Water Resources Management and Its Correlation with the Availability of Clean Water in Malang

P D Putri, A D Pramasela, G F Fachrezi, Sueb*

Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Jl. Semarang 5 Malang 65145, Indonesia

*Corresponding author: sueb.fmipa@um.ac.id

Abstract. Despite its water resources potential, Indonesia is known for poorly managing its water resources. The purpose of the research was to know the correlation between human activities regarding water resources management and the availability of clean water in Malang City. The research method was quantitative analytical research using Spearmen correlation and n=100. The results showed that there was a positive relationship between water resource management and availability of clean water, which was statistically significant. We suggested for the people around Malang that they need to consider the amount of water they need to use so that the water would not be wasted and there needs to be a better sewage treatment for liquid waste in Malang City.

Keywords: Water resources management, the availability of clean water

1. Introduction

Water is an inseparable element from human life. Water is essential component of life; almost 60% of our body is created from water. Without water, human beings could survive only for a few days because water is an integral part of human metabolism and osmoregulation [1]. “Water” is every water that exists on the above or below the ground surface. While “Water Resources” is water and all its potentials including watering facilities and infrastructure [2]. Water available in two places, in the groundwater and surface water area, these two making fresh water available for a human to use [1].

Indonesia is a rich country with a vast, unique potential of hydro-meteorology. This potential cannot be separated from the distribution variety of water resource potentials in Indonesia itself. Generally, it can be said that the surface water potential determined by some factors, such as the condition of current river area and the kind of physical water resources; area and volume of its container (natural or human-made); climate effect; and the aspect of water resources management by human [2].

Water resources management can be defined as an effort to arrange, execute, screen, and assess the implementation of water assets, use of water resources, and control of water destructive power [2]. Despite its water resources potential, Indonesia is known for poorly managing its water resources. We waste and pollute it. Usually, the solid or liquid household or factory waste are discarded into the water system. In the urban area, it is estimated that 55-60% of its water system from the area consists of household waste [3]. This shows how poor we manage our water resources.
In some major cities in Indonesia, the average water consumption is reaching 80 gallons/capita each day far from the typical water consumption that goes from 50-65 gallons/capita each day, resulting in wasting a significant amount of water [3]. In the household activities, the main water waste mostly comes from the use of flushing down the toilet (25 gallons/capita each day) and from shower and bathing activities (12 gallons/capita each day) [3].

Malang is one of the major cities in Indonesia. Malang is a densely populated city which needs a parcel of water assets to be provided. It supplies water to 120,000 benefit associations measuring to roughly 600,000 individuals, which is around 70% of the city’s populace. Roughly 30% of the supply is pumped to eight capacity specifically for springs to the clients, and 70% of the supply is pumped to eight capacity supplies with add up to the highest capacity of 18,000 cubic meters (4,755.97 US gallons).

However, there was a lack of water supply and low reservoir levels due to leakage and pipe bursts that had led to 30% of the population being regularly lack of water supply from the standard distribution mains [4]. Since 1/3 Malang population regularly lacks water supply, it makes the Malang residents realize the importance of managing water. Also, the Malang city water necessity is predicted to increase in the next year up to 15-30%, while the problem of water shortages for 30% of Malang population is still occurring.

One of the efforts to prevent water shortages and to increase water supplies in Malang city is by using filtrated rainwater [4]. Untari and Kusnadi said that water resources management is including the activity of remodeling and design of strategies to create a better or alternative source of water like using filtered rainwater [4]. Yulistyorini also proposed that one of the solutions to manage water resources in the urban area (Malang) is by harvesting rainwater. Water collecting is the strategy of collecting water runoff from a catchment range to utilize as a water supply [5]. It can be gotten from a house/lot of building or runoff water. However, Fulazzaky argues that to manage water resources there need to be a paradigm shift into integrated water resources management (IWRM) [6]. The purpose of the research was to reveal the correlation between human activities regarding water resources management and the availability of clean water in Malang City. This research was carried out as part of research [7].

2. Methods

The research took place in around Malang City area. The research was done according to the research schedule from February until March 2018. The sampling was taken in Selorejo Street, Lowokwaru village, Malang. Moreover, we involved 100 people as samples based on the Slovin’s formula.

