International Journal on Food, Agriculture, and Natural Resources
Volume 02, Issue 01, Page 31-34
ISSN: 2722-4066
http://www.fanres.org

Original Paper

The Analysis of Water Quality Compliance of Jompo River Irrigation in Jember Regency

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Received: 1 March 2021; Accepted: 16 April 2021
DOI: https://doi.org/10.46676/ij-fanres.v2i1.24

***Abstract* — Jompo river is one of many tributaries in Jember regency has become one of water sources for residents nearby to meet their daily needs. People activities may lead to the emergence of pollution in Jompo river in long term. The measurement needs to determine water quality of the river. The research site ranged from Patrang to Kaliwates district with six nodes and covered a distance of 625 m. Based on the data analysis, average value of water quality in the river was characterized by 67 mg/l TSS (Total Suspended Solids), 72 mg/l TDS, pH at 6.73, 8.34 mg/l DO, 1.20 mg/l BOD, and EC at 145 µmhos/cm. Based on Government Regulation No. 82 of 2001 and Electricity value, the water quality of Jompo river was included in Grade II criteria. Jompo River was appropriate to irrigation water.**

***Keywords*— Jompo River, appropriate, irrigation water**

I. INTRODUCTION

Bedadung River has several tributaries, one of which is Jompo river. Jompo river passes through Patrang, Sumbersari and Kaliwates districts. According to Jember regency Regional Regulation, Number 1 of 2015 concerning Regional Spatial Planning, from 2015 to 2035, the planned activity system in Patrang and Sumbersari districts will serve as urban system. This plan has an impact on the increasing number of people living in this area. Along with the increasing population and various community activities such as washing, bathing, and garbage disposal, the potential for contamination in Jompo river increases, and there is the quality of river water is assumed to sink in the future. This will affect the use of water to meet community needs both for consumption and as irrigation water.

The objectives of this study were twofold. First, it was projected to determine the water quality in Jompo river by delving into analysis parameters involving Total Suspended Solids (TSS), Total Dissolved Solids (TDS), pH, Biological Oxygen Demand (BOD), Dissolved Oxygen (DO). and Electrical Conductivity (EC). In addition, the study aimed to determine the suitability of the irrigation water quality of Jompo river.

In general, irrigation is defined as the initiative for providing water to meet demand for water to support plant growth. Irrigation work includes collecting and extracting water from its source, draining it through canals to agricultural land, and storing excess water into drains. The purpose of irrigation is to provide additional water (other than rainwater) and provide water for crops in sufficient quantities when needed. Irrigation in paddy fields is intended to saturate the soil in order to obtain a good mud structure for the growth of rice plants, meet crop water needs, support inundation, and replace water loss along canals or rivers [8].

Irrigation water sources must meet quality requirements so that they are not harmful to plants to be irrigated. Polluted water may affect the quality of agricultural production in the long run [1]. Irrigation water must also be assessed from its source. The source of irrigation needs to be fully understood to determine whether or not contamination has taken place. It is equally important to study the level of danger resulting from contamination.

Schwab and Flevert in [3] state that irrigation sources have to meet quality requirements. This is in consideration that water has to be safe for plants to be irrigated because in the long run it can affect the quality of agricultural production. Plants consist of 80 - 90% water, so the availability of quality water is extremely essential to support the success of cultivation [9]. Water quality can be determined from the substances contained in its source (wells or rivers), as well as its acidity [1]. One of the water quality parameters that affect irrigation water is Electrical Conductivity.

Electrical Conductivity is one of the parameters measured directly at the research site. EC is useful to identify the salinity or concentration of salts in water. The amount of concentration of salts in water can be seen from the EC value. The higher the EC value is, the higher the salinity content in the water becomes. The EC value of the five samples of springs is classified as moderate, which ranges from 500 to 700 µmhos/cm [1]. Water capacity to conduct electricity is influenced by the number of ions or salts dissolved in water. The more salt is dissolved, the higher the electrical

conductivity becomes. EC is an indirect measurement of salt concentration that can be used to determine the suitability of water for crop cultivation and to monitor nutrient solution concentrations. EC measurements can be used as reference to maintain target nutrient concentrations in the root zone which is an indicator for determining nutrient solution delivery to plants. The units of measurement for EC are millimhos per centimeter (µmhos/cm), millisiemens per centimeter (mS/cm), and microsiemens per centimeter [9]. Based on the EC value, the following classification of irrigation water is developed, as presented in the following table.

