of water increases, or a combination of both. Understanding the system here is a system of drainage network in a region. [10]

While the drainage system can be generally defined as a series of waterworks that serve to reduce and/or remove excess water (flooding) of a region or land, so the land can function optimally, so the drainage system is an engineering infrastructure of the region to cope with the inundation floods. [14]

Drainage network system in a region already properly designed to pond normal flow rates, especially during the rainy season. This means that the capacity of the drainage channel is already taken into account to accommodate the flow of water occurs so that the area is not experiencing inundation or flooding. If the capacity of a drainage channel system decreases due to various reasons, the normal discharge even can be accommodating by the existing system.

While declined because drainage capacity, among others, there are many deposition, physical damage tissue system, the other buildings on top of the network system. At certain times during the rainy season is often an increase in the flow rate, or there has been increased discharge caused by various reasons, the capacity of the existing system can no longer accommodate the flow rates, resulting in flooding in a region. While the cause of the increasing discharge including high rainfall out of habit, changes in land use, environmental damage to the watershed in a region. Then if an urban or regional decrease system capacity at the same time an increase in the flow rate, the flooding is increasing, both the frequency, extent, depth and duration.

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II. METHODS

A. *Location Research*

The location research is Bendung watershed. The research location as in figure 3.1. (Figure 1. Map of the location study). [12]

Fig.1. Research location [9]

B. *Tools and Materials Research*

The tools will be used in this study are shown in Table 1.

TABLE I
LIST OF THE TOOLS USED IN THE STUDY

No.	Name tools	Number of uses	Description
1	Stationery	1 box	Data recording
2	Computer (RAM 2 GB)	1 unit	General perform model
3	Printer	1 unit	Display report form
4	Software GIS, Arc-View, MS-Excel	1 piece	To perform modelling and data processing
5	Laptop and Printer	1 unit	Assist in preparing report

Source: author's propose, 2016

III. RESULTS AND DISCUSSION

A. *Bendung Watershed*

Determine of flood discharge plan to do with method of Nakayasu Unit Hydrograph Synthetic. Before entering in the calculating of the discharge planed using data of Nakayasu Synthetic Unit Hydrograph are necessary length of Bendung river. Bendung watershed divided into sub watersheed with the Global Mapper program. Bendung division can be seen in figure 2. [12]

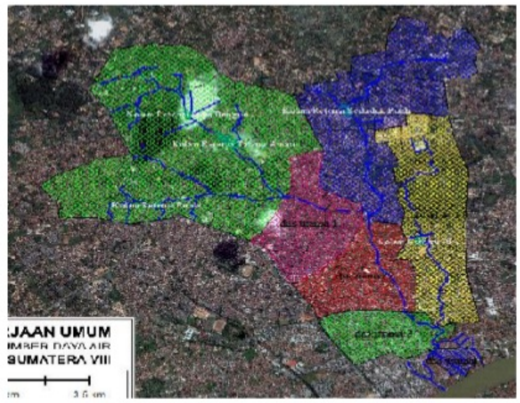


Fig. 2. Distribution of Bendung sub-watershed with Global Mapper program [5]

B.Rainfall

Rainfall data used for 23 years, from 1991 through 2013. The data attached to the rainfall data hourly. Rainfall data can be seen in Table 2.

TABLE II
SHORT-TERM DATA MAXIMUM RAINFALL

Years	Duration 60 minute	Years	Duration 60 minute
1991	73.50	2003	71.50
1992	80.10	2004	80.00
1993	55.70	2005	91.90
1994	48.50	2006	60.90
1995	60.00	2007	65.00
1996	47.20	2008	86.00
1997	91.80	2009	79.50
1998	52.30	2010	90.00
1999	73.50	2011	80.00
2000	70.40	2012	86.93
2001	77.00	2013	77.63
2002	60.90		

Source: BMKG Kenten, 2014

TABLE III
RAINFALL INTENCITY

Years	Intencity (mm/hours)	Years	Intencity (mm/hours)
1991	73.50	2003	71.50
1992	80.10	2004	80.00
1993	55.70	2005	91.90
1994	48.50	2006	60.90
1995	60.00	2007	65.00
1996	47.20	2008	86.00
1997	91.80	2009	79.50
1998	52.30	2010	90.00
1999	73.50	2011	80.00
2000	70.40	2012	86.93
2001	77.00	2013	77.63
2002	60.90		

Source: BMKG Kenten, 2014

C. Frequency Analysis

Before analyzing rainfall distribution, first determine the parameters of existing statistics. Then calculate the total amount, the amount of data (n), the maximum data Ri average, standard deviation (S), Coeffisien of Variation (Cv), Coeffisien of Skewness (Cs), and Coeffisien of kurtosis (Ck).

