# Vegetation Analysis as Indicator of Mangrove Degradation Level in Keboromo Village, Tayu

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**Abstract**

Mangrove degradation is one of the common issues in the coastal areas of Java, which can cause ecological impacts and even disadvantage for local community. The mangrove forest degradation can be identified based on the vegetation analysis results, which could potentially contribute to the mangrove ecosystem management and rehabilitation programs in the coastal areas. Mangroves in Keboromo Village was the rehabilitation and cultivation area, but often get damaged by ocean waves. This study aims to determine the vegetation conditions of mangrove ecosystems consist of species composition, density, canopy cover, tree height, and environmental parameters were held in February 2023. The method used was direct observation using transect quadrants of 10x10 $m^2$. The average mangrove density of all observation stations was 3.425 individuals/ha for the tree category, 575 individuals/ha for the sapling category, and 250 individuals/ha for the seedling category. The average percentage of canopy cover and tree-hight from all station was 78.41% and 4.15 m. The environmental parameters were still compatible with the water quality standard for biota and mangrove life. The mangrove forest degradation level based on standard criteria and guidelines for determining mangrove degradation is categorized as low, indicated by mangrove density >1500 individuals/ha and canopy cover >75%. Poor conditions were measured for sapling and seedling densities, which may be caused by unsupportive factors for mangrove regeneration. Based on the results of mangrove vegetation analysis in Keboromo Village, it can state the mangrove ecosystem condition is good. However, management programs are needed to keep the mangroves sustainable.

**Keywords:** Density, Canopy cover, Environment, Sustainable.

## INTRODUCTION

Coastal natural resources are one type of resource with high utilization potential. Alongi (2022) states that mangrove forests are one of the productive estuarine ecosystems, having a habitat at the meeting area between land and sea which is affected by tides continuously. The existence of mangrove ecosystems has many benefits for local communities living in coastal areas, from the benefits of ecology, economic benefits, and also physical benefits. Ekosafitri *et al*. (2017) mentioned various types of benefits and functions of mangroves causing many parties who want to utilize them, so mangrove forests also included as an area that is susceptible to changes due to utilization activities. Degradation of mangrove ecosystems needs to be a concern and avoided so that the function and role of mangroves in the environment can be sustained.

Natural factors are the drivers of mangrove forest degradation that cannot be controlled but it is different from anthropological factors that can be limited through the proper management systems. In accordance with the statement of Gnansounou *et al*., (2021), damage caused by nature is difficult to control, but the knowledge and management of human activities can help to reduce the damage to mangrove forest ecosystems. Maulani *et al*. (2021) state that natural disasters such as large waves during the east wind season and the prolonged dry season can cause damage to mangrove land areas. The level of mangrove degradation was assessed based on the Decree of the Indonesian Minister of Environment Number 201 of 2004, about the Criteria and Guidelines for


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Determining Mangrove Degradation with indicators of degradation observed through the value of tree density by hectare and the percentage of canopy cover. In an addition, the assessment of the ecological condition of mangrove forests is also based on the Guidelines for Inventory and Identification of Critical Mangrove Lands by the Indonesian Ministry of Forestry, Directorate General of Land Rehabilitation and National Forestry in 2005.

Pati Regency is an area with mangrove ecosystems found almost along its coastal areas. The degradation of mangrove areas which is quite concerning based on the "Pati dalam Angka" by the Central Statistics Office is found in Tayu Sub-district, with a decrease of mangrove area from 60.5 ha in 2011 to only 20.65 ha in 2017. Mangroves in Tayu District in 2020 according to Prahesti *et al*. (2021) showed an increase to 44.8 ha. According to Salampessy *et al*. (2015), the low level of public knowledge as well as inappropriate regulations and monitoring systems for mangrove sustainability conditions are the major factors behind the frequent cases of mangrove degradation in coastal areas. Keboromo Village has a mangrove forest area of around 5 ha, which is the result of rehabilitation and planting around 2012. The existence of mangroves in Keboromo Village is quite important, considering that the majority of people on the coast work as crab fishermen. According to Redjeki *et al*. (2020), the existence of mangrove forests in coastal areas is an important ecosystem in the survival of the crab life cycle, especially in the larval and juvenile phases.