In this research, the data collecting technique was performed used questionnaire and interview method. The questionnaires were given to the people (subject) in Selorejo Street, Lowokwaru village, Malang that regularly use water. The questionnaire consisted of 27 questions regarding Water Management Resources and Clean Water Availability. Water resources management (X Variable) consisted of 10 questions, for Water Availability (Y Variable) also consisted of 10 questions, for the solution part of the questionnaire method consisted of 7 questions, each question was given 5 existing choice that can be chosen (S [Always], SR [Often], J [Rarely], K [Sometimes], and TP [Never]). 5 existing choices bear its own value: S = 5, SR = 4, J = 3, J= 2, TP = 1. The interview was started in Selorejo Street, Lowokwaru village, Malang that regularly use water. The interviewer asked a question about water availability in Malang City area and water resources management that the subject was done. The interview was given a time amount for each subject (around 10-15 minutes).

The data analysis was performed using rho-Spearman’s correlation test and quantitative descriptive approach [8]. Since the data were not normally distributed, the alternative of Kruskal Wallis test was used.
3. Results and Discussion

**Table 1.** Gender characteristics of respondents

| Gender | Frequency | Percent | Valid Percent | Cumulative Percent |
|--------|-----------|---------|---------------|--------------------|
| Valid  |           |         |               |                    |
| Men    | 47        | 47.0    | 47.0          | 47.0               |
| Women  | 53        | 53.0    | 53.0          | 100.0              |
| Total  | 100       | 100.0   | 100.0         | 100.0              |

The Respondent’s gender from Table 1 consisted of 47 men and 53 women.

**Table 2.** Distribution of respondents based on last education

| Last Education | Frequency | Percent | Valid Percent | Cumulative Percent |
|----------------|-----------|---------|---------------|--------------------|
| Valid D1       | 1         | 1.0     | 1.0           | 1.0                |
| Undergraduate  | 34        | 34.0    | 34.0          | 35.0               |
| Master         | 1         | 1.0     | 1.0           | 36.0               |
| Elementary School | 9   | 9.0     | 9.0           | 45.0               |
| Junior High School | 1 | 1.0     | 1.0           | 46.0               |
| Senior High School | 37 | 37.0    | 37.0          | 83.0               |
| Vocational School | 11 | 11.0    | 11.0          | 94.0               |
| Junior High School | 5 | 5.0     | 5.0           | 99.0               |
| STM            | 1         | 1.0     | 1.0           | 100.0              |
| Total          | 100       | 100.0   | 100.0         | 100.0              |

Table 2 shows that most of the respondent last education are undergraduate which consisted of 34 people, Senior High School which included of 37 people, and the respondent’s last education that consisted of lesser number of people including D1, Master, Junior High School, and Vocational School.

**Table 3.** The Respondent’s Family Member Frequency

| Family Member | Frequency | Percent | Valid Percent | Cumulative Percent |
|---------------|-----------|---------|---------------|--------------------|
| Valid         | 1         | 2.0     | 2.0           | 2.0                |
|               | 2         | 13.0    | 13.0          | 13.0               |
|               | 3         | 30.0    | 30.0          | 43.0               |
|               | 4         | 43.0    | 43.0          | 86.0               |
|               | 5         | 9.0     | 9.0           | 95.0               |
|               | 6         | 3.0     | 3.0           | 98.0               |
|               | 7         | 1.0     | 1.0           | 99.0               |
|               | 8         | 1.0     | 1.0           | 100.0              |
| Total         | 100       | 100.0   | 100.0         |                    |
Table 3 described that the respondent family member mainly ranges from 2 until four members of the family.

Table 4. The respondent’s job frequency

| Job       | Frequency | Percent | Valid Percent | Cumulative Percent |
|-----------|-----------|---------|---------------|--------------------|
| Valid     | Police    | 1       | 1.0           | 1.0                |
|           | Teacher   | 13      | 13.0          | 14.0               |
|           | Housewife | 27      | 14.0          | 42.0               |
|           | Student college | 6   | 6.0          | 49.0               |
|           | Traders   | 5       | 5.0           | 52.0               |
|           | Employees | 1       | 1.0           | 53.0               |
|           | Farmer    | 2       | 2.0           | 55.0               |
|           | Government Employees | 1 | 1.0           | 56.0               |
|           | Security  | 1       | 1.0           | 57.0               |
|           | Civil     | 1       | 1.0           | 58.0               |
|           | Private   | 26      | 26.0          | 84.0               |
|           | Entrepreneur | 15 | 15.0        | 99.0               |
|           | Entrepreneurship | 1 | 1.0           | 100.0              |
| Total     |           | 100     | 100.0         | 100.0              |

