ASSESSMENT OF IRRIGATION PERFORMANCE OF SEKAMPUNG BATANGHARI IRRIGATION AREA, LAMPUNG PROVINCE, INDONESIA

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ABSTRACT

Sekampung Batanghari Irrigation Area is included in Sekampung Irrigation System located in Lampung Province, Indonesia. The irrigation system is classified as technical irrigation network which one of the indicators is permanent headworks and supporting irrigation structures. Sekampung irrigation system is in national priority as this area provides the most paddy rice for Lampung province. The irrigation performance of Sekampung irrigation system including Sekampung Batanghari Irrigation Area impacts on food security for this province and the country in general. This study aims to investigate the irrigation performance of Sekampung Irrigation System based on the canal density, structure density, complexities of canal section and canal length and gate coefficient. Research method includes calibrations of irrigation gates and collecting secondary data about network density and network complexity. Result of this study show that the densities of canal and structures are insufficient in some networks. The complexities of canal sections are insufficient for all networks. On the other hand, the complexities of canal lengths are sufficient for all networks. The gates perform good water delivery during the calibration experiments. Some recommendations to improve the irrigation performance can be addressed such as improving network density and network complexity in order get the irrigation water distributed efficiently and uniformly until the tertiary and quaternary canals.

Keywords: Sekampung Batanghari irrigation area, Sekampung Irrigation system, irrigation performance

1. INTRODUCTION

The existence of a reliable irrigation system is an absolute requirement for the implementation of a strong and important national food system for a country (Abernethy, 2010; Mukherji et al., 2009). Irrigation System is an effort made by humans to obtain water by using structures and channels to irrigate their paddy field using irrigation infrastructure, irrigation water, irrigation management, irrigation management institutions and human resources. In order to provide a good irrigation infrastructure, a good planning is required, so that the irrigation system becomes effective, efficient and sustainable, in order to support the productivity of farming.

Lampung Province is one of the provinces that was claimed as national rice barn by the Ministry of Agriculture and Food Security with significant irrigation system is Sekampung irrigation system. Sekampung irrigation system is technical irrigation network consisting of seven irrigation areas, which are supported by two feeder canals (Kusumastuti and Jokowinarno, 2018). Feeder Canal I serves Sekampung Bunut, Sekampung Batanghari, Raman Utara, and Batanghari Utara drainage areas. Feeder Canal II serves North Punggur, Bekri and Rumbia irrigation areas.

Several aspects related to the performance of an irrigation network including efficiency of water distribution, uniformity and adequacy of water are determined by the infrastructures of the irrigation network (Wang, 2019; Dirwai et al., 2019). The density of canals and structures, the complexity of structures as well as the canal gate conditions are among some important factors in determining the performance of the irrigation network. Thus the aim of this study is to analyse the irrigation performance of Sekampung Batanghari irrigation area by analysing the canal gate coefficient, the density of canals and structures, and the complexity of structures.

2. METHODS

Data collected includes the length of the canal sections, the number and type of existing irrigation structures, the number of canal section. This secondary data is mainly for calculating the variables of canal density (KS), structure density (KB), complexity due to the canal section (β), and complexity due to the length of canal section (θ).

Canal density, *KS*, and structure density, *KB*, are calculated as in Equations (1) and (2) as follows:

$$KS = S/A \quad (1)$$

$$KB = B/A \quad (2)$$

with *KS* is canal density (meters/ha), *KB* is building density (unit/ha), *S* is canal length (meters), *B* is the number of structures (units) and *A* = functional area (ha).

Network complexity including complexity due to the canal section (β) and complexity due to the length of canal section (θ) are calculated using Equations (3) and (4) as follows:

$$\beta = e/v \quad (3)$$

$$\theta = m/v \quad (4)$$

with β is complexity due to the canal section (segment/distribution box), θ is complexity due to the canal length (meters/distribution box), *e* is the number of canal section (section), *v* is the number of tertiary and quarternary distribution box and *m* is total length of tertiary, quarternary and drainage canals (meters).

In addition to the density and complexity of canal and structures, the gate coefficient needs to be assesses by conducting gate calibration. It needs to perform measurement in the irrigation canal including measuring the discharge at the upstream and downstream gate, water level, canal cross section and gate dimension. The equation used to calculate gate coefficient is presented in Equation (5):

$$Q = C_d a \sqrt{2g(H_1 - H_2)} \quad (5)$$

with C_d is gate coefficient, *a* is gate opening, H_1 is water elevation at the upstream gate and H_2 is water elevation at the downstream gate.

Study are is located in Sekampung Batanghari irrigation area with irrigation networks from KBH 1 to KBH 12 as presented in Figure 1. Several irrigation gates calibrated include KBH 4 Ki, KBH 5, KBH 7 Ka2, KBH 7, KBH 12 Ki2 and KBH 12 where the locations are indicated in Figure 1.