The unavailability of specific management for mangrove forests in Keboromo Village is the reason why it is important to analyze mangrove vegetation in order to assess the condition and level of mangrove degradation. This study aims to assess the level of mangrove degradation based on vegetation analysis which includes composition, density, diversity, canopy cover, and several environmental quality parameters. The results of this study were expected to become one of the sources and information for the Keboromo Village government and increase public awareness of the importance for maintaining the condition and sustainability of mangrove forests in coastal areas.

## MATERIAL AND METHODS

This research was held in February 2023, located in Keboromo Village, Tayu District, Pati Regency. The mangrove observation location consisted of 4 observation stations which aimed to cover all representative mangrove areas on the coast of Keboromo Village. The observation points and research locations are presented in Figure 1.


**Figure 1**. Research map and observation station for mangrove vegetation in Keboromo Village

The research method is direct observation with transects or quadrant plots measuring 10×10 meters. The results of data analysis are interpreted descriptively with the aim of explaining the results of observations in the form of numbers in a description of sentences that are easy to understand. Equipment used during the data collection process includes quadrant transects, roll meters, sewing meters, thermometers to measure temperature, hand-refractometers to measure salinity, pH meters, DO meters to measure dissolved oxygen levels, cameras, mangrove identification books (Handbook of Mangrove Indonesia) and notebooks. Data collection time is at the same time in the morning (08.00 a.m) for each station, so it is expected to minimize significant differences in some of the environmental parameters.

Mangrove vegetation data was collected using the quadrant transect method with a size of 10×10 meters for each observation plot (Dharmawan *et al*., 2020). The number of observation plots at each station is 3 plots. Some parameters of mangrove vegetation observed include mangrove species, number of trees, the diameter of mangrove trees, number of saplings and seedlings, environmental parameters, tree height, and canopy cover. The plotting scheme of mangrove vegetation data collection with quadrant transect is presented in Figure 2.

The mangrove canopy cover at the research site was observed directly using the hemispherical photography method. This method is carried out by taking pictures through the front camera of a handphone at chest height. The minimum requirement for camera quality is 3 MP (Dharmawan *et al*., 2020), which the camera used in this research was 32 MP. Some of the requirements of hemispherical photography that depend on the level of mangrove canopy cover are presented in Figure 3.

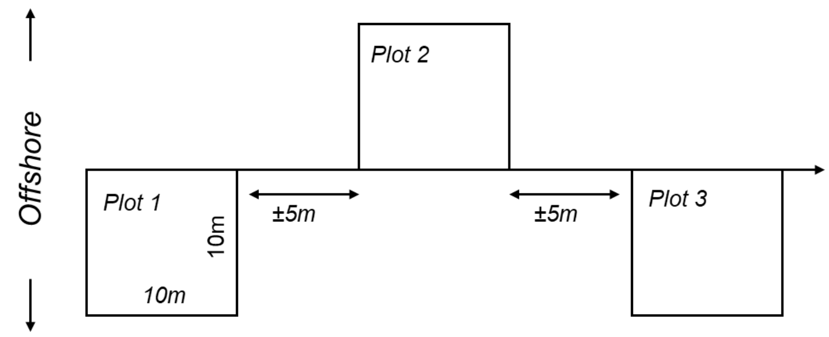
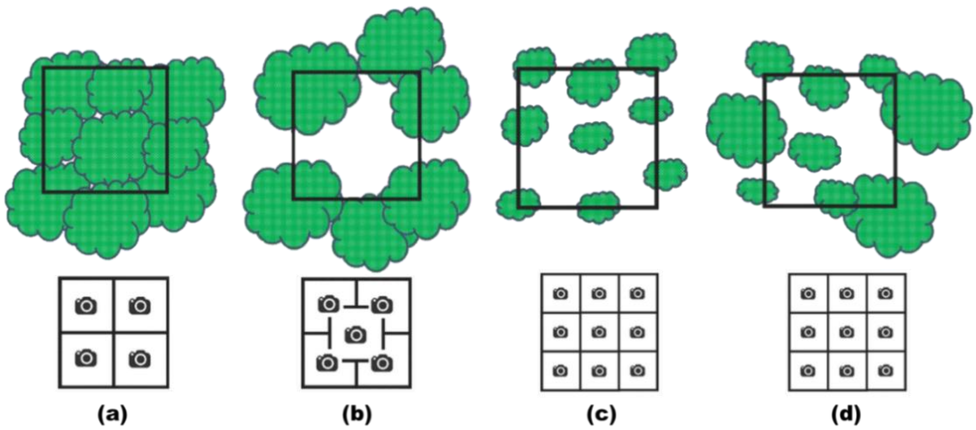



**Figure 2**. Schema of mangrove observation using quadran transect (Dharmawan *et al*., 2020)




**Gambar 3**. Hemispherical photography shooting points based on the condition of canopy density, (a) high density; (b) moderate density and open center; and (c) and (d) random covering and irregular density (Dharmawan *et al*., 2020).