From Table 4 it can be known that most of the respondent working as private (26 of 100 people)

3.1. Water Resources Management in Malang City

Table 5. Quantitative descriptive result of WRM scores

| Indicator | Mean |
|-----------|------|
| I1        | 2.52 |
| I2        | 2.26 |
| I3        | 4.71 |
| I4        | 2.52 |
| I5        | 2.54 |
| I6        | 3.61 |
| I7        | 2.96 |
| I8        | 3.30 |
| I9        | 3.92 |
| I10       | 2.41 |
| **Average** | **3.075** |

When the WRM scores were given the quantitative descriptive test, the results showed the scores of 3.075, and when the scores were compared with the interpretation of scores [8], the scores were categorized into moderate effective, which means that the WRM have moderate effectivity toward WA.

From the answer given by the respondent from an interview around the area of study about their water resources management, it can be inferred that the people have different sight about how they treat and manage their water resources. Some people were asked about how they usually use water in their daily activity have a different answer, mainly the people used water in their daily activity at a
moderate level, meaning that they did not use it too much nor they use it too little. They had a basic understanding of how to use water properly. However, when the respondents were asked about whether they saved water or not; the respondent showed little knowledge of how to keep more water.

When the respondents were asked whether they used the water from dishwashing or rice washing to water the plant, almost all the respondent answer no. These questions were considered to be hard to grasp, because they did not know why or how it would save the water. However, respondents knew the standard way to keep water like use less water for laundry and closing the faucet when not used. The respondents also showed positive behavior toward how to treat their water waste; they know what the residue affects the water and they used another alternative to manage their waste. The treatment they used ranged from collecting solid waste into commonplace like landfills to be processed or using a septic tank to contain liquid waste. The respondents admitted that the water they use for daily activity from the faucet was reasonable to be used for drinking water, they also stated that there was no side effect of drinking those water and the water usually clean, tasteless, and odorless.

Accordingly, when it comes to what more effective water resources management implemented on people around Malang City, it must be as simple and as close to the daily activity of its people, or the simple action that people can do like turning off the faucet when not used or using less water to wash the dishes or laundry. Those simple activities that people will do without sacrificing much effort. The water resources management of each people may vary because of their basic understanding and knowledge about water resources management.

The information of the person’s behavior impacts their demeanor; the higher level of open information empowers them to retain and get it the messages passed on by others and the government. The evaluation of the level of information is based on the understanding of individuals about how to save and use less water in their daily activity. Katz stated the motivational basis as individual behavior. The function of human behavior is categorized into four types, one of them is a knowledge function. Humankind is motivated to know, to search for reasoning, and to arrange experience. The existence of the original experience elements is not consistent with the knowledge known by an individual, which is able to be orchestrated, modified, or changed in such a way to reach consistency [9]. Availability of clean drinking water could be essentially required for great wellbeing, and it is additionally a crucial right of all humans which will be arranged, modified, or changed in such a way to reach consistency [9]. The availability of clean drinking water is a basic need for good health, and it is also a fundamental right of all human beings [13].

3.2. The Correlation Between Human Activities Regarding Water Resources Management and The Availability of Clean Water in Malang City

3.2.1. Normality Test

Table 6. Test of normality result

|             | Kolmogorov-Smirnov<sup>(a)</sup> | Shapiro-Wilk |
|-------------|----------------------------------|--------------|
|             | Statistic | Df | Sig. | Statistic | Df | Sig. |
| WRM         | 0.119     | 100 | 0.001 | 0.943     | 100 | 0.000 |
| WA          | 0.102     | 100 | 0.012 | 0.962     | 100 | 0.006 |

<sup>(a)</sup>Lilliefors Significance Correction

With a Shapiro-wilk test (p>0.05) shown that the WRM scores were not distributed normally or the data are not normal (0.000<0.005) [17]. Shapiro-wilk test for WA scores was not distributed normally, or the data are not normally distributed (0.006<0.005) [10]. When the data were not distributed normally or partially distributed normally, the data were calculated using Rho-spearman’s Correlation [8].
3.2.2. Rho-Spearman’s Test

