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THE ANALYSIS OF PLANTING PROCEDURES IN KATIGA IRRIGATION AREA, CIGANDAMEKAR DISTRICT, KUNINGAN REGENCY

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ABSTRACT
Water Resources Management involves planning, implementing, monitoring, and evaluating the conservation, utilization, and damage control of water resources. Various issues can arise from an insufficient irrigation water supply, particularly during the dry season. Therefore, assessing plant water requirements, irrigation water availability, and planting patterns is crucial. The Katiga irrigation area, covering 1,010 hectares, is actively used for rice cultivation. During the rainy season, the main crops grown by farmers are rice and secondary crops across three growing seasons. This research calculates water availability by determining the 80% discharge (Q80). The results indicate that the available water for the Katiga irrigation area, located in Cigandamekar Sub-District, Kuningan Regency, ranges from 201.20 l/sec to 1,137.55 l/sec, with the highest water requirement being 956.29 l/sec. The recommended planting pattern is 83% rice and 17% secondary crops for the first growing season, 66% rice and 34% secondary crops for the second growing season, and 29% rice and 17% secondary crops for the third growing season, with the additional division of the field into three groups.

Keywords: irrigation, planting patterns, water availability, water needs

INTRODUCTION

Effective water resource management is critical for planning and managing irrigation to achieve sustainable food security (Li et al., 2020). Moreover, utilizing limited irrigation water in a specific irrigation area to achieve good crop yields makes meeting irrigation water needs essential by scheduling water delivery to crops and selecting appropriate plant types. As a result, optimizing irrigation water allocation is particularly important, especially in dry regions (Kourgialas et al., 2019).

The goals of water resources management include conserving natural resources, utilizing them efficiently, and mitigating water-related damage, as outlined in Paragraph 1, Article 8 of Law Number 17 of 2019: “Water resource management is the process of planning, implementing, monitoring, and evaluating the conservation, utilization, and control of water resources.” To optimize the use of natural resources in each river basin (DAS), a natural resource allocation plan—commonly known as a global and detailed water allocation plan (RAAG/RAAD)—must be developed. This plan should consider water availability during rainy and dry seasons, as stipulated in Government Regulation 42/2008 on Natural Resources Management (Hernawati et al., 2022).

The Katiga irrigation area covers a relatively large expanse of 1,010 hectares with active rice fields. Farmers primarily plant rice and secondary crops over three growing seasons during the rainy season. However, due to water shortages during the third growing season, portions of the agricultural land are often left uncultivated, as the available water is insufficient to meet the needs of the entire area. The Katiga Irrigation Area relies primarily on the Cibulan River in Manis Kidul Village, Jalaksana District, Kuningan Regency. Over time, significant land development has occurred, including the opening of new land and changes in land use. The irrigation canals, built initially to distribute water based on past requirements, must now adapt to these new conditions. This study aims to calculate the irrigation water needs for rice, secondary crops, and sugarcane (Kang et al., 2017; Musthofa & Zainul Ikhwan, 2022).

As regulated in the Regulation of the Minister of Public Works No. 08/PRT/M/2015 regarding determining irrigation network boundaries, Article 4, Paragraph 1 specifies that these boundaries encompass the edges of irrigation canals (Astriani, 2016, 2018). These include supply or connecting channels, primary and secondary channels, drainage channels, and/or the borders of irrigation structures. Meanwhile, Article 5, Paragraph 1 states that in determining the boundaries of irrigation canals, factors such as the height of the embankment, channel depth, and/or the use of embankments must be considered. Additionally, Article 5, Paragraph 2 states that the boundaries of irrigation canals, as referred to in Paragraph 1, include boundaries of canals without embankments, embanked canals, and canals located on slopes or cliffs (Arif et al., 2024; Arifah et al., 2022; Laban et al., 2015; Ma'Mun et al., 2021; Tanjung et al., 2024).

Given the issues outlined above, this research seeks to assess the availability of irrigation water in the Katiga Irrigation Area (DI), analyze the water requirements for irrigation, and identify the most suitable planting pattern. The objective is to address the imbalance between food demand and water availability. The resulting planting pattern for the Katiga Irrigation Area is intended to serve as a valuable reference for relevant agencies and organizations while also offering guidance to farmers in the region (Moehansyah et al., 2004; Sumarga et al., 2024; van Rotterdam-Los et al., 2008; Wu et al., 2023).