Mangrove vegetation parameters analyzed include species density (Ki), relative density (KR), species frequency (Fi), relative frequency (FR), basal area (BA), species dominance (Di), relative dominance (DR), important value index (INP), the diversity index (H'), and tree height (h). The calculation formula for some of these parameters based on Dharmawan *et al*. (2020) is presented in Table 1.

**RESULT AND DISCUSSIONS**

Observations of mangrove vegetation at the research site are divided into two categories, namely the tree category (tree), and the breeding category consisting of saplings and seedlings. Mangroves in the tree category have a stem diameter of >4 cm, the sapling category has a stem diameter of <4 cm, and the seedling category has a height of about 15 cm and no branch yet (Dharmawan *et al*., 2020). Mangroves that were successfully identified at the observation station were only 2 species from the Avicenniaceae family with the species *Avicennia marina* and *Avicennia alba*. The results of mangrove vegetation analysis at the research site based on the tree category (tree) and the breeding category (sapling and seedling) are presented respectively in Table 2, Table 3, and Table 4.

**Table 1**. Mangrove Vegetation Data Analysis Formula (Dharmawan *et al*., 2020)

| Parameter | Formula | Description |
|---|---|---|
| Species density | $Ki = n_i/ A$ | $n_i$ : Total number individual species-i<br>A : Total area observation plots |
| Species frequency | $Fi = q_i/ q_{total}$ | $q_i$ : Total number plot found species-i<br>$q_{total}$ : Total of plot observation |
| Basal Area | $BAi = \pi \times [(DBHx_i)^2/4)]$ | Π : Constanta of circle area (3,14)<br>$DBHx_i$ : Trees diameter individual-x, species-i |
| Species dominance | $Di = BAi/ A$ | |
| Relative density | $KR = n_i/N \times 100\%$ | N : Total density |
| Relative frequency | $FR = Fi/ F \times 100\%$ | F : Total frequency |
| Relative dominance | $DR = Di/ D \times 100\%$ | D : Total dominance |
| Important index value | $INP = KR + FR + DR$ | |
| Diversity index Shannon-Wiener | $H' = -\Sigma [(n_i/N) \times (Ln\ n_i/N)]$ | |
| Tree hight | $h = h_0 + (d \times \tan \theta)$ | $h_0$ : Observer hight (m)<br>d : Distance observer to trees (m)<br>θ : angle of observation (°) |
| Canopy cover | $C = P_{255}/ P_{total} \times 100\%$ | $P_{255}$ : Total canopy cover pixel of 255<br>$P_{total}$ : Total of pixel photos |

**Table 2.** Vegetation Analysis of Tree Categories

| Station | Species | Ki (indiv/ha) | KR (%) | Fi | FR (%) | Di ($m^2$/ha) | DR (%) | INP | H' | h (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | *A. marina* | 3,266.67 | 100 | 1 | 100 | 3,778.87 | 100 | 300 | 0 | 4.15 |
| 2 | *A. marina* | 3,366.67 | 84.87 | 1 | 50 | 1,283.94 | 87.56 | 222.44 | 0.42 | 4.09 |
| | *A. alba* | 600 | 15.12 | 1 | 50 | 182.37 | 12.43 | 77.56 | | |
| | Total | 3,966.67 | 100 | 2 | 100 | 1,466.32 | 100 | 300 | | |
| 3 | *A. marina* | 3,266.67 | 100 | 1 | 100 | 2,302.57 | 100 | 300 | 0 | 3.90 |
| 4 | *A. marina* | 1,366.67 | 42.71 | 1 | 50 | 416.29 | 38.81 | 131.52 | 0.68 | 4.47 |
| | *A. alba* | 1,833.34 | 57.29 | 1 | 50 | 656.29 | 61.19 | 168.48 | | |
| | Total | 3,200 | 100 | 2 | 100 | 1,072.58 | 100 | 300 | | |