Table 1. Classification of Irrigation Water with Respect to EC

Water Grade	EC (µmhos/cm)	Description
I	0 – 250	Very Good
II	> 250 - 750	Good
III	> 750 - 2000	Fair
IV	> 2000 - 3000	Poor
V	> 3000	Very Poor

Source: Colorado State University in Fitriyah (2012)

II. MATERIALS AND METHOD

A. *Equipment and Materials*

The equipment used in this study was divided into two parts, including field equipment and laboratory equipment. The equipment used in the field involved digital cameras, current meters, meters, ropes, sample bottles, cool boxes, stopwatches, GPS, and thermometers. The equipment used in the laboratory included 250 ml Winkler bottles, 1000 ml erlenmeyers, 100 ml volumetric pipettes, 25 ml burettes, funnels, suction balls, syringes, pH meters, TDS meters, desiccators, analytical scales, ovens, and 0.45 µm filter paper .

The materials used in this study were water samples from Jompo river, distilled water, MnSO4, Alkali-iodide-azide, 0.1 N H2SO4, and 0.025 N thiosulfate.

B. *Research Procedure*

Survey and Determination of Research Site

The determination of research site and field survey aimed to study the area around the river. The determination of research site was extremely important to minimize the possible risks throughout the study. The location of each research site is presented in Table 2.

Table 2. Different Points of Research Site along Jompo River

Description		Village	District	Coordinate ^{0})
Segment I	Point 1	Gebang	Patrang	113.6967365
				-8.17052202
Segment II	Point 2	Jember Kidul	Kaliwates	113.6.940.339
				-8.17387556
Segment II	Point 3	Jember Kidul	Kaliwates	113.6907750
				-8.17654216
Segment IV	Point 4	Jember Kidul	Kaliwates	113.6887197
				-8.17974124
Segment V	Point 5	Sempusari	Kaliwates	113.6873929
				-8.18405044
	Point 6	Kaliwates	Kaliwates	113.6833410
				-8.18631035

Distance between Points

The total distance of the research site in Jompo river was 3.12 km, ranging from the starting point to the end point. The points were divided into 6 points along the research site with the same distance between points by considering the accessible location and easy access.

Sampling

The sampling was carried out at the research site, which represented diverse characteristics of waste and possible contamination associated with these characteristics. Sampling was carried out in each segment with a total of 3 sample bottles taken at the same time. Measurement of water quality in river water supply at each location was carried out in the laboratory with observation parameters focusing on pH, TDS, TSS, DO and BOD. The water samples were then put into a cool box with a temperature of 4o C, so that the temperature was maintained, preventing the impact on the oxygen content in the sample bottles. The water samples were analyzed for water quality in the laboratory.

Laboratory Testing

The assessment of water quality of Jompo river involved the following parameters:

1. pH test to determine water acidity level using pH meter
2. TDS test by using TDS meter
3. TSS test by employing the equation below:

$$\text{TSS (mg/l)} = \frac{a-b}{c} x\ 1000$$

4. DO test by employing the following equation

$$\text{OT} = \frac{a.N.8000}{V-4}$$

Where:
DO = dissolved oxygen (mg/I);
a = volume of natriumtiosulfat (ml);
N = normality of natriumtiosulfat (ek/I);
V = volume of Winkler bottle *(*ml).

