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Priority Scale of Drainage Rehabilitation of Cilacap City

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Abstract. Characteristics of physical condition of Cilacap City is relatively flat and low to sea level (approximately 6 m above sea level). In the event of a relatively heavy rainfall resulting in inundation at several locations. The problem of inundation is a serious problem if there is in a dense residential area or occurs in publicly-used infrastructure, such as roads and settlements. These problems require improved management of which include how to plan a sustainable urban drainage system and environmentally friendly. The development of Cilacap City is increasing rapidly, this causes drainage system based on the Drainage Masterplan Cilacap made in 2006 has not been able to accommodate rain water, so, it is necessary to evaluate the drainage masterplan for subsequent rehabilitation. Priority scale rehabilitation of the drainage sections as a guideline is an urgent need of rehabilitation in the next time period.

1. Introduction

Flood is a natural disaster that often occurs in Indonesia, especially in the rainy season. This incident hit almost all cities in Indonesia and repeated every year, but this problem has not been resolved, even tends to increase, both frequency, extent, depth and duration [1,2].

Therefore every development of the city should be followed by the evaluation and improvement of the drainage system as a whole, not only on the development site, but also the surrounding areas affected [3]. For example, the development of a settlement area in upstream of a drainage system, then drainage planning is not only done in the settlement area, but the downstream drainage system should also be evaluated and redesigned if necessary.

The drainage development masterplan needs to be revised to suit the development of the city. Since the last five years the growth of housing construction, office buildings, and shophouses is quite rapid, so a lot of open land that turned into buildings [4,5,6]. Complete drainage system improvement is necessary but drainage improvement at the same time is not possible. Therefore, priority scale is needed to determine which drainage sections need to be prioritized for rehabilitation [7].

2. Experimental

Analithycal Hierarchy Process (AHP) is a method used in the decision-making process of complex issues such as planning problems, alternative determination, prioritization, policy selection, resource allocation, needs determination, forecasting performance planning needs, optimization and conflict resolution. Saaty establishes a quantitative scale of 1 (one) to 9 (nine) to assess the comparative importance of an element to another. [8].

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According to Wignyosukarto, the use of Analytical Hierarchy Process (AHP) method in urban drainage system has the following strengths [9] :

a. Structuring the problem systematically.
b. Designed to use ratios and intuition to choose the best alternative, in the event of flooding in urban / an area. The best alternative is the one that has the least disadvantage, and has the greatest advantage.
c. Match the factors that make decisions gradually from the general to the specific

The reason for choosing the AHP method, according to Marimin, is that AHP has many advantages in explaining the decision making process :

a. Determination of the most dominant criteria greatly affects the outcome.
b. The end result can be graphically depicted, so it is easy to be understood by all parties involved in decision making.
c. A complex decision process can be decomposed into smaller decisions. [10] .

3. Results and Discussion

Cilacap City area is relatively flat field typology and there are many river. The relatively flat surface of land makes the drainage slope limited, so it is very possible that the flow becomes substandard. While the proximity of areas of the city with a coastline allows the back water (reverse flow) on the rivers and drainage canals during high tides. Generally Cilacap City drainage system is shown in Figure 1.Cilacap City Drainage System outline served with drainage that flow by gravity, divided into 17 Main Drainage (Major and Sub Maj Drain) as shown in Table 1. In preparing the proposed priority criteria used are Condition Values, Debit Plan and Rehabilitation Costs.

