E-ISSN: 2528-388X
P-ISSN: 0213-762X

INERSIA
Vol.19, No.1, May 2023

Efficiency Analysis of Tertiary Channels in Mataram Irrigation. Special Region of Yogyakarta

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Keywords:
Efficiency
Evaporation
Water Loss

ABSTRACT

Mataram irrigation canal is an agricultural infrastructure built around 1942 with a channel length of ± 34.5 km. Changes in land use patterns that occur in Yogyakarta will certainly have an impact on changing the demand for water discharge in the canals and the ability of the canals to drain water. The tertiary network in the Mataram irrigation canal is the most influential on land use change. where the network connects the Mataram main network with the surrounding rice fields. This study reviews how much efficiency and water loss occurs in the Mataram irrigation tertiary channel. Analysis of the efficiency of the Mataram irrigation canal was carried out by comparing the discharge inflow and outflow in the channel while the analysis of water loss in the channel is carried out by calculating the amount of evaporation and seepage that occurs in the channel. Efficiency results in 25 Mataram tertiary channels. there are 9 channels where water utilization is greater than water demand indicated loss that occurs in the channel. Loss in the channel is caused using water for other factors or water leakage occurs in the channel. This is indicated by the fact that the water supplied to the canal is greater than the required amount of water. so that the percentage of water usage in this channel is more than 100%. Different conditions were obtained from the other 16 canals. where water utilization was less than the water requirement. so there was excess water in the canals. This incident occurred because the irrigation service area had experienced a change in land use or a lot of land that did not need water. This causes the downstream water discharge to be greater than the given discharge because there is additional discharge from other sources.

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1. Introduction

Mataram Irrigation Canal is a waterway built around 1942 during the Japanese colonial period on the advice of Sultan Hamengku Buwono IX as the King of Mataram to save the people of Yogyakarta from the forced labor of Romusha [1]. The Mataram Irrigation Canal is one of three main channels: Karangtalun Main Channel. Van der Wijck Channel. and Mataram Main Channel [11]. The Mataram Channel has a length of ±34.5 km and stretches from the Progo River (upstream) to the Opak River (downstream) as Figure 1. which crosses three districts: Sleman. Bantul. and Yogyakarta. with a total catchment area of ±25.993 hectares. [2].

The condition of the Mataram Irrigation Canal that divides the city of Yogyakarta is undoubtedly influenced by changes in land use that occur in Yogyakarta. Regarding the zoning directive in the Sleman Regency RTRW for 2019-2039. the area inside the Ring Road is an urban area with the potential to develop evenly but with various functions. On the other hand. in the area outside the Ring Road. most land allotments are as irrigated food rice (paddy fields). plantations. and settlements. as shown in Figure 1. [3].

When reviewing the current condition of the upstream mataram channel. many lands were originally in the form of rice fields. changing their functions as settlements and places of aquaculture. strengthened by the Sleman Regency Government trying to utilize mataram irrigation water in addition to being used for the agricultural sector also used for the fishery sector [4]. When reviewing the mapping carried out by the Serayu-Opak River Area Center (BBWS SO) in 2017. several fish farms utilize water from the Mataram irrigation tertiary channel.

This land use change resulted in conditions in the Mataram tertiary channel. physical form. and the required water requirements along the channel (Figure 2). An evaluation of the efficiency of the Mataram irrigation canal is needed. especially regarding the ability of the tertiary channel to carry water downstream. It is hoped this research result can be used as a reference in improving the management of mataram irrigation canal water management so that it can improve the welfare of the people of Yogyakarta.

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http://dx.doi.org/10.21831/inersia.v19i1.53760
Received October 10th, 2022; Revised December 21st, 2022; Accepted December 23rd, 2022
Available online May 31st, 2023

