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Study of nitrogen (N) and phosphorus (P) in the land of mangrove sediments in ecotourism area Wonorejo Surabaya and coastal area of Jenu Tuban

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Abstract. The mangrove forest is one of the wealth of natural resources in Indonesia. Based on data from the Ministry of Environment in 2006 that the Indonesian mangrove forest area reached 4.3 million hectares. Nutrient element N (nitrogen) and P (phosphorus) is an element that affect the growth of mangroves. The element nitrogen affect amount of photosynthesis that occurs in mangrove. Low uptake of phosphorus can cause plant tissue volume becomes smaller and the leaf color becomes darker. This study aims to measure the concentration of nitrogen and phosphorus in soil sediments obtained from the mangrove Ecotourism Wonorejo Surabaya and coastal Jenu Tuban. This research uses descriptive method through field surveys by sampling. Sampling was carried out at six points in each region. The results of this study showed that the highest nitrogen content was at the point A_4 coastal areas Jenu Tuban is 40.86%, while the lowest nitrogen content is at the point B_3 Ecotourism Mangrove Wonorejo Surabaya is 31.55%. Phosphorous levels are at their highest A_6 coastal areas Jenu Tuban is 0.043 ppm, while the phosphorus content is in the lowest point of the region B_3 Ecotourism Mangrove Wonorejo Surabaya is 0,021 ppm.

Introduction

Indonesia's mangrove forest is one of the largest in the world. Indonesia's mangrove forest area reaches 4.3 million hectares. Indonesia has mangrove forests covering an area of 3,062,300 hectares in 2005, which is 19% of the total area of mangrove forests worldwide [1]. However, from 1999 to 2006, the mangrove forest had decreased by about 64 percent. Currently, only 3.6 million hectares of mangrove forests in Indonesia are in good condition, the rest is in a damaged and moderate condition.

There are many abilities possessed by the mangrove ecosystem, one of them is smangrove ecosystem has a high capacity to neutralize excess nutrients and other pollutants [2]. The waters around mangroves are an area rich in nutrients, both organic and inorganic [3]. Each location in the mangrove ecosystem has different nutrient conditions. Nutrients have an important role in determining the ability of the soil to support plants [4]. Nutrient elements N (nitrogen) and P (phosphorus) are elements that affect mangrove growth. Nitrogen has an effect on the number of photosynthetic processes that occur in mangroves [5]. Nitrogen concentration in leaves is used to increase electron transport in the photosynthesis process. The amount of phosphorus in plants is smaller than that of nitrogen, but phosphorus is considered the key to life. Low phosphorus uptake can cause the volume of plant tissue to become smaller and the leaf color to darken [6].

There has been an overlap in the use of mangrove forest areas for various activities, such as logging of mangroves for firewood, building materials and other uses. Mangrove forest areas are also often converted into ponds and residential areas [7]. The exploitation of mangrove forests that has been carried out so far has caused damage so that it has reduced its ability to carry out its ecological and biological functions [8]. Damaged mangrove forests result in reduced nitrogen and phosphorus nutrients in the soil, so that if the nutrients in the soil are continuously reduced, it can cause a decrease in mangrove area. Based on this problem, the researchers were interested in examining the differences

in nitrogen and phosphorus content in the mangrove sediments obtained from Ecotourism Wonorejo and the Jenu coast.

2. Material and methods

2.1. Tools and material

The tools used in the mangrove soil sediment sampling include a shovel, 500 gr plastic, label paper, markers, rubber bands, black plastic bags, scales, digital cameras, soil pH meters, and refractometers. The materials used in this study were mangrove soil sediment samples obtained from the Ecotourism Mangrove Wonorejo area of Surabaya and the coast of Jenu, Tuban Regency.

