ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

Available online at
https://jurnalteknik.unisla.ac.id/index.php/CVL
https://doi.org/10.30736/cvl.v2i2

Evaluation of Irrigation Water Availability and Demand in Blang Rongka, Bener Meriah District

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A R T I C L E I N F O

Article History :
Article entry : 2022-10-21
Article revised : 2023-01-03
Article received : 2023-02-22

Keywords :
Discharge, Effectiveness, Efficiency, Irrigation Network Scheme, Rice Field

IEEE Style in citing this article :
A. Rahmat, C. Azizah and M. Fahmi, "Evaluation of Irrigation Water Availability and Demand In Blang Rongka, Bener Meriah District," CIVILA, vol. 8, no. 1, pp. 1-6, 2023.

A B S T R A C T

Evaluating the availability of irrigation water is a paramount phase in planning and managing an irrigation network system. This research aimed to calculate the availability and demand of irrigation water in the area of Blang Rongka, Timang Gajah Subdistrict, Bener Meriah District. Blang Rongka irrigation waters 81 hectares of rice fields from the Peusangan watershed. There are 408 households in Blang Rongka Village, with an estimated population of 1.418 people, consisting of 743 men and 675 women, with 43% of the population working as farmers. The data used in this research were primary and secondary. Preliminary data includes flow velocity, channel dimension, and a set of questionnaires. Secondary data includes irrigation network schemes, topography, demographics, and climate data. In addition, we also measure water discharge using the buoy method (manual) by finding the cross-sectional area and flow velocity. This research showed that the average value of water availability is compatible with the cropping pattern (paddy – *palawija* – paddy). The level of farmers' satisfaction with irrigation was 80% while the level of water adequacy was 85%. The results have proven that the current irrigation is highly beneficial for farmers.

1. Introduction

Blang Rongka irrigation has a total extent of 81 ha, located in Timang Gajah Subdistrict, Bener Meriah District. Blang Rongka irrigation is the source of the Peusangan watershed [1,2]. The most common concern in the irrigation area is the inability to water agricultural land, leading to insufficient irrigation water for the Blang Rongka agricultural area.

ISSN (*Online*) 2620-7222
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The decreasing amount of irrigation water was due to declining water discharge during the dry season and loss of water from evaporation [3,4]. According to [5,6], water deficiency will result in uneven and un-optimum water distribution [7], thus resulting in lower yield. A broken irrigation network also reduces irrigation's effectivity [8,9] since it results in water loss in the water supply [10,11]. All the problems happened in D.I Blang Rongka; thus, availability, needs, efficiency, and irrigation effectivity must be evaluated.

This study aimed to evaluate water availability and demand in Blang Rongka irrigation and determine the irrigation network's efficiency and effectiveness in fulfilling the water needs for agriculture. The research significance of the study is to evaluate water availability and demand in Blang Rongka irrigation to assess farmers' satisfaction levels.

2. Research Method

2.1 Research Location

The study was conducted at Timang Gajah Sub District, Bener Meriah Regency, Aceh Province (Figure 1). Lut Tawar Lake is upstream of the Peusangan watershed. D.I Blang Rongka was built in 2016 by the Irrigation Service of Bener Meriah Regency.

Source: Google Earth (2019).

Figure 1. Research Location

2.2 Data collection

Data is the primary information needed to accomplish the research objective. This study uses primary and secondary data. Primary data is directly delivered to the one who collects it. Primary data is obtained from interviewing the research subject [12]. In contrast, secondary data is considered processed primary data for further analysis and is presented either by the data collector or other parties in tables or graphs [13].

Primary data gathered for the analysis comprises average stream velocity, measured using research tools, such as cork, tape measure, stop-watch, and log [14]. To gain information on water discharge, we measure the extent of the surface area and its water velocity [15]. Afterward, for the channel dimension, we estimate the channel depth and width [16] and gather some information directly from the farmers who frequently use irrigation water.