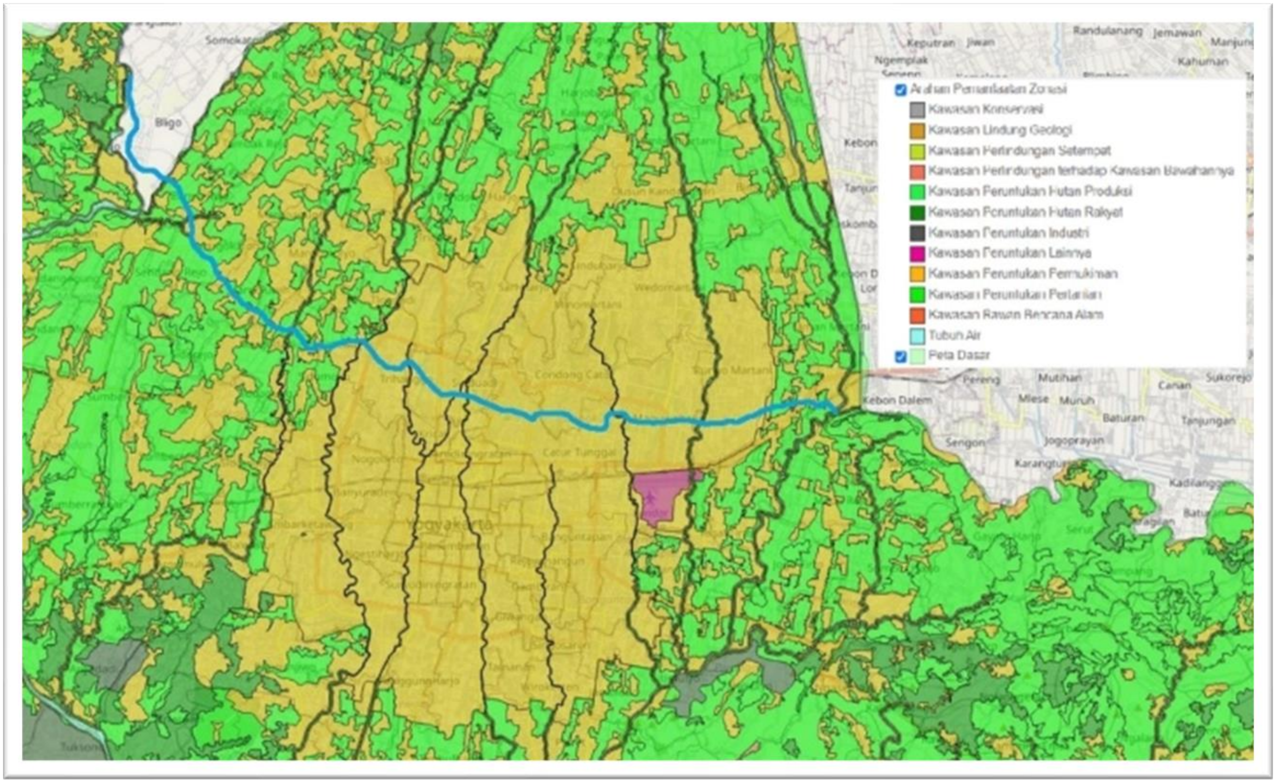

Figure 1. DIY Provincial Land Allotment Directive Map [3]

Figure 2. Conditions of the Mataram Irrigation Tertiary Channel MA9/T1 and MA7/T3 [12]

Several parameters were used in this study. such as water availability. water requirements (irrigation and non-irrigation). water loss. and efficiency in the channel.

a. Water availability.

The calculation of water availability analysis in this study was carried out by reviewing the water discharge given in the upper reaches of the Mataram irrigation tertiary channel (tap); the discharge data were obtained by measuring the wet appearance area of the channel and the flow speed with the equation $Q = A \times V$. where Q = water discharge (m^3/s). A = Area of the channel (m^2). and V = water flow rate (m/s). This study uses the buoy method to determine the flow velocity in the channel. a tool used as a float in the form of Ping-Pong.

b. The need for irrigation water

The factors that include land treatment. consumptive water use. percolation. replacement of water layers. and effective rain donation can influence the water requirements for rice plants. The net need for water in rice fields is total minus the influential rain factor. The need for water in rice fields can be expressed in mm/day or lt/s.

a. Non-irrigation water needs.

Aquaculture is the most dominant non-irrigation water requirement in the Mataram irrigation tertiary channel. Fisheries can be categorized into 2 types: ordinary ponds and rushing water pools. The need for water in ordinary ponds to replace lost water requires a continuous flow of water of 10-15 It/s/ha [10]. If the pool unit is significant. the need for water for filling and replacing lost water will also increase. The water requirement in a heavy water pool is to fill the pool while maintaining the water level.

b. Loss of water.

Physical factors. including leakage or seepage. channel evaporation. or percolation. cause water loss during the channeling process. Due to many influencing factors. the assessment approach to each of them will provide many parameters for calculating the value of water loss. To facilitate the assessment of the price of water loss. a lump factor system is used using the principle of water balance. where the concept of water balance shows the balance between the amount of water that enters the. which is available. and that exits a particular system (sub- system) Figure 3. Generally. the water balance equation is formulated with $I = O \pm \Delta S$. with I = inlet discharge (m^3/s). O = discharge out (m^3/s). and ΔS = change of deposit at a given time.

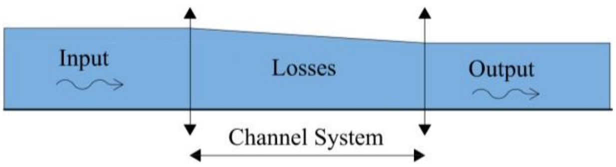

Figure 3. Principle of Input Output on a Channel [8]

c. Channel efficiency

The efficiency of irrigation canals is defined as a comparison figure of the amount of natural irrigation water used for agricultural and non-agricultural needs with the amount of water coming out of the intake door [6]. In principle. the efficiency value can be calculated by the following equation:

1) Water utilization in channels.

