



Proceeding Paper

Utilization of a Telemetry Monitoring System for the Dynamics of Water Quantity and Quality in the Dadahup Swamp Irrigation Area [†]

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Abstract: One of the technological developments supporting irrigation modernization is the installation of telemetry monitoring systems that are built based on three main elements of sensors, internet connections, and data centers. The Dadahup Swamp Irrigation Area is one of the development areas that has been supported by the installation of a telemetry monitoring system at three points located on the upstream and midstream sides of the irrigation area. The water management system of the Dadahup Swamp Irrigation Area has not been working optimally in regulating the water level, which has resulted in the irrigated land not receiving good water quality for rice plant growth. The research objective is to describe the condition of the water quantity and quality profile based on the telemetry monitoring system. The research method was carried out by observing the water level elevation, rainfall, and pH, during the rainy and dry seasons in the upstream, midstream, and downstream parts. The results showed that the dynamics of the water quantity greatly affected the water quality in both the rainy and dry seasons.

Keywords: telemetry monitoring system; water quantity; water quality; Dadahup



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1. Introduction

The food estate development program is one of the Government's efforts to anticipate a food crisis due to the significant increase in population in recent years [1]. One of the efforts to develop food land into agricultural cultivation is the rehabilitation and improvement of the Dadahup Swamp Irrigation Area network with a potential area of ±21,226 thousand ha in Kapuas Regency, Central Kalimantan Province [2].

Due to the extreme seasonal changes, the Dadahup Swamp Irrigation Area is often flooded, resulting in crop failure [3]. The condition of the channel network system and the irrigation buildings that are not functioning optimally along with the broken and collapsed embankments around the irrigation area has resulted in the conversion of the area into shrubland [4].

The development of technology that supports the polder water system is the installation of the internet of things (IOT) which consists of sensors, internet connections, and data centers [5]. The installation of a telemetry monitoring system in the Dadahup Swamp Irrigation Area aims to observe changes in the water quantity and quality in the upstream and midstream of the main primary channel in order to optimize the operation and maintenance of the irrigation networks and buildings [6].

2. Material and Methods

2.1. Study Area

The research site is located in the Dadahup Swamp Irrigation Area of Kapuas Regency, Central Kalimantan Province, which is traversed by the Barito, Kapuas Murung, and

Mengkatip Rivers. The tertiary blocks of the Dadahup Swamp Irrigation Area are divided into seventeen tertiary blocks dominated by shrubs, shown in Figure 1.

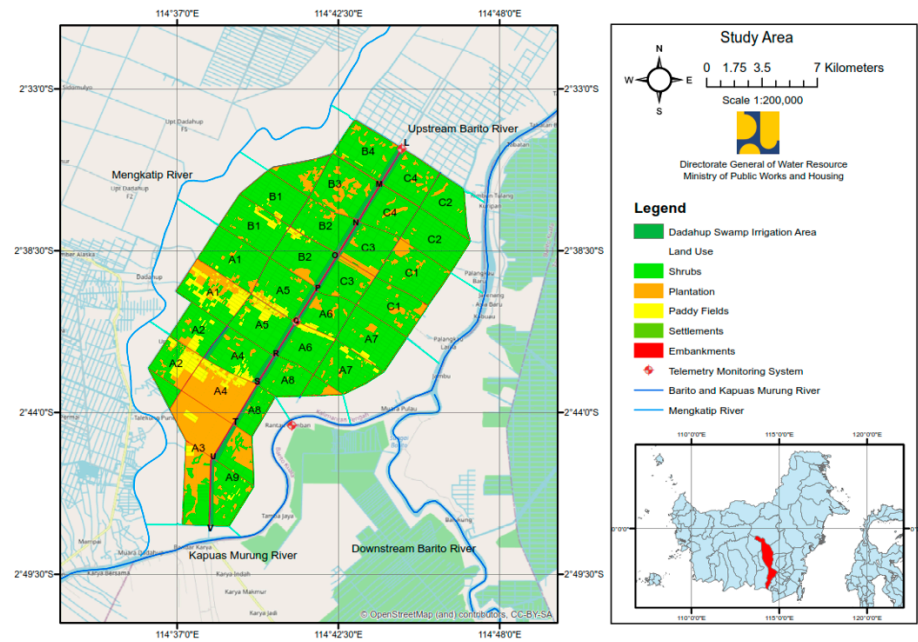


Figure 1. Study Area.