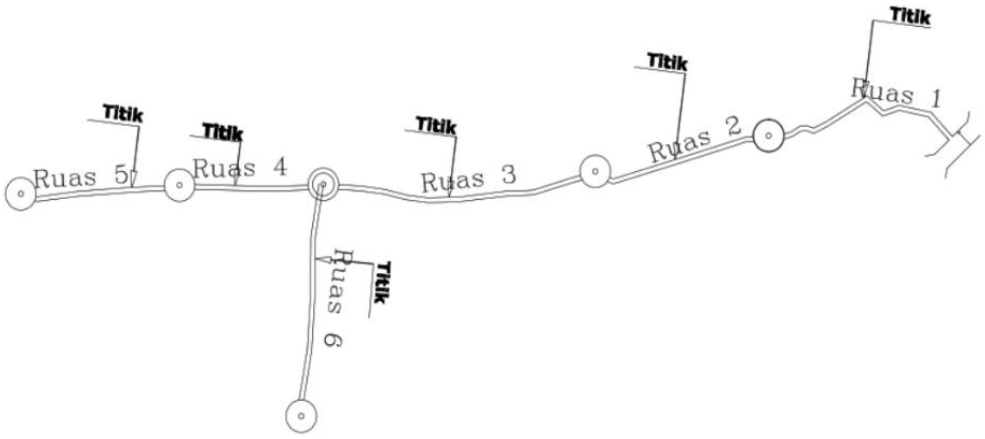
In addition, we also gather secondary of, which comprises the irrigation network scheme from the Ministry of Public Work and Housing (PUPR) Bener Meriah District, topography data from Google, population data and land area from the Blang Rongka Village Administration, and climate data from the District Profil of the Bener Meriah document.

3. Description and Technical

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

Primary data analysis, according to [16], comprises (1) Discharge flow measurement, obtained from the multiplication of surface area with average water velocity; (2) Water velocity measurement, obtained by dividing distance with time; (3) Channel surface area measurement, obtained from the multiplication of channel width and surface water level.

Secondary data analysis comprises (1) Irrigation network scheme to determine the six points of the channel segment to be observed; (2) Topography data to identify territorial boundaries bordering the village of Blang Rongka; (3) Climate data to discover temperature and humidity information of the Blang Rongka Village; (4) Population data to determine the amount of the household and occupation of the Blang Rongka communities.



Source: Blang Rongka irrigation network scheme (2022).

Figure 2. Network carrier channel of D.I. Blang Rongka. Data collection was conducted on each channel section.

4. Results and Discussions

4.1 Climate

The 2018 statistical data revealed the surface temperature of the Blang Rongka ranged from 20°C to 23°C. On average, the lowest temperature recorded in January amounted to 20 °C, while the highest was in July, reaching 23,55°C. Air humidity in the area ranged from 77% to 91%. March and April are the two months with the highest humidity level, 91,5%. Annual rainfall is 2300 mm/year with an equatorial rain pattern. The peak of the rainy season happened on April and November [17,18].

4.2 Topography

The altitude of the Blang Rongka Village reaches 355 – 826 m asl. The village was on a close border to Setie Village and Pantan Lues Village on the east side, Panta Kemuning Village and Meriah Jaya Village on the west side, Timang Gajah Village and Setie Village on the north side, and Simpang Layang Village and Sumber Jaya Village in the south side.

4.3 Demography

Blang Rongka Village has a total area of 513 ha out of the 100,41 km² area of Timang Gajah Subdistrict. The population in Blang Rongka Village is 1.418 people from 408 households with varied occupation types. Most of the community worked as farmers, approximated to be 43% of the total population (622 persons), comprising 58% male and 42% female [19,20].

4.4 Irrigation water availability

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Referring to the results obtained in this study, water availability for Blang Rongka irrigation is sufficient for agriculture, the community in the area, and religious sites. Recorded data from the six-channel segments showed that the average value for water discharge is 0,174 m^3/s.