Effective management of water resources is critical for planning and managing irrigation to achieve sustainable food security. This study addresses the issue of insufficient irrigation water supply, particularly during the dry season, which significantly impacts agricultural productivity. The novelty of this research lies in its comprehensive assessment of water availability and its direct correlation to optimal planting patterns in the Katiga irrigation area. By calculating the 80% dependable discharge (Q80), this study provides new insights into irrigation management that can enhance crop yields and sustainability (Ding et al., 2024; Distanont et al., 2018; Xie et al., 2018).

Water resource management goals include conserving natural resources, efficiently using them and mitigating water-related damage. As Article 8 of Law Number 17 of 2019 outlines, effective management requires a well-structured allocation plan that considers seasonal variations in water availability. Previous studies have highlighted the importance of optimizing irrigation water allocation, particularly in dry regions. However, many have not critically evaluated the specific planting patterns that best utilize available water resources.

While existing literature provides a foundation for understanding water resource management and irrigation optimization, gaps remain in critically evaluating these strategies and their implementation in specific contexts. This study aims to fill these gaps by assessing water availability and recommending strategic planting patterns based on empirical data.

The Katiga irrigation area, covering 1,010 hectares primarily for rice cultivation, is ideal for this research. Given the variability in water supply and the historical challenges of water shortages during the third growing season, this study seeks to provide actionable recommendations for farmers and relevant authorities. The findings aim to establish a framework for more effective irrigation practices that align with modern agricultural needs.

METHOD

This research is located in Sangkanmulya Village, Cigandamekar District, Kuningan Regency. It consists of three stages: data collection in the field, data processing, and data analysis. Data was collected in the field at the Katiga irrigation spring in Sangkanmulya Village, Cigandamekar District, Kuningan Regency.

This research employs a development-oriented approach, focusing on developing irrigation networks. The data required for this research includes both primary data, such as field surveys of the leading and secondary irrigation networks, and secondary data obtained through literature reviews, interviews with farmers, and consultations with officials from Sangkanmulya Village and Cigandamekar District, Kuningan Regency. The required data for this research includes:

This study utilizes primary and secondary data to analyze planting patterns in the Katiga Irrigation Area, Sangkanmulya Village, Cigandamekar Subdistrict, Kuningan Regency. The primary data include topographic maps, a situational map, the location of water sources, the planting pattern system, and the area size. In contrast, secondary data includes rainfall data and the existing irrigation network scheme. The research focuses on variables such as land area (A) in hectares, available discharge (Qn) in m^3/sec, average rainfall (Ch) in mm/day, land preparation time (T) in days, and flow speed (V) in m/sec. The analytical method employs Microsoft Excel to evaluate the data and determine the results. This approach is designed to comprehensively analyze planting patterns and optimize water utilization based on discharge, offering insights for sustainable irrigation management.

The data required for this study includes both primary and secondary data. Primary data is collected through field surveys, which include topographic maps, situational maps, locations of water sources, and information on planting patterns and area sizes. Secondary data is obtained from literature reviews, interviews with farmers, and consultations with local officials. The study uses Microsoft Excel to process and evaluate the collected data for data analysis. This analysis aims to determine irrigation water needs and optimize planting patterns based on available discharge, ultimately providing insights for effective water management in the Katiga Irrigation Area.

RESULTS AND DISCUSSION

Water Availability

Water availability is calculated by determining the central discharge from discharge data at the weir gate over the past 10 years and processing it into semi-monthly data. The semi-monthly discharge data is arranged in descending order, and the probability for each data point is calculated according to its rank. The analyzed 80% dependable discharge (Q80) is presented in Table 1 below.