Water utilization = Residual water discharge – Downstream *output* discharge of the channel. (1)

2) Losses in channel.

Losses = ∑ Water needs (agriculture and fisheries) – Water utilization (2)

3) Persentase irrigation water.

$$\text{Percent water used} = \frac{\text{Water Used}}{\sum \text{Water used}} x100 \qquad (3)$$

2. Method

The research location is in the tertiary area of the Mataram channel starting from the upstream / intake channel. namely in Karangtalun village. Ngluwar District. Magelang Regency. by taking water from the Progo river through the Karangtalun wier building. The downstream part of the Mataram channel. which is the end of the channel. is in the east of the province of the Special Region of Yogyakarta. precisely in the village of Tamanmartani. Kalasan District. Sleman Regency. flowing into the Opak river. The mataram main channel has 72 tapping buildings connecting the Mataram main channel and the mataram irrigation tertiary channel. In this study. measurements were carried out on 25 tertiary tapping buildings such as Figure 4 and Table 1. where all measurements were not taken due to improvements in the lining of the Mataram main channel starting from the Tambakbayan river to the Tepus river. which caused the mataram main network water to flow downstream of the channel.

Table 1. Coordinates of The Control Gate Irrigation Channel of Mataram

No	Control Gate Irrigation Code	Geographical Location	
		Latitude	Longitude
1	KT.3/T1	-7.680857	110.268760
2	KT.3/T2	-7.682039	110.268147
3	MA.1/T1	-7.693915	110.272054
4	MA.1/T2	-7.693796	110.273477
5	MA.2/T1	-7.696371	110.277243
6	MA.2/T3	-7.698113	110.280356
7	MA.2/T3a	-7.698361	110.281234
8	MA.3/T2	-7.705774	110.284411
9	MA.3/T3	-7.699557	110.281664
10	MA.3/T4	-7.70199	110.282960
11	MA.4/T2	-7.716193	110.285971
12	MA.4/T2a	-7.717073	110.286305
13	MA.5/T1	-7.720967	110.290928
14	MA.5/T2	-7.722254	110.292203
15	MA.6/T1	-7.727175	110.295785
16	MA.7/T2	-7.735566	110.299646
17	MA.7/T3	-7.735908	110.303798
18	MA.8/T1	-7.737762	110.307471
19	MA.8/T2	-7.743318	110.309451
20	MA.9/T1	-7.747761	110.316293
21	MA.9/T3	-7.750454	110.318356
22	MA.10/T1	-7.748201	110.324014
23	MA.10/T2	-7.747303	110.325021
24	MA.11/T1	-7.747156	110.330056
25	MA.11/T2	-7.747431	110.329692

In this study. several data were needed to analyze the efficiency of the Mataram irrigation tertiary channel. the data used were categorized into two types. namely primary and secondary data. The primary data is in the form of measurement data on the dimensions of channel appearance. flow speed. and aquaculture locations in the form of coordinate points. Meanwhile. the secondary data used is in the form of a map of the raw land area of Karangtalun rice fields in 2017. which was digitized according to the land allocation in 2022. irrigation network maps in 2017. rain data of 7 stations (Godean. Seyegan. Beran. Gemawang. Prumpung. Santan. Plataran) with a minimum time interval of 10 years. Barongan climatological data with a time interval of 10 years. and planting patterns obtained from several previous studies. In order to make the implementation of the research more focused. a research flow chart is made as Figure 5.

