Analysis of biodiversity in the Pamotan Mudal spring area, Rembang Regency

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Abstract. The community's need for clean water is increasing along with the increase in population. In fulfilling clean water, most will use surface water and underground water. Mudal spring is one of the springs located in Pamotan District, Rembang Regency, and has 80 liters/second discharge. The community uses the uses of springs to meet their needs, such as drinking water and irrigation. This study aims to determine the diversity of fauna and flora of the Mudal spring area and identify the use and conservation efforts of the springs by the community in Pamotan District, Rembang Regency. This research uses descriptive quantitative research. Data were analyzed using the Shannon-Wienner Diversity Index formula. There are ten types of fauna in the Mudal spring area with a diversity index H'=1.82 which is included in the medium category. As for flora, 17 species were found with a diversity index H'=1.83 which was included in the medium category. The conservation and utilization efforts carried out by the surrounding community for the Mudal spring are reasonable enough so that it is necessary to improve the concept of sustainable and environmentally sound management so that it remains by following with its function.

1. Introduction
The community's need for clean water is increasing along with the increase in population. The reality that is happening today is that the quality and quantity of water are decreasing and experiencing deviations in order as a result of overexploitation and the behaviour of living things, especially human activities that do not pay attention to environmental aspects so that they do not reach their designation and quality for various aspects of life [1]. In fulfilling clean water, most will use surface water and underground water.

Groundwater is water contained in the soil or rock layers below the soil surface. The existence of groundwater cannot be separated from the hydrological cycle. Meanwhile, aquifers are called aquifers, the water-saturated rock layers that can store and transmit groundwater insufficient and economical quantities. The rain that falls is hampered by the presence of vegetation/plants or buildings. If there is no vegetation/plants, then the rain will fall on the ground surface directly. However, infiltration is still possible due to garbage, dirt, or other objects on the ground surface. Water that seeps into the soil is
retained as a reserve of soil moisture and additional groundwater reserves. In contrast, surface reserves will flow to lower areas, and some will seep back into the soil during drainage.

On the other hand, groundwater flowing in rocks (aquifers) can return to surface water as springs if the aquifer is cut by the slope of the topography of the land surface [2]. Purwitasari [3] states that springs are a condition where groundwater flows out of the aquifer to the ground surface by itself.

Mudal spring is one of the springs located in Pamotan District, Rembang Regency, and has 80 liters/second discharge. The community uses the use of springs to meet their needs, such as drinking water and irrigation. The condition of water sources, especially springs in Rembang Regency, has been degraded. It is caused by the destruction of catchment areas and water catchments around water sources. One of them is in the Mudal spring, which has experienced a decrease in discharge for the last two years. Environmental conservation efforts are being encouraged to restore the spring discharge. One of the efforts made is the planting of several types of plant vegetation.

This study aims to determine the diversity of fauna and flora of the Mudal spring area and identify the use and conservation efforts of the springs by the community in Pamotan District, Rembang Regency.

2. Methodology
The research is located in the springs of Mudal village, Pamotan sub-district, Rembang district, in October-November 2020. The research method uses descriptive quantitative research. The data of this study consisted of primary data and secondary data. Primary data collection is done through direct observation and interviews with residents. Secondary data were collected from various literature studies, report books, journals, research results, and other supporting data related to the research being conducted.

The materials and tools needed in this research are GPS, camera, ArcMap 10.1 software, and other supporting tools. The data obtained were analyzed using the Shannon-Wiener Diversity Index formula to determine the level of diversity and the evenness index to express the total number of individuals scattered in each species obtained as follows:

$$H' = -\sum p_i \ln p_i$$

Description:

- $H'$ = diversity Index of Shannon Wiener
- $p_i$ = proportion of species to 1 in the total sample
- $N_i$ = number of individuals of all types
- $N$ = the total number of individuals of all types

Criteria for the diversity of types is determined as follows:

- $H'< 1$ = diversity is kind of low.
- $1 < H' < 3$ = the diversity of types of being.
- $H' > 3$ = the diversity of the type of high.