Description: A. *marina* (*Avicennia marina*); A. *alba* (*Avicennia alba*)

**Table 3.** Vegetation Analysis of Sapling Categories

| Station | Species | Ki (ind/ha) | KR (%) | Fi | FR (%) | Di ($m^2$/ha) | DR (%) | INP | H' |
|---|---|---|---|---|---|---|---|---|---|
| 1 | *Avicennia marina* | 233.33 | 100 | 0.667 | 66.67 | 17.67 | 100 | 266.67 | 0 |
| 2 | *Avicennia marina* | 433.33 | 61.90 | 1 | 50 | 23.88 | 59.81 | 171.71 | 0.66 |
| | *Avicennia alba* | 266.67 | 38.10 | 1 | 50 | 16.06 | 40.19 | 128.29 | |
| | Total | 700 | 100 | 2 | 100 | 39.94 | 100 | 300 | |
| 3 | *Avicennia marina* | 700 | 100 | 1 | 100 | 41.77 | 100 | 300 | 0 |
| 4 | *Avicennia marina* | 300 | 45 | 0.67 | 40 | 19.61 | 45.09 | 130.09 | 0.68 |
| | *Avicennia alba* | 366.67 | 55 | 1 | 60 | 23.88 | 54.91 | 169.91 | |
| | Total | 666.67 | 100 | 1.67 | 100 | 43.49 | 100 | 300 | |

**Table 4.** Vegetation Analysis of Seedling Categories

| Station | Species | Ki (ind/ha) | KR (%) | Fi | FR (%) | INP | H' |
|---|---|---|---|---|---|---|---|
| 1 | *Avicennia marina* | 266.67 | 100 | 0.33 | 33.33 | 133.33 | 0 |
| 2 | *Avicennia marina* | 233.33 | 70 | 1 | 60 | 130 | 0.61 |
| | *Avicennia alba* | 100 | 30 | 0,67 | 40 | 70 | |
| | Total | 333.33 | 100 | 1.67 | 100 | 200 | |
| 3 | *Avicennia marina* | 133.33 | 100 | 0.67 | 100 | 200 | 0 |
| 4 | *Avicennia marina* | 66.67 | 25 | 0.33 | 33.33 | 58.33 | 0.56 |
| | *Avicennia alba* | 200 | 75 | 0.67 | 66.67 | 141.67 | |
| | Total | 266.67 | 100 | 1 | 100 | 200 | |

The tree category obtained species density values ranging from 600-1,833.34 individuals/ha for *Avicennia alba* and 1,366.67-3,366.67 individuals/ha for *Avicennia marina*. The highest species density was found at station 2 with a value of 3,966.67 individuals/ha, while the lowest density value was found at station 4 with a value of 3,200 individuals/ha. The dominating mangrove species is *Avicennia marina* which is indicated by the relative frequency (FR) value at each station is ≥50% compared to other mangrove species. The dominance of the species obtained ranged from 182.37-656.29 $m^2$/ha for *Avicennia alba* and 416.29-3,778.87 $m^2$/ha for *Avicennia marina*, with the highest value found at station 1 of *Avicennia marina* with a value of 3,778.87 $m^2$/ha. The index of importance (INP) for *Avicennia marina* species ranged from 131.52-300, while *Avicennia alba* species ranged from 77.56-168.48. The diversity index in the tree category was found to be 0-0.68 which is included in the low category, namely H'<1. The height of trees at the observation station ranged from 3.90-4.47 m, with the average height of mangrove trees in Keboromo Village being 4.15 m.

The density of mangrove species in the tree category has an average of 3,425±181.24 individuals/ha, referring to the Decree of the Indonesian Minister of Environment Number 201 of 2004, the density of mangroves in the research location is included in the high-density category. The mangrove ecosystem in Keboromo Village is the result of planting activities that began around 2012, which is dominated by *Avicennia marina* species so it has a high importance value index compared to other mangrove species. According to Sani *et al*. (2019), mangrove density levels in locations that are the result of rehabilitation and planting are likely to have high-density values compared to natural mangrove ecosystems. The mangrove density value of this study is lower than in the research of Azzahra *et al*. (2020) in Bedono of 4,875±374.5 individuals/ha but has a higher density value than the research of Purnama *et al*. (2020) in Betahwalang with a mangrove density of 2,283±479.28 individuals/ha and research by Pratiwi *et al*. (2022) in Bekasi with a value of 333.25 individuals/ha. According to Akbar *et al*. (2017), a higher value of mangrove tree density indicates a high level of regeneration and mangroves are able to survive in environmental conditions at that location. Mangrove density in areas that are the result of planting or rehabilitation tends to have a homogeneous distribution (Pamungkas *et al*., 2023).