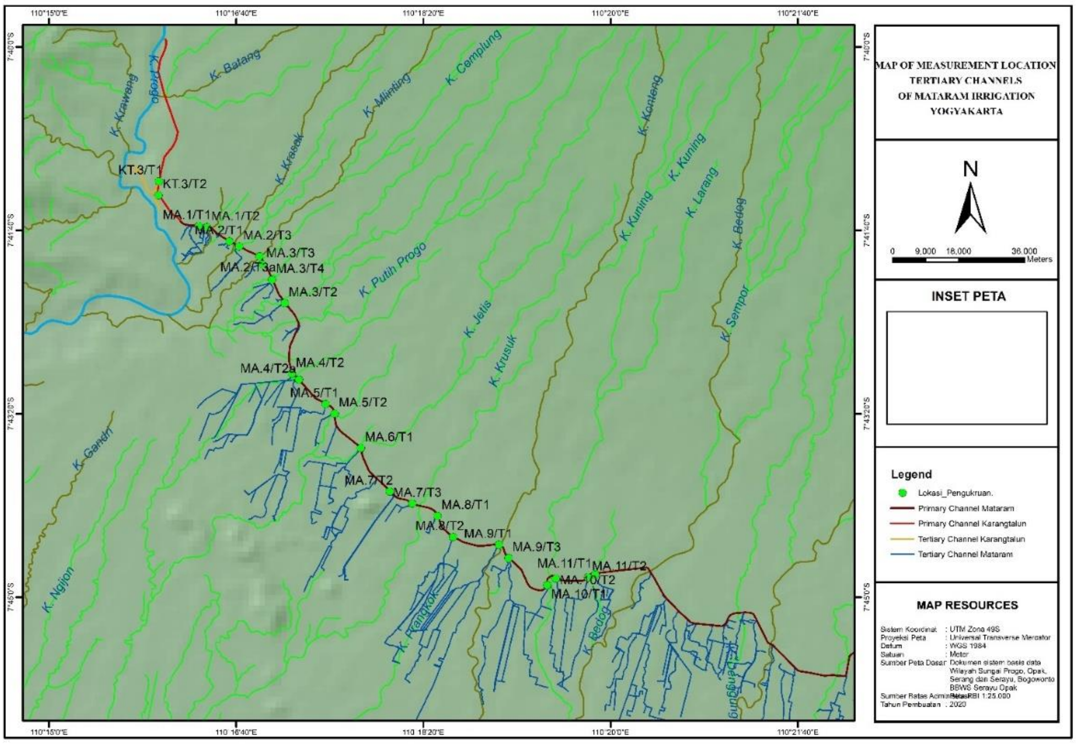

Figure 4. Mataram Irrigation Tertiary Channel Research Site Map [5]

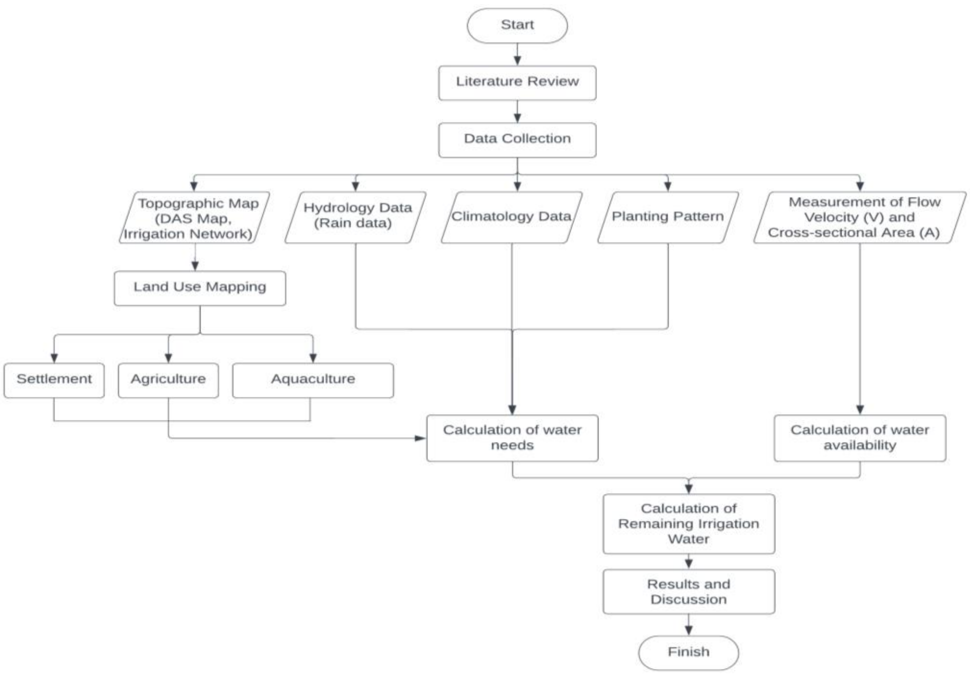

Figure 5. Research Flowchart

2.1. Data Availability

In this study. some data is needed to analyze the efficiency of the Mataram irrigation tertiary channel. The data used is categorized into 2 types. namely primary and secondary data.

a. Primery Data

The primary data that will be used in this thesis is data obtained directly at the research location. the data consists of:

1) Dimensional measurement data of the Mataram tertiary channel section.
2) Flow velocity measurement data on the Mataram tertiary channel.
3) Data on aquaculture locations are in the form of coordinate points.

b. Secondary Data

1) Map of the standard area of Karangtalun rice fields obtained from the Serayu Opak River Region Center (BBWS SO) in 2017.
2) The Mataram irrigation network map was obtained from BBWS SO in 2017.
3) Rain data for 7 stations (Godean. Seyegan. Beran. Gemawang. Prumpung. Santan. Plataran) obtained from DPUP ESDM DIY with a minimum time interval of 10 years.
4) Barongan climatological data with time intervals of 10 years. starting in 2010-2020.
5) Planting pattern data obtained from several previous studies.