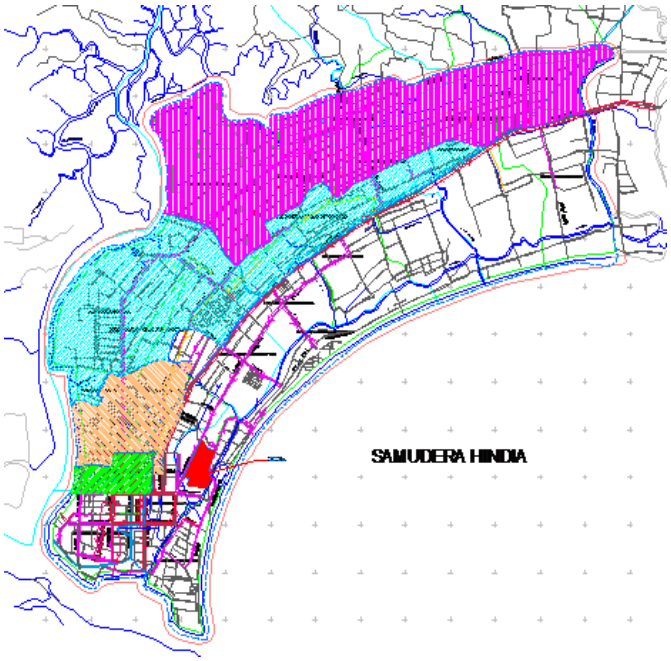

Figure 1. Drainage System of Cilacap City.

Table 1. Main Drainage (Major and Sub-Major Drain)

Number	The name of river segment
1	Kali Sabuk
2	Kali Yasa
3	Kali Menganti
4	Kali Irigasi
5	Kali Ciglagah
6	Kali Tanjung
7	Kali Karangwaru
8	Kali Cinyemeh
9	Kali Sentul
10	Kali Kodok
11	Kali Gubed
12	Kali Donan
13	Kali Watu
14	Kali Beji
15	Kali Sendangsari
16	Kali Cidapur
17	Kali Sendang

3.1. Hierarchical structure

The diagram in Figure 2 presents the decision to select the priority of rehabilitation of the drainage network, while the criteria for making the decision are the value of condition, debit plan, rehabilitation cost.

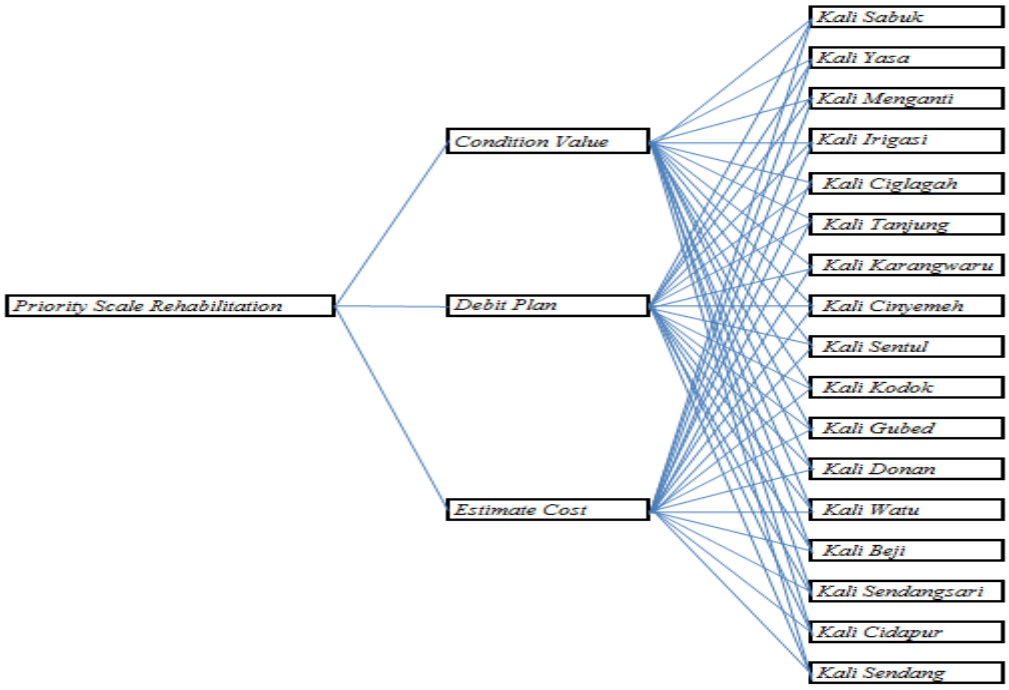

Figure 2. Hierarchy Structure Diagram

The alternative in making the decision is the main drainage section Kali Sabuk, Kali Yasa, Kali Menganti, Kali Irigasi, Kali Ciglagah, Kali Tanjung, Kali Karangwaru, Kali Cinyemeh, Kali Sentul, Kali Kodok, Kali Gubed, Kali Donan, Kali Watu, Kali Beji, Kali Sendangsari, Kali Cidapur dan Kali Sendang.