2.2. Methods

The research was conducted at point locations L and Q by collecting data on the water level, rainfall, and pH, which were obtained by direct observation through the telemetry monitoring system shown in Figure 2.

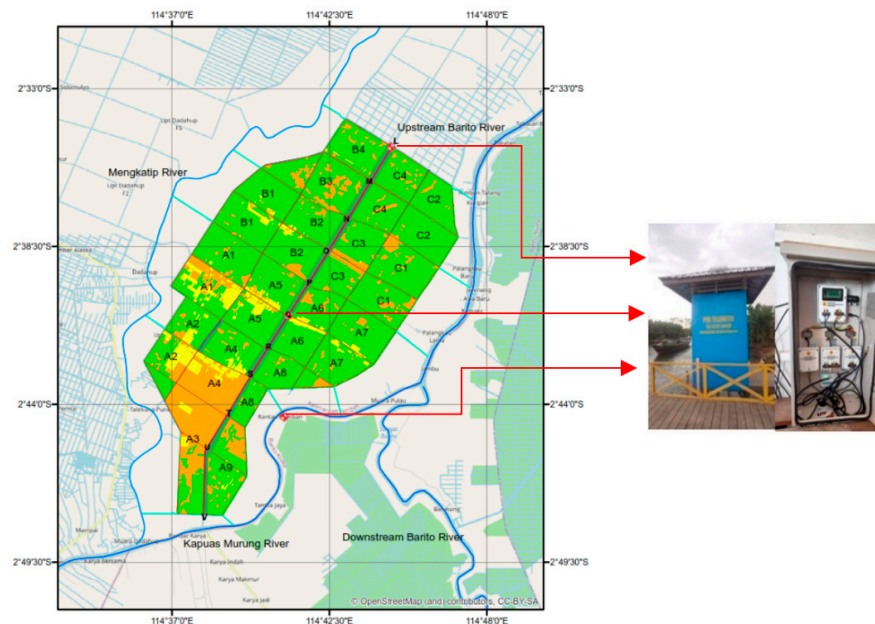
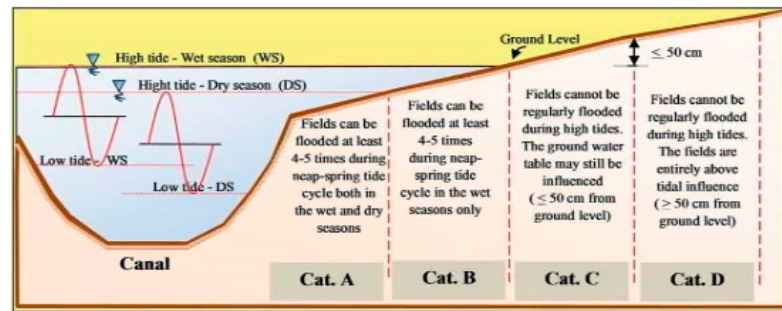


Figure 2. The Dadahup Swamp Irrigation Monitoring Telemetry System.

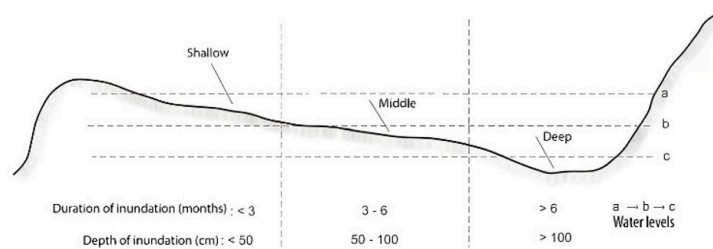
2.3. Characteristics of the Dadahup Swamp Irrigation Area

Hydro-topography is the relationship between the water table elevation and land elevation, which is a factor in determining the classification type of the swamp irrigation areas, as shown in Figure 3 [7]. The Dadahup Swamp Irrigation Area falls into categories C

and D, where the tidal water level never inundates the land elevation; so, the main source of water is rainfall, which is included in the nontidal swamp category shown in Figure 4 [8]. The characteristics of the soil, which is dominated by pyrite peat soil, can reduce the water quality and have a negative impact on rice growth [9]. The polder water system is one of the solutions for the development of the Dadahup Swamp Irrigation Area by utilizing rainfall as a water source by isolating the land, which is regulated through the operation of gate buildings in the north, east, west, and south [10].