2.2. Channel Discharge Measurement Scheme

The scheme for measuring the water discharge in the channel can be seen in Figure 6 and Figure 7.

In this study. measurements were made by first determining the location to be measured. In this study. measurements of the channel were carried out at the upstream and downstream of the channel. data collection on the upstream channel was carried out near the intake building in the form of a tapping gate. while the downstream channel was at the lowest end of the channel or at a location where the water discharge was very small. As an example. can be seen in Figure 6 and Figure 7. there are 2 types of canal ends. namely branched and non-branched. Measurements on branched irrigation networks are carried out by dividing the canal into 3 pias or parts. namely pias A. B. and C. On pias channel A. measurements are carried out upstream of the canal with the closest location to the tapping gate where the data is used as debitinput upstream and downstream of the channel asoutput channel. this was also carried out on the B and C channel banks. In this study. it is necessary to know the total dischargeoutput contained in the Mataram canal so that it can be compared with the water needs according to the land use in 2022. therefore the valueoutput those found in the downstream channel are added between channels B and C. In contrast to channel branches. channels that do not branch out can be measured upstream (located close to the tapping gate) and directly to the downstream channel or locations where the water discharge is very small. but to get more detailed values can be made by dividing the channel into several sections as well. as shown in Figure 7 with channel codes D and E.

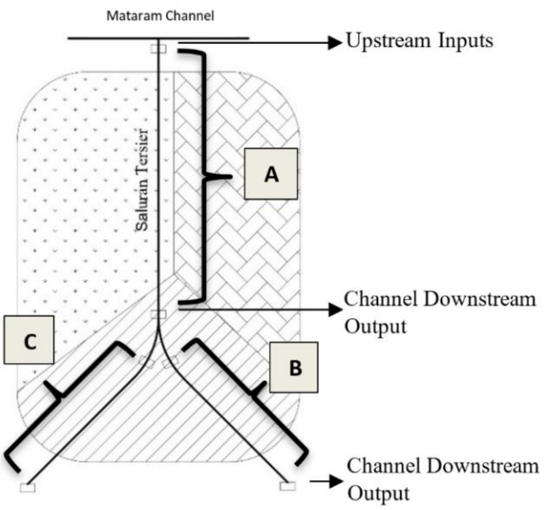

Figure 6. Mataram Canal Water Discharge Measurement Scheme

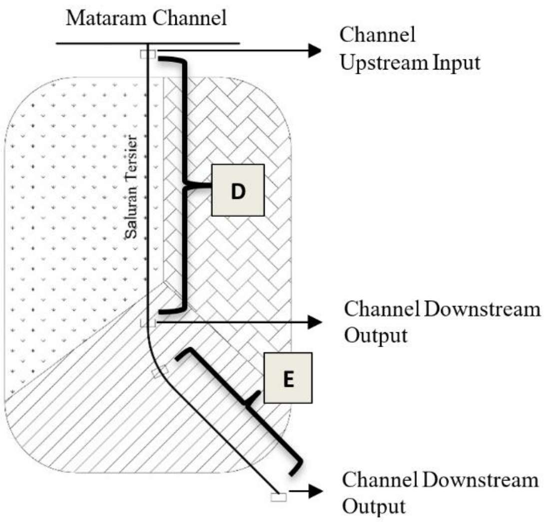

Figure 7. Mataram Canal Water Discharge Measurement Scheme

3. Results and Discussion

3.1. Tertiary Channel Efficiency

Water availability used in this study is based on water discharge in the tertiary channel's upper reaches. The discharge data collection was carried out by measuring the appearance of the channel and the flow speed at the study site using the media buoy method in the form of ping-pong balls. Measurements were made on 25 channels out of 72 Mataram tertiary channels (Table 2).

Table 2. Upstream and Downstream Measurements of Channels.

No	Control Gate Irrigation Code	Hulu Input (lt/s)	Downstream Output (lt/s)	No	Control Gate Irrigation Code	Hulu Input (lt/s)	Downstream Output (lt/s)
1	KT.3/T1	298.08	122.81	14	MA.5/T2	37.40	13.21
2	KT.3/T2	35.14	20.79	15	MA.6/T1	111.70	105.60
3	MA.1/T1	6066	78.20	16	MA.7/T2	415.58	122.65
4	MA.1/T2	111.70	91.07	17	MA.7/T3	33.76	3.43
5	MA.2/T1	53.74	44.83	18	MA.8/T1	74.61	51.78
6	MA.2/T3	32.88	13.88	19	MA.8/T2	89.55	60.66
7	MA.2/T.3a	148.65	49.27	20	MA.9/T1	478.13	135.85
8	MA.3/T2	52.89	29.52	21	MA.9/T3	255.42	173.33
9	MA.3/T3	18.52	7.37	22	MA.10/T1	405.90	360.61
10	MA.3/T4	478.13	372.932	23	MA.10/T2	163.84	38.75
11	MA.4/T2	85.14	17.56	24	MA.11/T1	141.22	138.24
12	MA.4/T.2a	20.24	6.65	25	MA.11/T2	103.45	170.89
13	MA.5/T1	328.21	367.92				

