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Efficiency Analysis of Suban Irrigation System, West Tanjung Jabung, Jambi Province

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Abstract. Water losses on the irrigation area affect the efficiency level of the drainage on the irrigation system, distribution of water can be told as efficient if the discharge of water which distribute by irrigation drainage optimally match to the need of water on the agricultural field. The purposes of this research are to analyze how much water losses on the primary drainage and secondary drainage and also to analyze the efficiency achieved on the water distribution of the Suban River Irrigation System. Efficiency and Water losses analyzed with measurement of incoming discharge and outgoing discharge on the primary drainage and secondary drainage, then for the measurement of flow velocity by the buoy method. Based on the analysis, total of water losses on the Suban Irrigation system is 6.46% and efficiency value on the primary drainage as 92.32%, efficiency value on the secondary left drainage as 95.40% and efficiency value on the secondary right drainage as 92.90%. From the efficiency of drainage it can be obtained that the total efficiency of drainage as 93.54%, which the Irrigation System of the Suban river classified as good condition.

1. Introduction

Overused of the water, uncontrolled distribution system and many of people that still taking the water for the daily activity were the factors that happen on the Irrigation area in Indonesia. So, it required to saving the water. Save the water can describe as the activity to achieve effective and efficient situation, there are amount water that gave larger advantage than previous condition.

Suban Irrigation area have the water distribution problem, located in West Tanjung Jabung regency. Suban irrigation area known as largest technical Irrigation in Jambi province, which has 5 times of planting per 2 years and productivity as ± 6 ton/ha. Suban Irrigation area is the potential food security supporter on the Jambi province, which functionally actived about 910 Ha from the 1.121 Ha potential on the area. However, Suban Irrigation area have deficiency of water caused by dry season, which indicated the wrong procedure for the exploitation and utilization of the drainage.

Based on the problem occurred at the Suban Irrigation area, needed the necessary to reevaluate the efficiency level of Irrigation drainage at the Suban Irrigation area by analyzing the loss water value and drainage efficiency value which achieved from water distribution on Irrigation system of Suban Irrigation area.

2. Method

2.1. Research Area

The research area located at Batang Asam district, West Tanjung Jabung reGENCY Jambi province, and the location can be reach by car for ± 3 hours from Jambi. Suban Dam located at Suban village, while 1.800 m left drainage located at Rawa Medang village which serving 480 Ha and 3.565 m secondary right drainage located at Sri Agung reGENCY serving 430 Ha. Potentially serving area of Suban Irrigation area widely about 1121 Ha and 910 Ha area functionally as rice field and produce ± 6 tonne/Ha with Rice-Rice-Secondary Crop pattern.

2.2. Method of Research

The method of this research is analysis of observation. The analysis was doing by Inflow and Outflow discharge water use conventional equation.

2.2.1. Tools

The tools that used are flow velocity and wet section measurement tools such as mineral water bottle as buoy, rope, measuring strap, depth stick, stopwatch, stationary, paint

2.2.2. Location

Measurement location selected on the primary and secondary drainage row which fullfil the requirements on the flow velocity measurement and wet section measurement. Measurement located on the upstream and the downstream of drainage, then for measuring the flow velocity it used Buoy method. The Measurement held about 3 times, where the buoy position situated on the right side, centre side and left side of the flow.

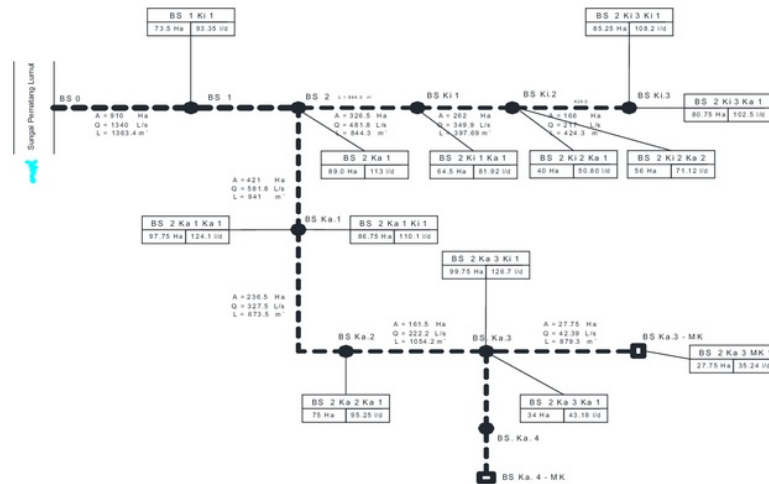


Figure 1. Point of measurement scheme of Suban Irrigation system

2.3. Calculation Method

2.3.1. Discharge Calculation

Discharge or drainage flow value is flow volume that stream through a cross-section of drainage per time unit (m³/s). Basically, the discharge measurement is metering the wet section area, flow velocity and level of water. The formula used is:

$$Q = \Sigma (A \times V) \tag{1}$$

Where :