(a)



(b)

Figure 3. (a) Tidal Swamp Hydro-topography and (b) Nontidal Swamp Hydro-topography.

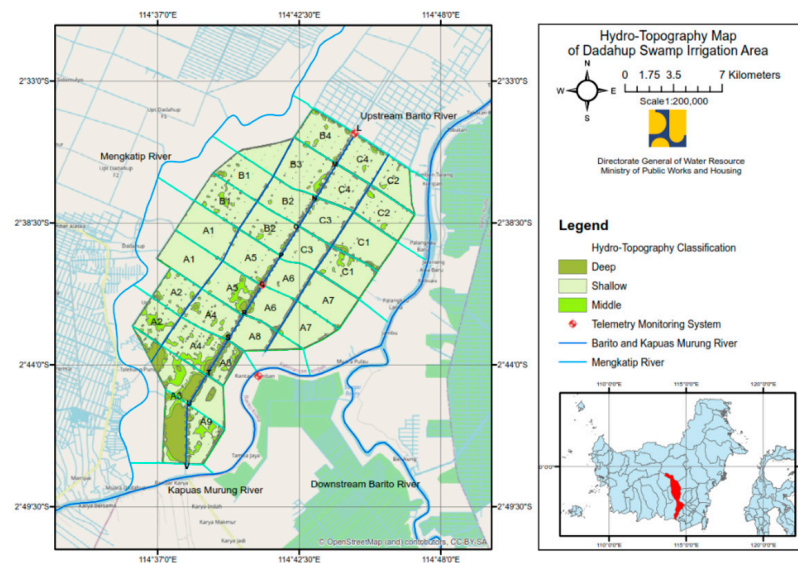


Figure 4. Hydro-topography Map of the Dadahup Swamp Irrigation Area.

2.4. Water Quantity and Quality

The tidal influence of the estuary and the upstream discharge of the Barito River can affect the water level at the intake channel of the Dadahup Swamp Irrigation Area

with a distance of up to 158 km to the upstream of the river [11]. The Dadahup Irrigation Area is included in the wet category of climate types B and E, where the rainy season occurs from May to October, and the dry season occurs from November to April. The swamp soil characteristics are influenced by the presence of pyrite formed from marine deposits containing organic matter and sulfate-reducing bacteria. The oxidation of pyrite can cause high acidity, which produces sulfuric acid and jarosite minerals that reduce the pH concentration and interfere with plant growth [12].

3. Results and Discussion

3.1. Water Quantity Dynamics Profile

The dynamics of the water quantity illustrate the profile of the relationship between the rainfall and water level during the dry and wet seasons at points L and Q in the main primary channel shown in Figures 5 and 6.