Table 1. Results for Irrigation Water Discharge Measurement

Measurement point (sampling segment)	Number of points	V (m/s)	A (m^2)	Q (m^3/s)	Q (L/s)
RS 1	1	0,558	0,530	0,296	295,92
RS 2	1	0,613	0,461	0,283	282,67
RS 3	1	1,418	0,105	0,149	148,94
RS 4	1	1,887	0,068	0,129	128,77
RS 5	1	1,385	0,070	0,097	96,95
RS 6	1	0,820	0,117	0,096	95,902
Average					**174,86**

Source: Calculation result of Blang Rongka Irrigation Channel (2022).

As shown in the table above, the first measurement point (RS 1) has the highest water discharge, which amounted to 0,296 m^3/s, while the lowest was found in the sixth measurement point (RS 6), which amounted to 0,096 m^3/s. The results suggested that water irrigation for Blang Rongka irrigation is under the surplus state; hence, it has the potential to be utilized for other activities (e.g., fisheries, hydroponic, hydroelectric building, etc.).

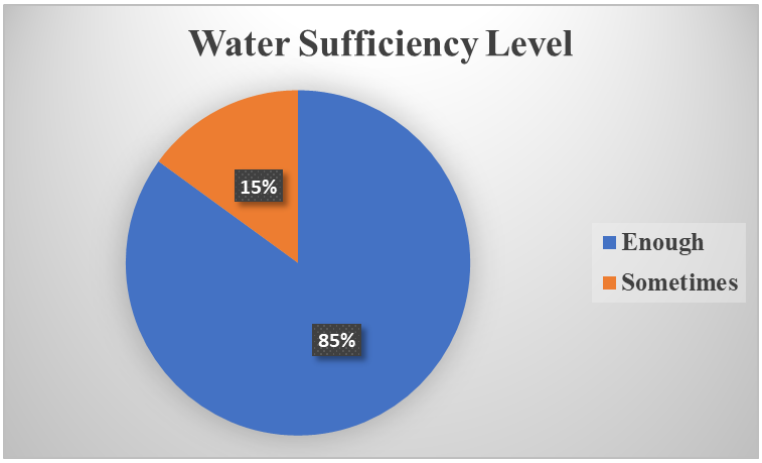
Source: research documentation (2022).
Figure 5. Sampling Segment One

4.5 Irrigation water demand

Water irrigation demand in the Blang Rongka irrigation area was obtained from a questionnaire given to twenty farmers in the study area. The result has shown that the irrigation system is sufficient for the current demand. Farmers have stated their satisfaction with the Blang Rongka irrigation amounted to 80%, while the level of water sufficiency was around 85%. The water irrigation needs to be satisfied for the cropping pattern of paddy – *palawija* – paddy. Farmers usually start their planting activity in January, May, and August. During our study

ISSN (*Online*) 2620-7222
ISSN (*Print*) 2503-2399

period, paddy fields in Blang Rongka were planted with *palawija*, a combination of corn, long beans, ground beans, and onions.



Source: Result of calculation of farmer's satisfaction level

Figure 7. Water sufficiency level according to farmer's perception at D.I Blang Rongka

5. Conclusions and Suggestions

5.1 Conclusions

As delivered in the results and discussion section, we conclude (1) As part of the performance evaluation of Blang Rongka irrigation, of which we observed under six channel segments, the average water discharge is 0,174,86 m3/s and is sufficient for agricultural purposes (2) Farmers satisfaction level to the Blang Rongka irrigation is 80%, with 85% for the water sufficiency level. Therefore, the water demand in Blang Rongka Village was sufficient.

5.1 Suggestions

Further study is needed to cover the information during the rainy season, including the water discharge in the rainy season. We also suggest using better equipment to measure water current that can provide higher accuracy.

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