The result of the calculation as follows:

a. Total amount = 1660.26 mm / hour
b. Total rainfall data, n = 23
c. On average Ri = 72.18 mm / h
d. The standard deviation (S) = 13.66
e. Variation Coeffision (Cv) = 0.19
f. Skewness Coeffision (Cs) = -0.34
g. Kurtosis Coeffision (Ck) = -0.90

D. Intensity Rainfall

The intensity of rainfall that is used is the rainfall intensity data from the calculation of the Normal Distribution.

TABLE IV
RAINFALL INTENSITY

R (Year)	X_T (mm/hours)
2	72.18
5	83.66
10	89.67
20	94.59
50	100.19
100	104.01

Source: analysis result, 2016

Period re-elected for further calculations that the return period of 2 years.

E. Runoff Coefficient

Runoff coefficient reflects the state of the surface flow area. Drainage coefficient, C is the ratio of the volume of water that reached the mouth of the river basin with the volume of water that fell on the watershed. Value for C drainage coefficient, be see in Table 5.

Data obtained from Bappeda Kota Palembang, extensive land use for residential areas :

Size high density = 7.09 km^2

Extensive catchment area = 7.37 km^2

Comprehensive trade area = 4.73 km^2

Based on the flow coefficient table 5 for residential areas with a high density area and retrieved 0.70 to 0.20 wide catchment areas taken as well as to extensive trade area taken 0.90.

Then the value Cw: runoff coefficient values obtained, Cw = 0:56 and in the calculation taken Cw = 0.60.

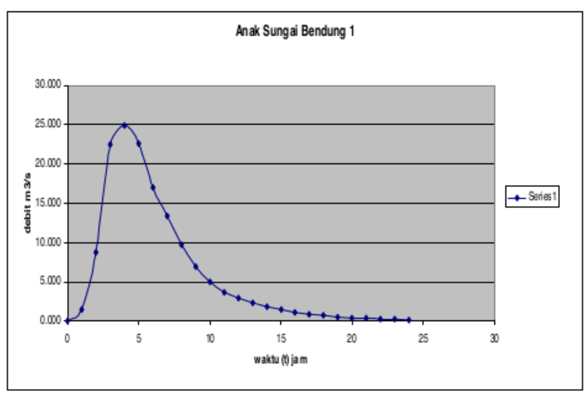
TABLE V
RUNOFF COEFICIENT

Region	Land use	Cw
Urban	Rural Settlement Region:	
	- Low density	0,25-0,40
	- Middle density	0,40-0,70
	- High density	0,70-0,80
	- With wells impregnation	0,20-0,30
	Trade zzone	0,90-0,95
	Industry region	0,80-0,90
	Parks, green lanes, gardens, etc.	0,20-0,30
Rural	Hills, slopes < 20 percent	0,40-0,60
	Canyons region, the slope of > 20	0,50-0,60
	percent	0,25-0,35
	Land with terracing Rice fields	0,45-0,55

Source: PUBM-SDA, 2014

D. Discharge Curve

Once the entire value discharge curve for each interval time is unknown, enter this value in the table below to get the value of run-off that occurs on an hourly basis with certain variations in rainfall. Unit hydrograph of Bendung watersheed can be seen figure 3.



Source: analysis result, 2016

Figure 3. Uunit Hydrograph Synthetic of Bendung watershed [12]

IV. CONCLUSIONS

Cases like mentioned above also occur in Bendung watersheed, so it is necessary to study the drainage network system to evaluation performance on the concept of sustainable drainage based on community participation. Drainage system performance can be evaluated from the technical aspects as well as non-technical. One technical aspect is the frequency analysis as a figure of unit hydrograph where the result from the figure that the maximum flow of 25 m^3 per sec at peak hours at the time of 4.8 hours and then slowly starting to go down at a time to 24 hours. [12]

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