Data that has been collected, then tabulated, processed, and analyzed descriptively qualitatively.

3. Results and discussion

3.1. Distribution of springs
Rembang Regency is located on the eastern coast of Central Java, directly adjacent to East Java Province so that it becomes the eastern gate of Central Java Province. There are forty springs, one of which is the Mudal spring. The Mudal spring is located in the Mudal Hamlet, Pamotan District, Rembang Regency, with three water sources. The following are the coordinates of the Mudal water source.

| Number | Location   | Coordinate point |
|--------|------------|------------------|
| 1      | Source 1   | 554733 E 9251994 S |
| Number | Location | Coordinate point |
|--------|----------|------------------|
| 2      | Source 2 | 554754 E 9252006 S |
| 3      | Source 3 | 554701 E 9252019 S |

**Figure 1.** Spring location.

Based on Figure 1, it can be seen that there are three points of water sources in the spring area. The source of water that has the most significant discharge is water source 2. Water sources 1 and 2 are dammed and accommodated by ponds and then placed by residents around several types of fish, while water source 3 has functioned as a place for residents' activities such as washing clothes and bathing specifically for women.

![Figure 2. Water source 1(a), water source 2(b).](image-url)
3.2. Diversity of flora in the spring area

Table 2. Flora diversity index.

| Number | Species                     | Total | pi     | Ln     | Index  |
|--------|-----------------------------|-------|--------|--------|--------|
| 1      | Manilkara kauki             | 1     | 0.0033 | -5.7038| 0.019  |
| 2      | Ficus benjamina             | 3     | 0.01   | -4.6052| 0.0461 |
| 3      | Swietenia mahagoni          | 8     | 0.0267 | -3.6243| 0.0966 |
| 4      | Mangifera indica L.         | 3     | 0.01   | -4.6052| 0.0461 |
| 5      | Cyperus rotundus            | 85    | 0.2833 | -1.2611| 0.3573 |
| 6      | Robinia                     | 7     | 0.0233 | -3.7579| 0.0877 |
| 7      | Pseudacacia L.              | 2     | 0.0067 | -5.0106| 0.0334 |
| 8      | Musa acuminata              | 6     | 0.02   | -3.912 | 0.0782 |
| 9      | Persea americana Mill.      | 4     | 0.0133 | -4.3175| 0.0576 |
| 10     | Averrhoa carambola L.       | 3     | 0.01   | -4.6052| 0.0461 |
| 11     | Acalypha indica             | 4     | 0.0133 | -4.3175| 0.0576 |
| 12     | Solanum erianthum           | 12    | 0.04   | -3.2189| 0.1288 |
| 13     | Morinda citrifolia          | 21    | 0.07   | -2.6593| 0.1861 |
| 14     | Samanea saman               | 3     | 0.01   | -4.6052| 0.0461 |
| 15     | Steleochocarus burahol      | 1     | 0.0033 | -5.7038| 0.019  |
| 16     | Adiantum capillus-veneris   | 120   | 0.4    | -0.9163| 0.3665 |
| 17     | Tiliacora triandra          | 17    | 0.0567 | -2.8706| 0.1627 |
| 18     |                             | 300   |        |        | 1.8347 |

There are 17 species of flora found in the Mudal spring area, with a value of $H'=1.83$, which means that with a value of $1≤H'≤3$, it includes moderate plant diversity and moderate community stability. Trimanto [5] stated that vegetation around the springs plays a role in maintaining the flow sustainability of the springs and the water availability in the area.

The Ficus Benjamina tree is found in the Mudal spring area with reasonably large size. It grows close to the edge of the spring, and even its roots are in the water. According to Fiq a et al [6], trees of the Ficus genus are plants with deep roots and a dense canopy type to conserve soil and water around the spring area.