5. BOD test using the following equation:

$$BOD_5\left(\frac{mg}{l}\right) = \frac{(X0 - X5) - (B0 - B5)(1 - P)}{P}$$

Where:
BOD_5 = Biological Oxygen Demand (mg/l)
X_0 = DO in sample at t = 0 (mg O_2/l)
X_5 = DO in sample at t = 5 (mg O_2/l)
B_0 = DO in sample at t = 0 (mg O_2/l)
B_5 = DO in sample at t = 5 (mg O_2/l)
P = Degree of dilution

Data Analysis

The data under analysis were obtained from the research sites and discharge measurements. Meanwhile,

laboratory data was obtained by measuring water quality parameters, namely dissolved solids (TSS), suspended solids (TDS), pH, DO and BOD.

III. RESULTS AND DISCUSSION

A. Water Quality of Jompo River

This research was conducted along Jompo river, starting from Patrang district to Kaliwates district, in Jember regency. Six research points were determined, with a distance of 3.12 km between points. The results of water quality test of Jompo river are presented in Table 3.

Table 4. Water Quality Test Results

No	Parameter	Unit	Government Regulation No. 82 of 2001				Average Water Quality of Jompo River
			I	II	III	IV	
1.	TSS	mg/l	50	50	400	400	67
2.	TDS	mg/l	1000	1000	1000	2000	72
3.	pH		6-9	6-9	6-9	5-9	6,73
4.	DO	mg/l	6	4	3	0	8,34
5.	BOD	mg/l	2	3	6	12	1,20
6	EC	*µmhos/cm*					145

Source: Government Regulation No. 82 Year 2001

Table 3 shows that the value of river water quality depends on its physical and chemical parameters. The physical and chemical parameters are elaborated in the following sections.

Physical Parameters

The analysis of physical parameters included TSS and TDS. TSS parameters were found to fall into Grade II. The TSS value is influenced by dense settlements at the observation site, thus allowing a large amount of domestic waste to enter the river. The overall results of the water quality parameter values tend to fall into Grade II, implying that the water can be used for recreational facilities and infrastructure to irrigate crops.

Chemical Parameters

Table 3 shows the analysis results related to chemical parameters germane to BOD, DO and pH. BOD concentration falls into Grade I. This indicates that the water can be used as the source of drinking water. However, based on field observations, the BOD value is found at Grade II, which corresponds to quality of water suitable for recreational facilities and infrastructure to irrigate plantations. The concentration of BOD can be affected by the amount of organic materials that come from domestic waste and other wastes [7]. In addition, the large number of public activities and garbage in the river can also increase the concentration of BOD.

At the observation points, DO concentration was higher than the minimum threshold requirement based on the Government Regulation of the Republic of Indonesia Number 82 of 2001. This indicates fine life of organisms in the water. A large discharge in a river can result in a high concentration of dissolved oxygen in river water.

pH is the degree of acidity that shows both acidic and alkaline conditions (Effendi, 2003). The pH value in Jompo river is still within the predetermined threshold for water quality standards. Most of the biota in the water are sensitive to changes in pH and can only sustain their life under pH values ranging from 7 to 8.5 (Effendi, 2003). The pH value of Jompo river water on average is 6.73, which falls into Grade II. This shows that the water quality of Jompo river can still support the life of aquatic biota.

Based on Government Regulation of the Republic of Indonesia No. 82 of 2001 concerning river water quality, the water quality of Jompo river falls into Grade II. This is because, according to the regulation, rivers or water bodies without prior assessment are considered to fall in Grade II. This grade corresponds to water suitable for recreation and infrastructure facilities. For example, water at Grade II can be used for freshwater fish farming, supporting livestock, and managing irrigation. In addition, the results obtained by the average EC parameter value of 145 µmhos/cm indicate that the water salinity l in Jompo river acknowledges fine source of irrigation water.

IV. CONCLUSION

The present study has conducted the water quality tests on TSS, TDS, pH, temperature, BOD, DO and EC in accordance with the Government Regulation of the Republic of Indonesia No.82 of 2001 concerning Water Quality Management and Water Pollution Control. The findings corroborate that the water quality of Jompo river falls into Grade II, with respect to water quality standard. As a corollary, the water is suitable as raw water for irrigation. This is strengthened by the average EC value of 145 µmhos/cm, indicating that the salinity level of Jompo river is within very good range as the source of irrigation water.

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