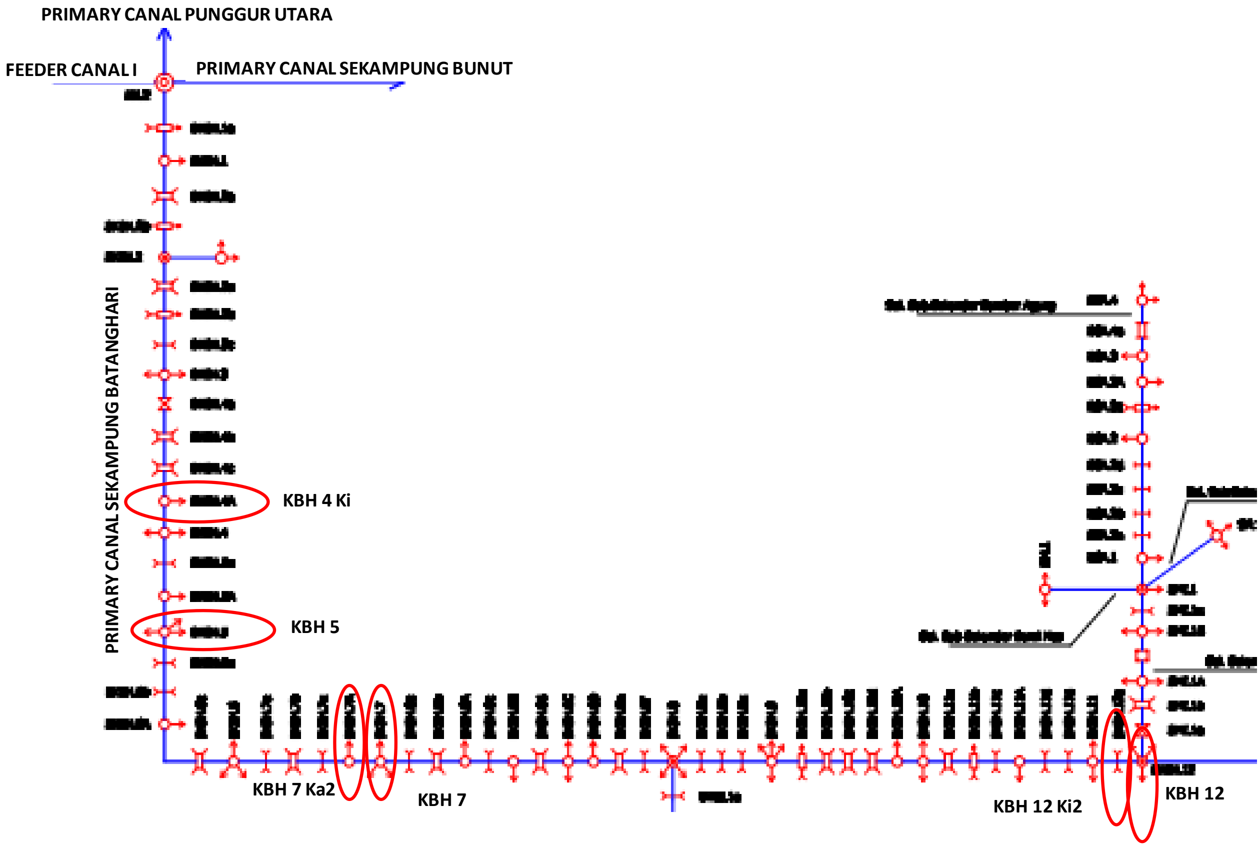

Figure 1. Study area of Sekampung Batanghari irrigation area

3. RESULTS AND DISCUSSION

The value of gate coefficient describes the performance of the gate. Gate coefficient obtained from the calibration can be used to determine how irrigation water is delivered through the gates, whether there is leaking on the gate itself or in the channel bed which sometimes is dug by farmer to let water keep running even though the gate is closed. The gates calibrated in this study include KBH 4 Ki, KBH 5, KBH 7, KBH 7 Ka2, KBH 12 Ki2, KBH 12. Figure 2 presents the pictures of the gates and corresponding rating curves resulted from the calibration.