The analysis of the sapling category obtained species density values between 266.67-366.67 individuals/ha for *Avicennia alba* and 233.33-700 individuals/ha for *Avicennia marina*. The highest species density was found at stations 2 and 3 with a value of 700 individuals/ha, while the lowest density value was found at station 1 with a value of 233.33 individuals/ha. The sapling category of *Avicennia marina* species was found in every observation station, while *Avicennia alba* species was only in station 2 and station 4. The dominance of the species obtained ranged from 16.06-23.88 $m^2$/ha for *Avicennia alba* species and 17.67-41.77 m2/ha for *Avicennia marina* species, with the highest value found in station 4 with a value of 43.49 $m^2$/ha. The importance index for *Avicennia marina* species ranged from 130.09-300, while *Avicennia alba* species ranged from 128.29-169.91. The diversity index in the sapling category obtained 0-0.68 which is included in the low category, namely H'<1. Observations in the seedling category obtained species density values ranging from 100-200 individuals/ha for *Avicennia alba* and 66.67-266.67 individuals/ha for *Avicennia marina*. The highest species density was found at station 2 with a value of 333.33 individuals/ha, while the lowest density value was found at station 3 with a value of 133.33 individuals/ha. The seedling category of the *Avicennia marina* species was found at each observation station, while the *Avicennia alba* species was only at station 2 and station 4. The important value index of the seedling *Avicennia marina* species ranged from 58.33-200, while the *Avicennia alba* species ranged from 70-141.67. The diversity index in the seedling category obtained 0 - 0.61 which is included in the low category, namely H'<1.

Mangrove budding, which includes saplings and seedlings, is observed in order to see the potential for expansion and the level of regeneration of a mangrove area (Syamsudin *et al*., 2019). Based on the guidelines for inventory and identification of mangrove critical land by the Indonesian Ministry of Forestry of 2005, mangrove seedlings in the study site were categorized as very low, with sapling density <1,000 individuals/ha and seedling density <2,000 individuals/ha. The density value of mangrove budding in Keboromo Village has lower results than research in Segara Anakan by Ananta *et al*. (2020) with a value of 10,230 individuals/ha for saplings and 17,460 individuals/ha for seedlings and research in Benoa Bay by Andiani *et al*. (2021) with a sapling density value of 901 individuals/ha, but has a higher value than the research of Istomo *et al*. (2019) in Baluran with a value of only 108 individuals/ha. Based on the statement of Koswara *et al*. (2017), low mangrove seedlings in a location can be caused by several common factors such as the age of the ecosystem which is still relatively young, the level of utilization and herbivory of mangrove fruit, the tidal cycle, environmental incompatibility, and garbage pollution.

The diversity index value found that the mangrove ecosystem at the research site is included in the low category due to only 2 mangrove species found at the observation station, namely *Avicennia marina* and *Avicennia alba*. Mughofar *et al.* (2018) state that the low levels of mangrove diversity are often found in ecosystems that are the result of rehabilitation, and usually, the types of mangroves found are pioneer mangrove groups. This condition is caused by the process of rehabilitation and mangrove planting must pay attention to the characteristics of the planting site and suitable species to increase the percentage of mangrove survival. The value of mangrove diversity in this study is lower than in Karimunjawa in the research of Ulyah *et al*. (2022) with a value of 0.24-1.55 for the tree category, 0.12-1.143 for the sapling category and 0.46-1.53 for the seedling category. These results show evidence of significant differences between natural mangrove ecosystems and the results of rehabilitation activities in the aspect of mangrove species diversity. Based on the result, density for the mangrove ecosystem in Keboromo Village are categorized good for the tree category with high density and lowest categorized for the sapling and seedling category with low density. Which means there is more concern in sustainable management for the mangrove potential regeneration in Keboromo Village.

