FLOOD CONTROL IN THE SEKANAK RIVER OF PALEMBANG CITY

Achmad Syarifudin

Civil Engineering Faculty, Universitas Bina Darma, Jl. Jend. A. Yani No. 3 Palembang, Indonesia
E-mail: syarifachmad6080@yahoo.co.id

Abstract. Floods during the rainy season 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 basin in a region. Cases like mentioned above also occur in Sekanak Sub-basin, so it is necessary to study the drainage network performance evaluation system based on the concept of sustainable drainage based on community participation. Good and bad, high and low of the drainage network system performance is largely 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/sec at peak hours at the time of 4.8 hours and then slowly starting to go down at a time to 24 hours. The others aspect is Social construction problems can be solved by Public Participation approach, with the Government acting on the principle of fair, development activities carried out with transparency and attention to the needs of the community.Social problems occurring both at the pre-construction stage (land acquisition and resettlement), construction (procurement and mobilization of labor, mobilization of heavy equipment and construction materials and equipment operations) and post-construction can be anticipated by social engineering forming between Other identification of community character and institutions, socialization, public consultation, community gathering and community

Keywords: flood control, drainage network system, unit hydrograph, public participation

I. INTRODUCTION

The flood disaster became a regular phenomenon in the rainy season which is spread in different basin in most parts 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 or social, transport infrastructure and infrastructure for agriculture or irrigation. In addition to the problem of precipitation as factors, the incidence of disasters can not be separated from environmental damages to ecosystems that occur in the basin and poor management of water resources. Their land damage leading to increased surface run-off coefficient greater. The area upstream basin 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 caused economic losses or even cause loss of life.

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 experienced 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 possibilities 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.

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.

Drainage network system in a region already properly designed to accommodate for 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 not be accommodated by the existing system. While declining 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 increased discharge include high rainfall out of habit, changes in land use, environmental damage to the basin 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*

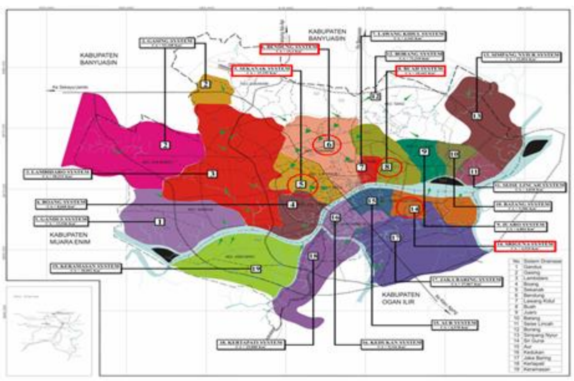

Fig.1. Research location [9]

The location research is Sekanak sub-basin. The research location as in figure 3.1. (Figure 1. Map of the location study).

B. *Tools and Materials Research*

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

Table 1. 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. *Sekanak Watershed*

Determination of flood discharge plan to do with Synthetic Unit Hydrograph method (Synthetic unit hydrograph) Nakayasu. Before entering in the calculation of the discharge plan using Synthetic Unit Hydrograph Method Nakayasu data are necessary length of the Sekanak river and Sekanak sub-basin area. Sekanak sub-basin is divided into sub-sub-basins with the help of Global Mapper program. Sekanak sub-basin can be seen in Figure 2.

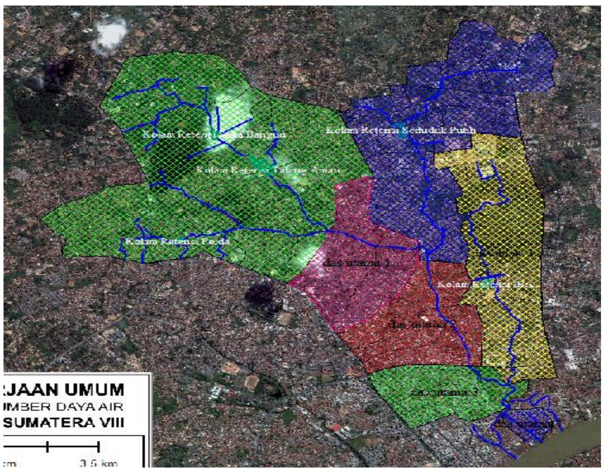

Fig. 2. Distribution of Sekanak sub-basin with Global Mapper program [5]