3.2. Assessment of criteria by filling in comparative data between criteria

Table 2 shows the comparison between criteria

Table 2. Comparison Between Criteria

	Condition value	Debit plan	Rehabilitation costs
Condition value	1	7	9
Debit plan	1/7	1	5
Rehabilitation costs	1/9	1/5	1

In the comparison of criteria can be explained as follows: Condition value is very important than the debit plan; Absolute Condition Value is more important than the cost of rehabilitation; Debit Plan is more important than the cost of rehabilitation

3.3. The weight data of each criteria on each alternative (river segment).

The obtained data are in the form of value/ weight of the degree of importance between the criteria and sub criteria that affect the decision making of the priority of drainage maintenance and rehabilitation. The weight result according to the Condition Values in Table 3., The weighted results according to Plan Debit in Table 5., and Weight Results According to Rehabilitation Cost in Table 7.

Table 3. The Assessment of Alternative Weight of Condition Value

River	Condition Value (%)	Weight assesment	River	Condition Value (%)	Weight assesment
Kali Sabuk	62	7	Kali Kodok	77	8
Kali Yasa	75	8	Kali Gubed	74	8
Kali Menganti	53	6	Kali Donan	68	7
Kali Irigasi	67	7	Kali Watu	67	7
Kali Ciglagah	54	6	Kali Beji	56	6
Kali Tanjung	51	6	Kali Sendangsari	66	7
Kali Karangwaru	55	6	Kali Cidapur	57	6
Kali Cinyemeh	66	7	Kali Sendang	62	7
Kali Sentul	68	7			

Table 4. Weight scale of condition value

Condition Value (%)	Weight Scale	Condition Value (%)	Weight Scale
0-10	1	51-60	6
11-20	2	61-70	7
21-30	3	71-80	8
31-40	4	81-90	9
41-50	5	91-100	10

Table 5. The Assessment of Alternative Weight of Debit Plan

River	Debit Plan (m3/s)	Weight assesment	River	Debit Plan (m3/s)	Weight assesment
Kali Sabuk	44	9	Kali Kodok	37	8
Kali Yasa	44	9	Kali Gubed	41	9
Kali Menganti	43	9	Kali Donan	40	9
Kali Irigasi	39	8	Kali Watu	33	7
Kali Ciglagah	35	8	Kali Beji	31	7
Kali Tanjung	34	7	Kali Sendangsari	36	8
Kali Karangwaru	32	7	Kali Cidapur	39	8
Kali Cinyemeh	35	7	Kali Sendang	42	9
Kali Sentul	38	8			

Table 6. Weight scale of Debit Plan

Debit Plan (m3/s)	Weight Scale	Debit Plan (m3/s)	Weight Scale
0-5	1	26-30	6
6-10	2	31-35	7
11-15	3	36-40	8
16-20	4	41-45	9
21-25	5	46-50	10

Table 7. The Assessment of Alternative Weight of Estimate Cost

River	Estimate Cost in Billion	Weight assesment	River	Estimate Cost in Billion	Weight assesment
Kali Sabuk	88	2	Kali Kodok	95	1
Kali Yasa	98	1	Kali Gubed	92	1
Kali Menganti	68	3	Kali Donan	82	2
Kali Irigasi	49	6	Kali Watu	41	6
Kali Ciglagah	45	6	Kali Beji	56	5
Kali Tanjung	57	5	Kali Sendangsari	59	5
Kali Karangwaru	55	5	Kali Cidapur	57	5
Kali Cinyemeh	53	5	Kali Sendang	45	6
Kali Sentul	88	2			