Table 1. 80% Reliable Debit

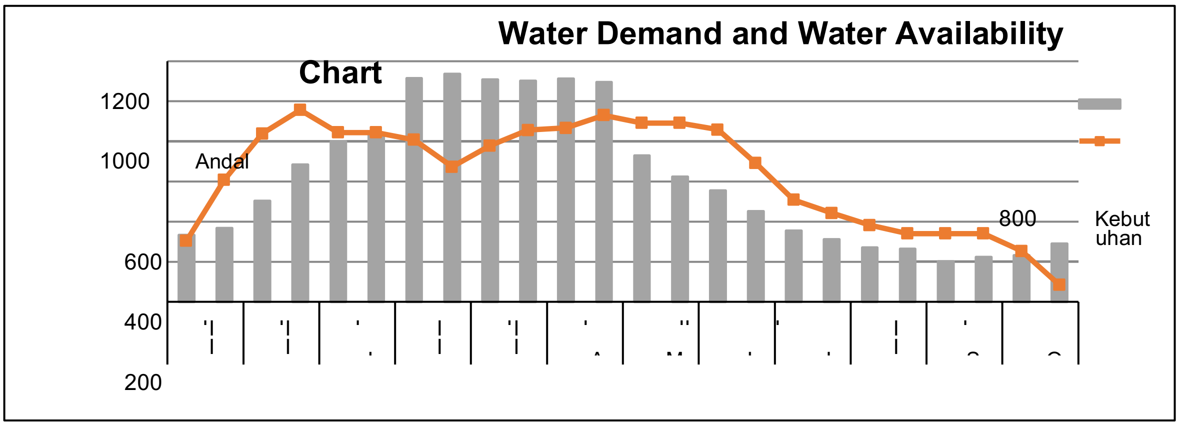
Month	Reliable Q	Month	Reliable Q
Jan I	800.88 l/sec	Jul I	355.40 l/sec
Jan II	837.40 l/sec	Jul II	311.20 l/sec
Feb I	1114.15 l/sec	Ags I	270.85 l/sec
Feb II	1137.55 l/sec	Ags II	264.33 l/sec
Mar I	1108.99 l/sec	Sep I	201.20 l/sec
Mar II	1101.75 l/sec	Sep II	223.80 l/sec
Apr I	1112.19 l/sec	Oct I	230.60 l/sec
Apr II	1094.75 l/sec	Oct II	289.64 l/sec
May I	728.60 l/sec	Nov I	332.40 l/sec
May II	624.80 l/sec	Nov II	366.40 l/sec
Jun I	555.80 l/sec	Dec I	503.84 l/sec
Jun II	451.60 l/sec	Dec II	684.80 l/sec

1. Effective Rainfall

Adequate rainfall refers to the amount of total rainfall that reaches the ground in a specific area and is available for use by plants in their growth process. The calculations for adequate rainfall are derived from rainfall data collected over a 10-year observation period.

2. Irrigation Water Requirements

Irrigation water requirements are influenced by several factors, including land preparation water requirements, changes in water layers, percolation, plant factors (such as plant type, growth phase, and planting area), and climate factors (such as rainfall and potential evapotranspiration). Irrigation water requirements are calculated for each group over 15 days, allowing for detailed knowledge of irrigation needs for each growth phase. Figure 1 illustrates a graph outlining the irrigation water requirements and the corresponding water availability for each period throughout the year. This analysis is based on the planned cropping pattern, highlighting the seasonal water needs and supply variations. The graph shows how irrigation demands fluctuate with different cropping stages, providing valuable insights for effective water management practices.



Graphic 1.
Water Demand and Water Availability

3. Potential Evapotranspiration

Potential evapotranspiration values are determined using climate data collected from 2013 to 2023 at the Climatology Station. The climate variables considered in this analysis include minimum temperature, maximum temperature, average humidity, average wind speed, and the monthly average duration of sunlight. The results of the potential evapotranspiration calculations are presented in Table 2.

Table 2. Potential Evapotranspiration

Month	Reliable Q	Bulan	Reliable Q
Jan	4.2 l/sec	Jul	3.9 l/sec
Feb	3.9 l/sec	Ags	5.0 l/sec
Mar	3.9 l/sec	Sep	6.1 l/sec
Apr	3.6 l/sec	Oct	6.0 l/sec
May	3.6 l/sec	Nov	5.0 l/sec
Jun	3.4 l/sec	Dec	4.3 l/sec

4. Water Balance

Water balance is a method to analyze the equilibrium between the water entering and leaving a system. Figure 2 shows the results of the irrigation water balance calculations based on the planned planting pattern. The water balance assessments under current conditions reveal specific months—especially during the dry season—when a water deficit occurs. This indicates that the water availability at the weir is inadequate to satisfy the irrigation demands for rice fields.

CONCLUSION

This study's findings highlight the necessity of effective water management practices in the Katiga Irrigation Area. However, it is important to note that the conclusions drawn regarding water availability and planting patterns lack sufficient empirical data to support them fully. Future research should focus on gathering comprehensive data to validate the results and recommendations made in this study. By enhancing the reliability of the data, the proposed planting patterns can be more accurately aligned with the actual water availability, thereby contributing to more sustainable irrigation practices.

To address the issue of water shortages, it is essential to simulate and optimize the reliability of the water supply by adjusting various parameters, including the number of groups, planting schedules, planting patterns, and the size of the planting area. The recommended planting pattern includes 83% rice and 17% secondary crops for the first planting season, 66% rice and 34% secondary crops for the second planting season, and 29% rice and 17% secondary crops for the third planting season, with group division extended to 3 groups. The planting schedule with 100% reliability is as follows: the first planting season starts on November 1, the second planting season starts on March 1, and the third planting season starts on July 2. This approach aims to enhance the effectiveness and efficiency of irrigation management and services, contributing to the modernization of irrigation systems.

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