3.2. Irrigation Water Needs

Several factors. including plant evapration. land treatment. consumptive water use. percolation. replacement of water layers. and effective rain donation. can influence the calculation of water requirements for plants.

a. Evaporation of Reference Plants (ET_o)

The evaporation of reference plants is an essential factor in calculating the value of irrigation water needs; the calculation of ET_o is carried out using the Penman-Monteith method [9] with daily climatological data of Barongan Station from 2010 to 2020. The results of the ET_o calculation show that the highest evapotranspiration value occurred in the middle of the second month of October. which was 4.51 mm/day. while the highest evapotranspiration and evaporation value of 3.13 mm/day occurred in the middle of the first month of July.

b. Effective Rainfall

There are 7 rain stations around the Mataram channel. such as Godean. Seyegan. Beran. Gemawang. Prumpung. Santan. and Plataran. so the rain data needs to be converted into regional average rain data. The average amount of rain in the region can be calculated using the Thiessen polygon method. Thiessen polygons used to calculate the area of the territory on the polygon can be obtained with the help of the ArcMap 10.5 application. The calculation of the average rain in the Mataram irrigation area produces 3 different Thiessen polygons according to the availability of rain data (Table 3).

Table 3. Regional rain weighting.

Station	Thiessen Weights 1	Thiessen 2 weights	Thiessen 3 Weight
Godean	0.59	0.70	0.70
Seyegan	0.13	0.00	0.00
Beran	0.00	0.18	0.18
Gemawang	0.16	0.11	0.18
Prumpung	0.00	0.00	0.12
Santan	0.11		
Plataran	0.005		

The regional rain weight p data on Table 3. can be used as a reference to determine the 80% rain capability. along with the results of the R_{80}% rainfall calculation on Table 4.

Table 4. Probability of 15 daily precipitation

Month		R_{80}%	Month		R_{80}%
Jan	I	87	Jul	I	0
	II	99		II	0
Feb	I	68	Ags	I	0
	II	65		II	0
Mar	I	83	Sep	I	0
	II	80		II	0
Apr	I	75	Oct	I	0
	II	37		II	0
May	I	19	Nov	I	55
	II	10		II	72
Jun	I	1	Des	I	86
	II	0		II	96

After calculating the effective rain probability value. because there are two types of crops grown. namely rice and palawija. the effective rainfall value (Re) is also different (Table 5 and Table 6).

Table 5. Effective rainfall of rice.

Month		Re Rice	Month		Re Palawija
Jan	I	4.06	Jul	I	0.00
	II	4.63		II	0.00
Feb	I	3.16	Ags	I	0.00
	II	3.05		II	0.00
Mar	I	3.88	Sep	I	0.00
	II	3.72		II	0.00
Apr	I	3.49	Oct	I	0.00
	II	1.73		II	0.01
May	I	0.87	Nov	I	2.55
	II	0.45		II	3.38
Jun	I	0.03	Des	I	4.03
	II	0.00		II	4.47

Table 6. Effective rainfall of Palawija

Month		Re Rice	Month		Re Palawija
Jan	I	2.90	Jul	I	0.00
	II	3.31		II	0.00
Feb	I	2.26	Ags	I	0.00
	II	2.18		II	0.00
Mar	I	2.77	Sep	I	0.00
	II	2.66		II	0.00
Apr	I	2.49	Oct	I	0.00
	II	1.23		II	0.01
May	I	0.62	Nov	I	1.82
	II	0.32		II	2.41
Jun	I	0.02	Des	I	2.88
	II	0.00		II	3.20

c. Land Preparation

In this study. three planting periods (MT) were used in one year. with 2 times for the rice planting period and one time for palawija. The results of the calculation of water requirements during land preparation for rice are as Table 7.

Table 7. Land Preparation 300 mm for 30 Days

Month		*Re* Rice	Month		*Re* Palawija
Jan	I	1.09	Jul	I	1.54
	II	1.04		II	1.55
Feb	I	1.20	Ags	I	1.58
	II	1.22		II	1.60
Mar	I	1.13	Sep	I	1.61
	II	1.15		II	1.62
Apr	I	1.16	Oct	I	1.64
	II	1.38		II	1.64
May	I	1.45	Nov	I	1.28
	II	1.49		II	1.19
Jun	I	1.54	Des	I	1.09
	II	1.55		II	1.05

d. Analysis Water Needs

The irrigation water needs calculation is based on the KP-01 Irrigation Planning Standard by reviewing the water requirements in each tertiary canal tapping channel. It used early planting on September 1 with the cropping pattern padi-padi-palawija.