**Table 7.** Rho-Spearman’s test result

|          | WRM     | WA      |
|----------|---------|---------|
| Spearman's rho | Correlation Coefficient |       |
|          | 1.000   | .283    |
| Sig. (2-tailed) |         | .004    |
|          | 100     | 100     |
| WA      | Correlation Coefficient |       |
|          | .283    | 1.000   |
| Sig. (2-tailed) |       | .004    |
|          | 100     | 100     |

A Spearman correlation was run to determine the correlation between WRM and WA. There was a strong, positive relationship between WRM and WA, which was statistically significant, \( p = 0.004 \) (\( p < \alpha = 0.05 \)). The correlation between WRM and WA are reasonably correlated according to the scale of Correlation Coefficient (0.283).

It means that there is a correlation between human activities from their effort to manage water resources and the availability of clean water in the corresponding area. The results and correlation coefficient showed that the higher the effort of human to manage water resources the more water will be available for them. The effort of human to manage water resources can be known by their act of using less water or saving more water in their daily activity. Those 3 acts of water resources management considered to be more easily to undergo because those are the kind of activity that more close to us or regularly done by us. It can be said that changing into more sustainable behavior to manage water resources having more possibility have a direct impact on the availability of water and water resources.

The previous study has reported that we could measure the impact of our activities on the environment by the simple multiplicative work of populace, utilization, and innovation [7]. The fundamental equation mention Affect = \( P \times A \times T \), where \( P \) stands for community, \( A \) for average Affluence (utilization per individual), and \( T \) for average source intensity of Technology used per unit production. Therefore, in this case, when the amount of water consumption is higher the impact on the availability of water will also higher, thus proving that the amount of water use or how frequent person use water will also impact the availability of water.

From the questionnaire, there is a specific part of water availability that explains the quality of clean water and its availability. From the questionnaire known that water quality in the corresponding area is excellent and considered to be clean water according to the Regulation of health Ministry Number 492 the year 2010 stated that the quality of fresh water is, physically clean water must be clear, odorless and tasteless. The quality of the water from the corresponding area known to fit the description of fresh water.

The problems of the water quality incorporate surface water and groundwater deimlement whereas problems of water amount incorporate the developing issue of expanding competition among water clients and the decays in the groundwater for urban regions of Java because of withdrawal rates that are greater than recharge rates [6]. It indicates that there is a dependent correlation between the availability of water and human activity regarding water resources management.

Meanwhile, the water is still available for people in Malang to use. Nowadays, agricultural water usage needs more than 90% of its use of water, whereas industrial and city water requirements need for less than 10%. The services of society water provided at a range of 40-60% of the supply of water in big cities of Java such as Malang, Surabaya, Semarang, Bandung, and Jakarta, while the rest from groundwater. The critical dependence on groundwater to serve industrial and household needs for Java’s vast urban region cannot continue [6]. In Cameroon, their representatives are at the lowest institutional level of government account for essential service provision to the society which includes the sustainable supply, use, and water resources management [14].
3.3. Solutions to Save The Water Resource in Malang City

Table 8. Quantitative descriptive result of I score

| Indicator | Always | Often | Sometimes | Rarely | Never | Mean |
|-----------|--------|-------|-----------|--------|-------|------|
| I1        | F 27   | % 27  | F 22      | % 22   | F 13  | % 13 | 3.04 |
| I2        | F 12   | % 12  | F 22      | % 22   | F 13  | % 13 | 2.80 |
| I3        | F 11   | % 11  | F 31      | % 31   | F 41  | % 41 | 3.34 |
| I4        | F 10   | % 10  | F 13      | % 13   | F 16  | % 16 | 2.32 |
| I5        | F 13   | % 13  | F 36      | % 36   | F 28  | % 28 | 3.78 |
| I6        | F 13   | % 13  | F 21      | % 21   | F 26  | % 26 | 3.71 |
| I7        | F 13   | % 13  | F 72      | % 72   | F 3  | % 3 | 4.60 |
| I8        | F 13   | % 13  | F 42      | % 42   | F 39  | % 39 | 4.19 |
| I9        | F 13   | % 13  | F 52      | % 52   | F 19  | % 19 | 4.19 |
| I10       | F 13   | % 13  | F 52      | % 52   | F 15  | % 15 | 3.72 |
| **Average** |       |       |           |        |       | 3.469 |
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