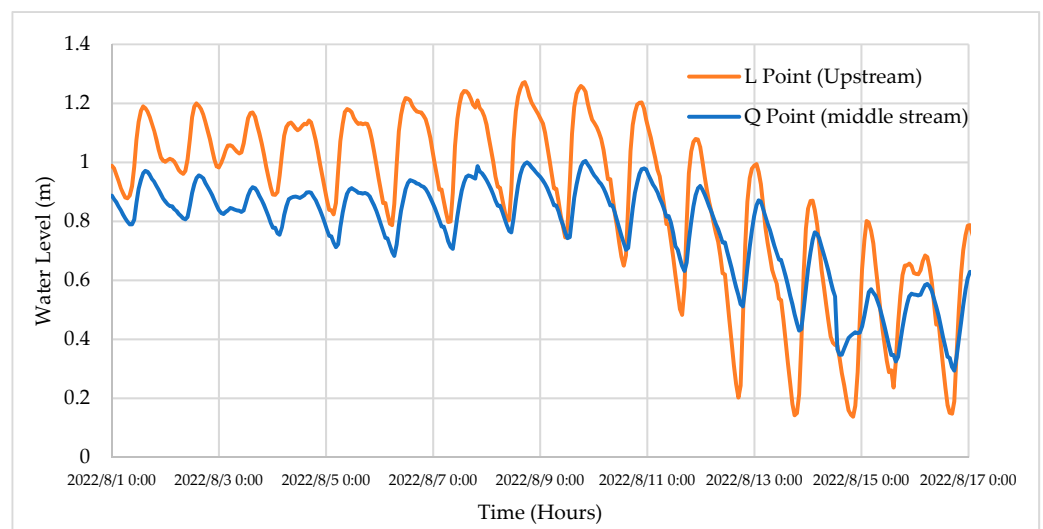


Figure 5. Water Level Dynamics Profile in the Dry Season in the Upper and Middle Sections of the Dadahup Swamp Irrigation Area.

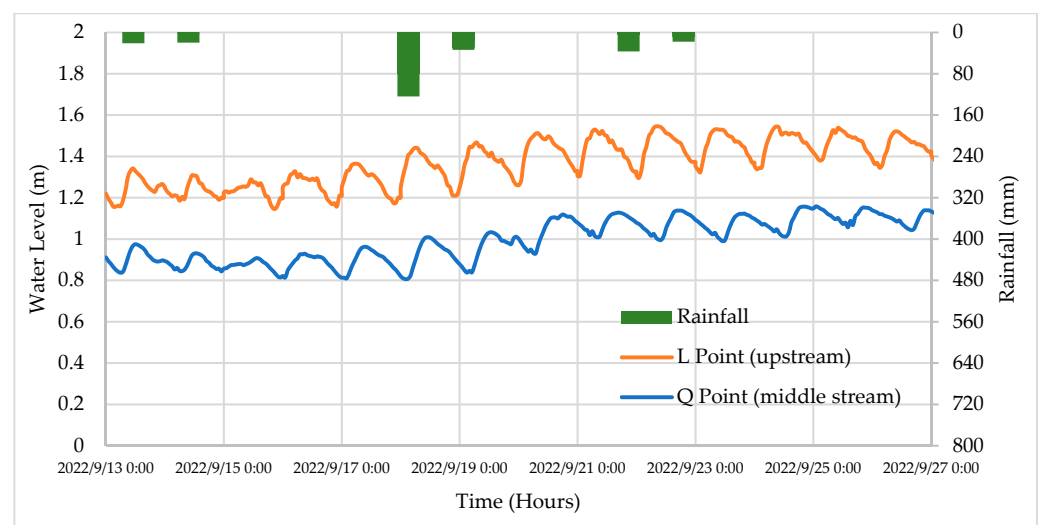


Figure 6. Water Level Dynamics Profile in the Rainy Season in the Upper and Middle Sections of the Dadahup Swamp Irrigation Area.

Based on the results of the description of the dynamic profile of the water level at points L and Q for the dry season and the rainy season, there was a change in the water

level elevation influenced by the rainfall with an average increase of 0.3 m, which is shown in Table 1.

Table 1. Changes in the Water Level during the Dry and Rainy Seasons at Points L and Q.

No	Point	Season	Water Level (m)
1	L	Dry	1.2
2	Q		0.9
3	L	Rainy	1.5
4	Q		1.2

3.2. Water Quality Dynamics Profile

The water quality dynamics illustrate the relationship profile of the pH during the dry and wet seasons. The results of the water quality dynamics profile at point L upstream and point Q midstream of the Dadahup Swamp Irrigation Area during the dry and wet seasons are shown in Figures 7 and 8.