The results of the analysis of mangrove canopy cover at the observation station obtained different results, which are expected because of the different levels of densities at each observation station. The results of the percentage of canopy cover based on processing through the ImageJ application are presented in Table 5.

The results of mangrove canopy cover analysis obtained the average percentage cover is 78.41±2.67%. The highest canopy cover value was found at station 3 with 81.41±1.12%, while the lowest percentage value was found at station 4 with 70.43±1.64%. The difference in mangrove cover value at each observation station is not too significant, which means that the environmental conditions of each station are almost the same or there is not too great an influence. The average percentage of mangrove canopy cover obtained is included in the dense category based on the Decree of the Indonesian Minister of Environment No. 201 of 2004, which is a percentage of more than 75%. The lowest percentage value of canopy cover was found at station 4 at 70.43%, which is assumed to be related to the lowest density value also among other stations.

The results of the mangrove canopy cover percentage in Keboromo Village are lower than in Genuk Subdistrict by 83.07% (Pamungkas *et al*., 2023), and Betahwalang Village by 81.07% (Purnama *et al*., 2020), but have a higher value than Bedono Village location with a percentage of 76.94% (Azzahra *et al*., 2020). The higher percentage of canopy cover indicates a high level of mangrove density as well, besides that the value of canopy cover also gets influenced by the type of mangrove composition. According to Anthoni *et al*. (2017), differences in the dominance of mangrove species that influence the value of percent canopy cover. Mangrove areas composed by *Rhizopora* sp. have a higher canopy cover value than *Avicennia* sp., which is due to differences in leaf shape and branching type in these mangrove species (Schaduw, 2019).

Sadono (2018) states that the importance of canopy cover affects the photosynthesis process, which after the process will be distributed for the growth of stem diameter and tree height. The existence of canopy cover regulates the control of the evaporation process, besides that for mangrove ecosystems it can reduce the sun light's intensity (Dalengkade, 2020). Based on the results of temperature measurements, the lowest percentage of canopy cover at station 4 shows a higher temperature than other stations. This condition proves the direct influence of mangrove canopy cover on the level of shade. Mangrove canopy cover has an influence on the growth of seedlings (saplings and seedlings), the higher the value of canopy cover the less the presence of seedlings (Purnama *et al*., 2020). Mangrove saplings and seedlings will be more difficult to get sunlight for the photosynthesis process because it is covered by the canopy. Based on the result, the value of canopy cover shows high-coverage almost in every station also means mangrove tree in Keboromo Village are high-level density. It is important to continue this canopy cover study periodically to monitor the existing condition of mangrove forest.

Environmental parameters at each observation station were measured in-situ including pore water temperature, air temperature, pore water pH levels, pore water salinity, and dissolved oxygen (DO). Measurement of environmental parameters is done simultaneously with the observation of mangrove vegetation, at the same time for each observation station. The results of the measurement of environmental quality parameters of the mangrove ecosystem in Keboromo Village are presented in Table 6.

**Table 5**. Percentage of Mangrove Canopy Coverage in Keboromo Village

| Station | Canopy cover (%) ± StdDev | Status* |
|---|---|---|
| 1 | 80,55 ± 0,65 | High-coverage |
| 2 | 81,23 ± 1,01 | High-coverage |
| 3 | 81,41 ± 1,12 | High-covergae |
| 4 | 70,43 ± 1,64 | Medium-coverage |
| Average | 78,41 ± 2,67 | High-coverage |

Description: *) Canopy cover status in Indonesian Ministry of Environment Decree No. 201/2004.

**Table 6**. Insitu Environmental Parameters Result of Mangrove Ecosystem in Keboromo Village

| Station | Environment parameter | | | | |
|---|---|---|---|---|---|
| | Pore Water temperature (ºC) | Air temperature (ºC) | Pore Water pH | Pore Water Salinity (ppt) | DO (mg/L) |
| 1 | 27.6±0.2 | 27.3±0.5 | 7.27±0.04 | 17.2±0.5 | 1.71±0.03 |
| 2 | 27.6±0.2 | 27.1±0.5 | 7.26±0.03 | 26.7±0.3 | 3.04±0.10 |
| 3 | 27.6±0.4 | 27.6±0.2 | 7.27±0.09 | 29.7±0.6 | 5.02±0.15 |
| 4 | 27.8±0.1 | 28.1±0.2 | 7.11±0.03 | 36.8±0.4 | 5.06±0.21 |
| Average | 27.65±0.05 | 27.52±0.22 | 7.23±0.04 | 27.60±4.06 | 3.70±0.82 |
| Quality standard*) | 28-32 | - | 7-8.5 | <34 | >5 |

Description: *) Seawater quality standards for marine biota and mangroves in Indonesian Government Regulation Number 22 of 2021.