- Q = Discharge (m³/s)
- A = Wide area of wet section (m²)
- V = Drainage average Flow velocity (m/sec)

Table 1. Calculation of discharge of the primary drainage and secondary drainage

Location of Measurement	Wide Area of Wet Section (m ²)	Flow Velocity (m/sec)	Water Discharge (m ³ /sec)
Primary drainage			
Row 1 (inflow)	3.04	0.46	1.40
Row 1 (outflow)	2.10	0.58	1.21
Row 2 (inflow)	2.37	0.50	1.17
Row 2 (outflow)	3.00	0.39	1.16
Left secondary drainage			
Row 1 (inflow)	0.59	0.56	0.33
Row 1 (outflow)	0.42	0.74	0.31
Row 2 (inflow)	0.66	0.46	0.31
Row 2 (outflow)	1.18	0.24	0.29
Row 3 (inflow)	0.39	0.72	0.28
Row 3 (outflow)	0.52	0.51	0.27
Row 4 (inflow)	0.36	0.38	0.14
Row 4 (outflow)	0.36	0.37	0.13
Right secondary drainage			
Row 1 (inflow)	1.31	0.61	0.79
Row 1 (outflow)	1.29	0.60	0.78
Row 2 (inflow)	1.20	0.58	0.69
Row 2 (outflow)	1.47	0.46	0.68
Row 3 (inflow)	0.77	0.78	0.60
Row 3 (outflow)	0.51	1.01	0.51
Row 4 (inflow)	0.32	1.33	0.43
Row 4 (outflow)	0.39	0.98	0.38

2.3.2. Water losses

Irrigation Water losses that happens at the water distribution especially caused by seepage on the drainage, evaporation (commonly small) and operational losses occurs when the run-off and spillover of disposal water at the drainage operation time and also over exploitation of water by the farmer.

Water losses in every Inflow – outflow measurement calculated as deviation of the inflow discharge and outflow discharge.

$$h_n = I_n - O_n \tag{2}$$

Where :

- H_n = Water losses on the measured row/section of drainage n (m³/s)
- I_n = Inflow measured n (m³/s)
- O_n = Outflow measured n (m³/s)

2.3.3. Efficiency of Irrigation

Efficiency of irrigation is based on the reality that not all of the water drainage which given or tapped and pull in to the drainage can be flown to the next tapped building or plotland, but there are the parts of missing or not being utilized. Generally the efficiency of irrigation defined as ration between amount of water given minus Water losses where the amount of water given as percent.

$$Ec = (Q_{out} / Q_{in}) \times 100\% \tag{3}$$

Where :

- Ec = Efficiency of distribution
- Q out = Discharge outflow (m³/s)
- Q in = Discharge inflow (m³/s)

2.4. Analysis Method

Analysis method by data processing that used on the research, are:

- a. Discharge inflow and outflow analysis on the primary and secondary drainage
- b. Water losses analysis and efficiency of irrigation system

3. Result

3.1. Discharge inflow and discharge outflow analysis on the primary and secondary drainage

Discharge inflow and discharge outflow analysis based on the measured data of flow velocity with buoy method and wide area of wet section of draiage. Calculation result of discharge flow as seen table 1:

3.2. Water losses analysis and efficiency of irrigation system

Water losses and efficiency at the analysis of every row measurement with distance depends on the drainage distance, both primary and secondary at table 2.

Table 2. Water losses analysis and efficiency

Location of Measurement	Water Discharge (m3/sec)			Efficiency (%)	Drainage Efficiency (%)	Percentage Water Losses (%)
	In	On	hn	Ec		
Primary drainage						
Row 1	1.40	1.21	0.20	86.02	92.32	7.68
Row 2	1.17	1.16	0.02	98.62		
Left secondary drainage						
Row 1	0.33	0.31	0.02	94.27	95.40	4.60
Row 2	0.31	0.29	0.02	93.56		
Row 3	0.28	0.27	0.01	95.61		
Row 4	0.14	0.13	0.00	98.15		
Right Secondary drainage						
Row 1	0.79	0.78	0.01	98.43	92.90	7.10
Row 2	0.69	0.68	0.01	98.59		
Row 3	0.60	0.51	0.09	85.59		
Row 4	0.43	0.38	0.05	89.01		
Primary and Secondary Drainage Efficiency					93.54	
Water Losses in Primary and Secondary Drainage						6.46

4. Conclusion

Based on the result discussion it can be concludes that:

1. Efficiency of water distribution on the system :
 - a. Efficiency of primary drainage averagely as 92.32% for the 1.690 m long drainage. Loss water on the primary drainage is 7.68%.
 - b. Efficiency of left drainage averagely as 95.40% for the 1.800 m long drainage.
 - c. Efficiency of right drainage averagely as 92.90% for the 3.565 m long drainage.
2. Water losseses overally at the Irrigation sytem of Suban irrigation area is 6.46%, the losses water causing by physical factors of drainage, to illegal water taking for daily needs and fish ponds.

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