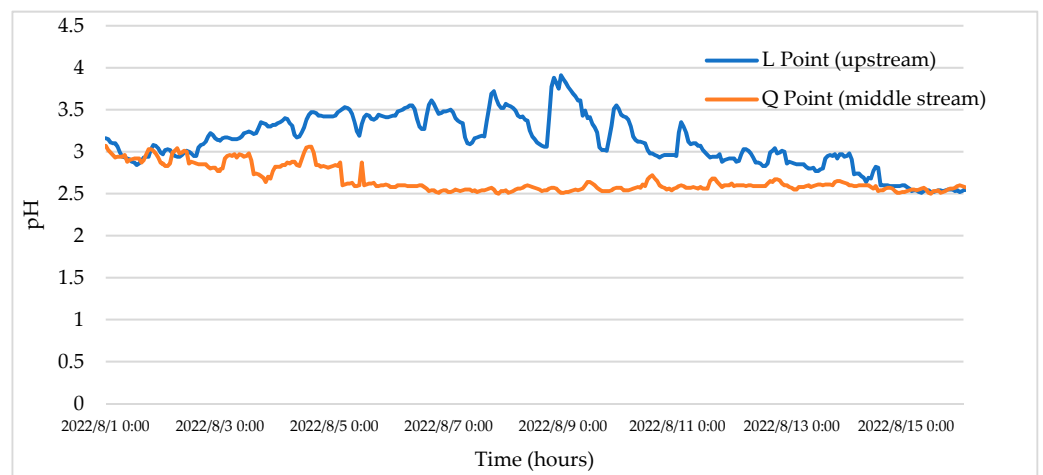


Figure 7. Water Quality Dynamics Profile in the Dry Season in the Upper and Middle Sections of the Dadahup Swamp Irrigation Area.

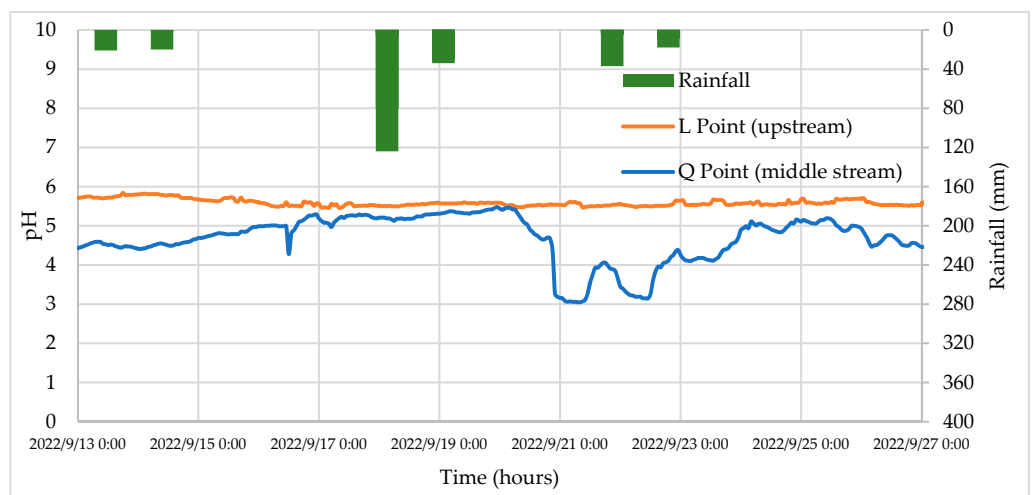


Figure 8. Water Quality Dynamics Profile in the Rainy Season in the Upper and Middle Sections of the Dadahup Swamp Irrigation Area.

Based on the results of the description of the dynamic profile of the water quality, there was a change in the pH value influenced by the rainfall with an average increase reaching level 3, which is shown in Table 2.

Table 2. Changes in the pH Values during the Dry and Rainy Seasons in the Upper and Middle Sections of the Dadahup Irrigation Area.

No	Point	Season	pH
1	L	Dry	3.91
2	Q		3.07
3	L	Rainy	5.84
4	Q		5.48

4. Conclusions

The results explained that the pH value and water level elevation increased as a result of the rainfall and became the basis for optimizing the operation and maintenance of the Dadahup Irrigation network by utilizing a telemetry monitoring system.

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