3.3. Non-Irrigated Water Needs

The need for water for good aquaculture for ponds is not less than 10 – 15 lt/s/ha. [10] There is this study used water needs for water replacement of 15 lt/s/ha. The following results from the calculation of water needs for fishpond farming shows in Table 8.

Table 8. Aquaculture water needs

No	Control Gate Irrigation Code	Pool Area (m^2)	Pool Water Needs (lt/s)
1	KT.3/T1	0.32	4.81
2	KT.3/T2	0.69	10.38
3	MA.1/T1	0.00	0.00
4	MA.1/T2	0.00	0.00
5	MA.2/T1	0.12	1.82
6	MA.2/T3	2.20	32.97
7	MA.2/T3a	0.00	0.00
8	MA.3/T2	3.96	59.37
9	MA.3/T3	0.35	5.20
10	MA.3/T4	0.00	0.00
11	MA.4/T2	2.23	33.45
12	MA.4/T2a	17.96	269.40
13	MA.5/T1	4.87	73.05
14	MA.5/T2	2.96	44.33
15	MA.6/T1	0.29	4.38
16	MA.7/T2	0.00	0.00
17	MA.7/T3	0.00	0.00
18	MA.8/T1	0.07	1.09
19	MA.8/T2	0.16	2.39
20	MA.9/T1	1.86	27.94
21	MA.9/T3	45.41	681.09
22	MA.10/T1	0.00	0.00
23	MA.10/T2	0.00	0.00
24	MA.11/T1	0.02	0.35
25	MA.11/T2	3.82	57.36

3.4. Tertiary Channel Water Delivery Efficiency

The calculation of efficiency in the Mataram irrigation tertiary channel is carried out by comparing the upstream input discharge. water requirements (irrigation and fishponds). and the output discharge downstream of the channel using equations 1 to 3. Several rice field locations require a large water discharge compared to the water discharge provided. such as in the MA.4/T2 channel. This happens because the rice field area data is a map of the raw land area obtained from BBWS SO in 2017. which has been adjusted to land conditions in 2022. The following is the result of the calculation of the efficiency of the Mataram tertiary channel due to changes in land use (Table 9).

Table 9. Calculating the Efficiency of the Mataram Tertiary Channel according to Land Use in 2022.

No	Control Gate Code	Upstream input (lt/s)	Downstream output (lt/s)	Water requirements: Agriculture (lt/s)	Water requirements: Fishing (lt/s)	∑ water needs (lt/s)	Water Utilization (lt/s)	*Losses* (lt/s)	Percentage of water consumption (%)
1	KT.3/T1	298.08	122.81	14.62	4.81	19.43	175.26	– 155.83	902%
2	KT.3/T2	35.14	20.79	3.11	10.38	13.49	14.35	– 0.86	106%
3	MA.1/T1	60.66	78.20	49.04	0.00	49.04	–17.54	+ 66.58	–36%
4	MA.1/T2	111.70	91.07	4.83	0.00	4.83	20.63	– 15.80	427%
5	MA.2/T1	53.74	44.83	14.74	1.82	16.55	8.91	+ 7.64	54%
6	MA.2/T3	32.88	13.88	20.54	32.97	53.51	18.99	+ 34.52	35%
7	MA.2/T3a	148.65	49.27	28.28	0.00	28.28	99.38	– 71.10	351%
8	MA.3/T2	52.89	29.52	52.23	59.37	111.60	23.36	+ 88.24	21%
9	MA.3/T3	18.52	7.37	9.87	5.20	15.07	11.14	+ 3.93	74%
10	MA.5/T1	478.13	372.93	114.13	0.00	114.13	105.19	+ 8.93	92%
11	MA.4/T2	85.14	17.56	403.13	33.45	436.58	67.58	+ 369.00	15%
12	MA.4/T2a	20.24	6.65	30.09	269.40	299.49	13.59	+ 285.91	5%
13	MA.5/T1	328.21	367.92	79.23	73.05	152.28	–39.72	+ 192.00	-26%
14	MA.5/T2	37.40	13.21	43.04	44.33	87.36	24.19	+ 63.17	28%
15	MA.6/T1	111.70	105.60	59.25	4.38	63.63	6.10	+ 57.53	10%
16	MA.7/T2	415.58	122.65	83.00	0.00	83.00	292.93	– 209.94	353%
17	MA.7/T3	33.76	3.43	8.99	0.00	8.99	30.32	– 21.33	337%
18	MA.8/T1	74.61	51.78	10.93	1.09	12.02	22.84	– 10.81	190%
19	MA.8/T2	89.55	60.66	97.90	2.39	100.29	28.89	+ 71.40	29%
20	MA.9/T1	478.13	135.85	123.70	27.94	151.64	342.28	– 190.64	226%
21	MA.9/T3	255.42	173.33	139.68	681.09	820.77	82.09	+ 738.68	10%
22	MA.10/T1	405.90	360.61	35.71	0.00	35.71	45.29	– 9.57	127%
23	MA.10/T2	163.84	38.75	31.37	0.00	31.37	125.09	+ 93.72	399%
24	MA.11/T1	141.22	138.24	55.80	0.35	56.15	2.98	+ 53.17	5%
25	MA.11/T2	103.45	170.89	18.64	57.36	76.01	–67.44	+ 143.45	–89%