3.3. Diversity of fauna in the spring area

Table 3. Fauna diversity index.

| Number | Species               | Total | pi     | Ln     | Index  |
|--------|-----------------------|-------|--------|--------|--------|
| 1      | Oreochromis niloticus | 68    | 0.12928| -2.0458| -0.2645|
| 2      | Clarias bathracus     | 3     | 0.0057 | -5.1667| -0.0295|
| 3      | Clarias bathracus     | 15    | 0.02852| -3.5573| -0.1014|
| Number | Species                          | Total | \(pi\)  | \(Ln\)  | Index  |
|--------|---------------------------------|-------|---------|---------|---------|
| 4      | *Oreochromis mossambicus*       | 137   | 0.26046 | -1.3453 | -0.3504 |
|        | *Barbonyx gonionotus*          | 15    | 0.02852 | -3.5573 | -0.1014 |
| 6      | *Oreochromis niloticus*         | 120   | 0.22814 | -1.4778 | -0.3371 |
|        | *Cyprinus carpio Linnaeus*      | 27    | 0.05133 | -2.9695 | -0.1524 |
| 8      | *Rasbora argyrotaenia*          | 117   | 0.22243 | -1.5031 | -0.3343 |
| 9      | *Cyprinus carpio Trachemys scripta elegans* | 23  | 0.04373 | -3.1298 | -0.1369 |
| 10     |                                 | 1027  | 0.0019  | -6.2653 | -0.0119 |

Ten fauna species are found in the Mudal spring area, with a value of \(H'=1.82\), which means that with a value of \(1 \leq H' \leq 3\), it includes moderate plant diversity and moderate community stability. Red tilapia and tilapia rank higher in number than the other fish. Mujair fish has a medium size with a maximum length that can be reached is 40 cm, flat in shape with black, greyish, brownish to yellow. These fish can adapt to various habitats and are considered the most widely distributed fish globally [7]. In addition, Tilapia is a fish that has the characteristics of being tolerant of a wide saline (Euryhaline) environment and has the potential to be cultivated in brackish water and pond environments [8][9].

Based on interviews with residents, the spring water flow has decreased in the last two years, wherein the dry season, it is estimated that it can only meet the residents' needs for a few months. With this phenomenon, residents have the initiative to carry out conservation. By promoting conservation, the springs can be protected and preserved. The decrease in spring discharge can be caused by several factors, namely the need for water which increases in line with population growth, and the lack of concern for residents with the environment. It affects the existence of springs.

Natural springs are groundwater flows that appear to the ground naturally due to the intersection of underground water flows by the area's topography [10]. According to Sudarmadji and Setiadi [11], the existence of springs is influenced by several factors, including rainfall, topography, geological structure, permeability, and aquifer characteristics. Buwono et al [12] states that community capacity is essential to know because its influence on conservation management is considerable. All human activities will have an impact on nature. Human activities that tend to damage will get worse if humans do not understand.

The Mudal community's participation in spring conservation is planting plant seeds in the spring area, placing several types of fish in the springs, having regulations aimed at residents and visitors not to litter and not take fish in the springs. In addition, residents also received plant seeds from PLTU Sluke Rembang as a Corporate Social Responsibility (CSR) program for environmental conservation. Aulia and Dharmawan [13] stated that the management of water resources needs to be done so that the water source can be helpful, where the existence of springs can be used for religious activities (supporting worship), drinking water, and toilets (bathing, washing, latrines), as well as the economy.

4. Conclusion
There are ten types of fauna in the Mudal spring area with a diversity index \(H'=1.82\) which is included in the medium category. As for flora, 17 species were found with a diversity index \(H'=1.83\) which was included in the medium category. The conservation and utilization efforts carried out by the surrounding community for the Mudal spring are reasonable enough so that it is necessary to improve the concept of sustainable and environmentally friendly management so that it remains by following its function.
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