Data on environmental parameters of the mangrove ecosystem obtained an average pore water temperature value of 27.65±0.05 ºC, while the air temperature at the observation site averaged 27.52±0.22 ºC. There is no significant temperature difference between the pore water temperature in the mangrove substrate and the air temperature at the observation station. The pH value of pore water was obtained on average 7.23±0.04 with almost every observation station showing a pH of 7 which means the acidity of water in the mangrove ecosystem tends to be neutral. Water salinity levels at the observation station obtained an average of 27.60±4.06 ppt, with the highest salinity value found at station 4 of 36.8±0.4 ppt while the lowest salinity was found at station 1 of 17.2±0.5 ppt. Different locations at each station result in differences in salinity values, where station 1 is closer to river waters while station 4 is directly on the coastline. Dissolved oxygen levels from the observation stations obtained an average of 3.70±0.82 mg/L, with the lowest DO levels found at station 1 amounting to 1.71±0.03 mg/L while the highest DO levels were found at station 4 with a value of 5.06±0.21 mg/L.

The pore water temperature was obtained on average 27.65±0.05 ºC from 4 observation stations, with the temperature difference between stations not significant. Based on the seawater quality standards for marine biota in Indonesian Government Regulation No. 22 of 2021, the water temperature obtained is below the minimum value. This condition is likely due to the ongoing weather at the research location and the time of data collection which was carried out in the morning. The air temperature at the observation station has a value that is not much different from the pore water temperature, but station 4 has the highest average temperature of 28.1±0.2 ºC. This condition is likely influenced by lower canopy cover compared to other stations. According to Ananta *et al*. (2020), mangrove canopy cover affects the level of shade and temperature in the mangrove ecosystem. The temperature value obtained in this study is lower than in other locations such as research by Pratiwi *et al*. (2022) in Bekasi with an average temperature of 31.80±0.36 ºC and research in Brebes by Hamzah *et al*. (2022) with a temperature of ±31.6 ºC, while the temperature in the Karimunjawa mangrove area (Ulyah *et al*., 2022) is almost the same as this study which is 28.75±1.31 ºC.

The pore salinity of the observed station is still included in the standard threshold of seawater quality for the life of biota and mangroves. There is the lowest salinity value at station 1 with a value of 17.2 ± 0.5 ppt, where the location of station 1 is on the side of the river and is more likely to be influenced by river flow. That condition is likely to cause the lowest salinity value obtained among other stations. The salinity value in this study is not much different than in other locations such as in the Karimunjawa mangrove area (Ulyah *et al*., 2022) of 26.6 ± 1.59 ppt, Brebes mangrove (Hamzah *et al*., 2022) of ± 27 ppt and Timbulsloko mangrove (Lestariningsih *et al*., 2018) of ± 28 ppt. Based on the result, shows the environmental parameters are classified as suitable and support for the life of biota and mangroves ecosystem in Keboromo Village.

## CONCLUSIONS

The composition of mangroves that dominate the research site is *Avicennia marina* and *Avicennia alba*. Mangrove density values obtained 3,200-3,966 individuals/ha for the tree category which is included in the category of good condition, while the density of 233-700 individuals/ha for the sappling category and the density of 133-333 individuals/ha for the seedling category which is included in the category of very low or poor condition. The highest mangrove importance index was obtained from the *Avicennia marina*. The percentage of canopy cover is 78.41 ± 2.67% which is included in the high-dense category and good condition. Environmental parameters in the mangrove ecosystem in Keboromo Village are still in accordance with seawater quality standards for biota and mangroves. Based on the results that have been obtained, it is known that the condition of mangroves in Keboromo Village is classified as a good category, but an integrated management form is needed to maintain its sustainability, and diversity of the mangrove area. Suggestions for further research to be able to add other environmental parameters in order to complete each parameter that affects mangrove life.

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