The plus and minus signs on losses explain that:
(–) = water requirement < water utilization
(+)= water needs > water utilizationabo

From the calculation results (Table 9). there are 2 positive and negative symbols. The negative symbol explains that the water requirement in the channel is smaller than water utilization. so water loss occurs in the channel. Water use causes loss in the channel for other factors or a water leak (losses). This is indicated by the water given to the channel being more significant than the amount of water demand that should be so that the percentage of water use in this channel is more than 100%. The positive symbol in the table explains that the need for water in the irrigation service area is more significant than water use. so there is no water loss in the channel. This incident occurs because the irrigation service area has undergone changes in land function (not intended as agricultural or fishery land) or many lands do not need water. This causes the water discharge downstream to be greater than the discharge given because there is additional discharge from other sources. so the percentage of water use is below 100%.

3.5. Workaround Solutions

The efficiency level of irrigation canals is used to determine a channel's feasibility level. In research that has been carried out on the Mataram irrigation tertiary canal. results have been obtained that show the lack of ability of the channel to drain water. which causes irrigation to be unable to reach the farthest plot of the irrigation canal. Several alternatives can be used to increase the efficiency value of irrigation canals. among others:

a. Cleaning and removal of sediment in the ducts

Cleaning and sediment extraction in the tertiary has not been carried out continuously. Channel cleaning can be done periodically for 2 weeks or once every 2 months to reduce existing sedimentation. It is necessary to cooperate with P3A to be able to improve channel efficiency.

b. Rehabilitation and restoration of channel lining

The channel wall is the most significant water loss. among other factors. Participatory rehabilitation and maintenance with P3A related to Water Use Dues (IPAIR) are required so that. if needed. these rehabilitation activities do not need to wait for a contractual budget.

c. P3A control in the management of water administration.

There needs to be socialization or counseling on P3A in the use of irrigation water. with the hope that water users are aware of other irrigation water needs so that with this awareness. the use of water can be used evenly downstream of the channel.

d. The efficient irrigation water used

For the foreseeable future. the increase in food production will be increasingly constrained by the scarcity or limited availability of irrigation water. The limited availability of water will be even more dangerous if there is competition for water use between irrigation water users. Therefore, it is necessary to have effective and efficient water management and distribution in each sector of irrigation water users. Effective and efficient can be interpreted as the division of water that is no more and no less.

4. Conclusions and Suggestions

4.1 Conclusions

Irrigation efficiency in this study is interpreted as a comparison between inflow discharge and outflow. which considers water needs (irrigation and non-irrigation) following land use that occurs in the Mataram channel area in 2022. Based on the land use around the Mataram irrigation canal in 2022. the land is used as settlements. rice fields. and aquaculture. In this case. land use also impacts changing water discharge needs and the ability of channels to drain water. So. it is necessary to calculate the efficiency of utilization and water loss along the channel.

Based on the calculation of efficiency in 25 tertiary channels of Mataram. there are 9 channels where water utilization is greater than the need for water. so there is water loss that occurs in the channel. Water use causes loss in the channel for other factors or a water leak (losses). This is indicated by the water given to the channel being more significant than the amount of water demand that should be so that the percentage of water use in this channel is more than 100%.

Different conditions are obtained from the other 16 channels. where the water utilization is smaller than the water requirement. so there is excess water in the channel. This incident occurs because the irrigation service area has undergone changes in land function (not intended as agricultural or fishery land) or many lands do not need water. This causes the water discharge downstream to be greater than the discharge given because there is additional discharge from other sources. so the percentage of water use is below 100%.

4.2 Suggestion

It is necessary to calculate and re-check in the field so that the data obtained is more accurate. both for the area of fishponds and rice fields. The measurement of the Mataram irrigation network can be carried out thoroughly on primary. secondary. and tertiary channels.

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