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 2. 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 3 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. Coeffisien of Variation (Cv) = 0.19
f. Coeffisien of Skewness (Cs) = -0.34
g. Coeffisien of kurtosis (Ck) = -0.90

D. Rainfall Intencity

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

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

Table 4 Rainfall intencity

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

E. Run-off Coefficient

Table 5 Run-off Coefficient

Region	Land use	C
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,	0,20-0,30
Rural	etc.	0,40-0,60
	Hills, slopes < 20 percent	0,50-0,60
	Canyons region, the slope of	0,25-0,35
	> 20 percent	0,45-0,55
	Land with terracing Rice fields	

Source: PUBMSDA, 2014

Run-off 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 drainage coefficient, C can be seen in Table 5.

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

F. Discharge Curve

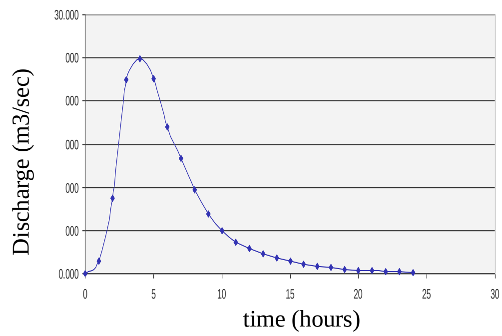

Fig 3. The unit hydrograph Synthetic of Sekanak sub-basin

Once the entire value discharge curve for each interval time is unknown, enter these value in the table below to get the value of runoff that occurs on an hourly basis with certain variations in rainfall. Unit hydrograph of Sekanak Sub-basin can be seen figure 3.

G. Land free of Sekanak river

Table 6. Kapten A Rivai road till the estuary of Sekanak river

	Amount of Strucutre		
Picture Code	Left of River	Right of River	Description
C-3-4-02	0	1	1-2
C-3-2-22	4	4	2-3
C-3-2-25	6	2	3-4
C-3-2-18	1	6	4-5
C-3-2-14	4	20	5-6
Total	48		

Note:
1-2: Jl. Kapten A Rivai – Jl. Letnan Mukmin
2-3: Jl. Letnan Mukmin – Jl. Letnan Jaimas
3-4: Jl. Letnan Jaimas – Jl. SW Subekti
4-5: Jl. SW Subekti – Lrg. Kosib II
5-6: Lrg. Kosib II – The estuary of Sekanak River

H. Condition, Land used and Structure

For condition, land used and structure on figure 4 belows

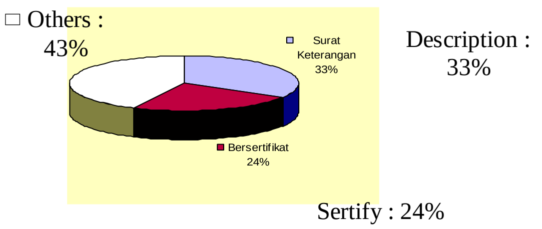

Figure 4 Land Status

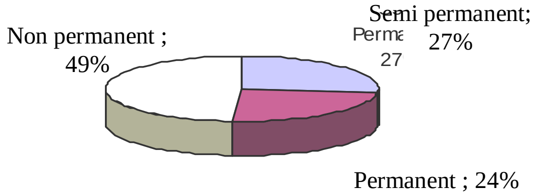

Fig 5 Structure Condition

IV. CONCLUSIONS

Cases like mentioned above also occur in Sekanak sub-basin, so it is necessary to study the drainage network performance evaluation system based 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 to look at the picture unit hydrograph. Analytical results from this study may be that the maximum flow of 25 m^3/sec at peak hours at the time of 4.8 hours and then slowly starting to go down at a time to 24 hours.

Condition of land used and structure, only 24% structure has sertify and only 24% is permanent structure. This is problem for city government to resolve flooding area, so we need the exact data especially rainfall data.

Social construction problems can be solved by Public Participation approach, with the Government acting on the principle of fair, development activities carried out with transparency and attention to the needs of the community.

Social problems occurring both at the pre-construction stage (land acquisition and resettlement), construction (procurement and mobilization of labor, mobilization of heavy equipment and construction materials and equipment operations) and post-construction can be anticipated by social engineering forming between Other identification of community character and institutions, socialization, public consultation, community gathering and community empowerment.

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