Table 8. Weight scale of Estimate Cost

Estimate cost in billion	Weight Scale	Estimate cost in billion	Weight Scale
0-10	10	51-60	5
11-20	9	61-70	4
21-30	8	71-80	3
31-40	7	81-90	2
41-50	6	91-100	1

Priority Scale with AHP method indicates that the lowest priority scale value is 5.667 in Sentul and Kali Kodok, meaning First Priority of rehabilitation of Cilacap City drainage system is done in Sentul and Kali Kodok, second priority in Kali Sabuk, Kali Yasa, Kali Menganti, Kali Tanjung, Kali Karangwaru, Kali Gubed, Kali Donan, Kali Beji. Third Priority in Cinyemeh River. Fourth Priority in Ciglagah River, Kali Watu, Sendangsari River. Fifth Priority in Kali Irrigasi. The Sixth Priority in Kali Sendang. Shown in Table 9.

Table 9. Results of Priority Scale Determination with AHP Method

No.	River	Weight Criteria			Result	Priority Scale
		Condition Value	Debit Plan	Rehabilitation Cost		
1	Kali Sabuk	7	9	2	6.000	2
2	Kali Yasa	8	9	1	6.000	2
3	Kali Menganti	6	9	3	6.000	2
4	Kali Irigasi	7	8	6	7.000	5
5	Kali Ciglagah	6	8	6	6.667	4
6	Kali Tanjung	6	7	5	6.000	2
7	Kali Karangwaru	6	7	5	6.000	2
8	Kali Cinyemeh	7	7	5	6.333	3
9	Kali Sentul	7	8	2	5.667	1

10	Kali Kodok	8	8	1	5.667	1
11	Kali Gubed	8	9	1	6.000	2
12	Kali Donan	7	9	2	6.000	2
13	Kali Watu	7	7	6	6.667	4
14	Kali Beji	6	7	5	6.000	2
15	Kali Sendangsari	7	8	5	6.667	4
16	Kali Cidapur	6	8	5	6.333	3
17	Kali Sendang	7	9	6	7.333	6

4. Conclusion

Based on the survey and analysis of drainage conditions in Cilacap overall is good, although drainage rehabilitation must be done in several places to cope with flooding. This can be seen from the percentage of drainage condition weight, that is Sentul 68% and 77% Kali Kodok. Rehabilitation of damaged drainage network should be implemented gradually based on priority scale sequence with priority order, first priority of rehabilitation is done in Sentul and Kodok. This is based on the high weight of Condition Values, Debit Plans and Rehabilitation Costs.

References

[1] Kleidorfer M 2013 *J. Procedia Engineerin. Elsevier.*
[2] Tingsanchali T 2011. *J. Procedia Engineering. Elsevier*.
[3] Suripin 2004 *Sistem Drainase Perkotaan yang Berkelanjutan* (Jogyakarta: Andi)
[4] Kodoatie R 2003 *Manajemen dan Rekayasa Infrastruktur* (Jogyakarta: Pustaka Pelajar)
[5] BAPPEDA Kab.Cilacap 2012 *Master Plan dan DED Sistem Drainase Kota Cilacap*
[6] Dinas Cipta Karya dan Tata Ruang Kab.Cilacap 2015 *KAK Kajian Penanganan Banjir Kota Cilacap*
[7] Chow J f 2013 *J. Procedia Engineering. Elsevier.*
[8] Saaty T L 1980 *The Analytic Hierarchy Process* (New York: McGraw-Hill)
[9] Wignyosukarto B 2001 *Malang J. App. Himpunan Ahli Teknik Hidraulik Indonesia* (*HATHI) Kongres VII dan PIT VIII*
[10] Marimin 2004 *Pengambilan Keputusan Kriteria Majemuk* (Jakarta: Grasindo)