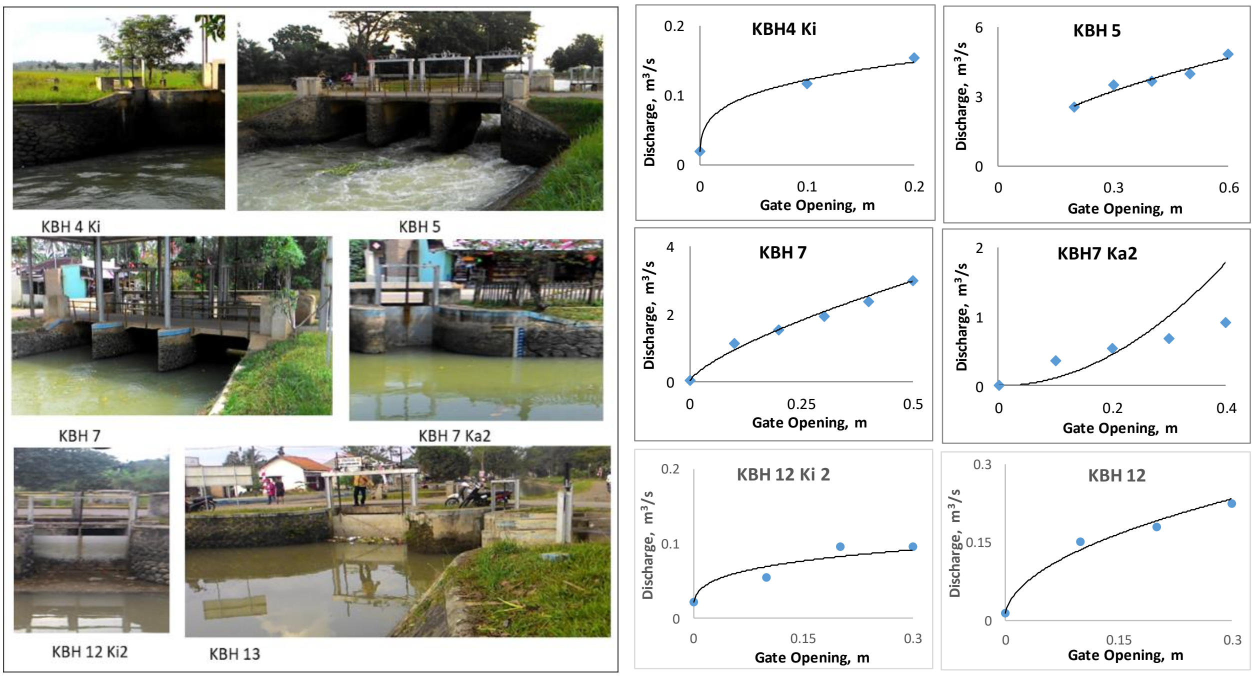

Figure 2. The gates and corresponding rating curves

From the experiments on the field it is obtained the flow discharges for corresponding gate openings for each gate. Using Equation (5) it can be calculated the gate coefficients as presented in Table 1. The values of gate coefficients range from 0.502 to 0.744 and according to Kusumastuti and Jokowinarno (2018) the gates can be classified as well performing.

Some variables needed to calculate the density and complexity of the irrigation network in Sekampung Batanghari irrigation area are presented in Table 2. In can be seen that there are some missing values for some variables in KBH 9 to 12 and it causes the complexity values cannot be calculated. Canal density (*KS*) at tertiary level can be considered as sufficient when the value is between 50 to 100 m/ha, while structure density (*KB*) can be considered as sufficient when the value is between 0.11 – 0.40 unit/ha. Furthermore, in order to get water management easily done and the water can be distributed uniformly and fairly up to the paddy field, the value of β should be between 2.21 – 2.50 section/distribution box and the value of θ should be between 500-1000 m/distribution box.

The result of this study presented in Table 2 shows that canal densities (*KS*) for KBH 1-4, KBH 6-8 and KBH 12 are considered sufficient while the rest are not. Structure densities are sufficient for most networks except for KBH 1 and 9. Complexities due to the canal sections (β) are insufficient for all networks, while complexities due to the canal length (θ) are sufficient for all networks. However, the networks with no available data, i.e. KBH 9-12 cannot be classified whether the complexities are sufficient or not.

Table 1. Discharge coefficient

Gate Name	Observed Discharge (m^3/s)	C_d
KBH 4 Ki	0.117 – 0.153	0.693
KBH 5	2.524 – 4.832	0.744
KBH 7	1.131 – 2.997	0.582
KBH 7 Ka2	0.359 – 0.919	0.502
KBH 12 Ki2	0.084 – 0.332	0.740
KBH 12	0.152 – 0.225	0.575

Table 2. Coefficient for density and complexity

Irrigation network	Planting Area (ha)		Number of Structures (unit)	Channel Length (m)	Number of Distribution Box	Number of Channel Section (e)	KS	KB	β (section/ distribution box)	θ (m/distri-bution box)
	Potential	Functional								
KBH 1	13	13	0	1500	0	0	115.38	0	0	0
KBH 2	288	236	40	26137	12	21	102.07	0.11	0.88	901.54
KBH 3	252	229	42	26248	14	22	117.29	0.18	1.56	1949.15
KBH 4	460	355	79	33163	21	33	104.94	0.39	1.68	1316.62
KBH 5	542	471	73	21045	29	16	44.83	0.16	0.52	804.78
KBH 6	408	375	91	20389	24	34	58.28	0.25	1.37	867.16
KBH 7	446	394	94	22265	26	31	61.69	0.26	1.38	908.66
KBH 8	1874	1759	200	84419	22	29	58.53	0.16	1.46	582.87
KBH 9	697	641	58	17777	0	0	29.45	0.09	-	-
KBH 10	252	252	55	12520	0	0	48.18	0.23	-	-
KBH 11	344	344	34	18750	0	0	47.02	0.11	-	-
KBH 12	933	909	96	40873	0	0	70.43	0.12	-	-

4. CONCLUSIONS

Variables assessed to find out the performance of Sekampung Batanghari irrigation area include gate coefficient, canal and structure densities, complexities of canal sections and canal length. The canal and structure densities are not sufficients in some networks, while the complexities are insufficient in terms of the canal sections and sufficient in terms of the canal length. The gate coefficients show good performance of the gates in delivering water.

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