2.2. Work procedure

The research method is used to solve a problem that can be done by collecting data through observation, surveys, or through experiments [9]. This study uses a descriptive method through field surveys with sampling. Samples were taken from the Ecotourism Mangrove Wonorejo area and the Jenu coast, Tuban Regency. The samples taken in this study were mangrove soil sediments. The mangrove soil sediments were taken directly based on the sampling area group, starting from the coastal area of Jenu District, Tuban Regency (points A1, A2, A3, A4, A5 and A6), and the Wonorejo Mangrove Ecotourism area (points B1, B2, B3, B4 , B5 and B6), with samples were taken at each point randomly. Samples were taken as much as ± 300 g per point using a shovel. Soil sampling is done when the water is receding. The soil sample used was oxidized mangrove sediment (5 cm above the surface of the sediment). Each location was sampled 6 times. Samples taken are stored in plastic and given a sample number based on the group of sampling locations. The samples taken were then analyzed at the Surabaya City Center for Health Laboratory to determine the amount of nitrogen and phosphorus nutrient content in the sample.

2.3. Data analyisis

The data analysis used is descriptive form, by presenting the data on the amount of nutrient content of nitrogen and phosphorus at each point of the sample sediment sampling area, then analyzed using the T-test (unpaired comparison). The use of the T-test is to compare the t count with the t table [9].

3. Results and discussions

The nitrogen test results from samples taken from two regions ranged from 31.55% - 40.86%. The highest nitrogen content of the two regions is located at point A4 (40.86%), while the lowest nitrogen content is at point B3 (31.55%).

Data on nitrogen nutrient content were analyzed by means of the T-test (unpaired comparison). The results of the T-test analysis (unpaired comparison) with a confidence interval of 95% showed that there was a very significant difference (Highly significance) between the nitrogen nutrient content in the coastal area of Jenu, Tuban Regency and Ecotourism Mangrove Wonorejo Surabaya.

Table 1. Nitrogen content test results

Location Points (Jenu Coast)	N (%)	Location Points (Wonorejo Ecotourism)	N (%)
A_1	40.36	B_1	31.67
A_2	38.75	B_2	34.56
A_3	36.92	B_3	31.55
A_4	40.86	B_4	38.04
A_5	39.22	B_5	31.75
A_6	38.67	B_6	33.58

The nitrogen nutrient content in this study had different results at each point (table 1). The highest nitrogen nutrient content in the coastal area of Jenu, Tuban Regency is located at point A4 (40.86%), while in the Ecotourism area of Wonorejo Surabaya it is located at point B4 (38.04%). This is because the two highest points are the closest to the river estuary, so they are rich in organic materials from rivers and the sea. One of the parts of the coast that has the highest fertility rate is the estuary area (river mouth) [10]. The highest nitrogen nutrient content of the two research areas was at point A4 (40.86%). The cause of the high nitrogen element at point A4 is not only because it is located close to the estuary, there are also geographical factors, there are many semi-intensive shrimp ponds in the vicinity of the Jenu coast, so it is suspected that the organic matter left over from cultivation is carried by currents around the river mouth. Most of the dead shrimp are also discarded and carried away by the river to become organic material. The addition of organic matter can increase the population of soil microorganisms, including fungi. Organic matter is used by soil microorganisms as a constituent of the body and energy source.

Nitrogen nutrient content in the Ecotourism Mangrove Wonorejo area is relatively lower, as seen in the nitrogen test results at points B1, B3, B5. This is because the location of taking point B1 is close to the resting place of the tourist boat and Ecotourism Mangrove Wonorejo canteen, so it is possible that there is boat and canteen waste which causes the nutrients at point B1 to be relatively lower. The nitrogen test result at point B3 was the lowest of the two research areas, which was only 31.55%. This is because at point B3 is the end of the jogging track of the Wonorejo Mangrove Ecotourism area. Point B5 is also relatively low at 31.75%, this is because point B5 is close to the gazebos of the Wonorejo Mangrove Ecotourism visitors. At points B3 and B5, many visitors spend time to rest enjoying the natural nuances of mangroves so that it is possible that there is a lot of inorganic waste falling to the ground and inhibiting the process of forming nitrogen nutrients in the soil. Nitrogen in the soil comes from organic matter and N_2 in the atmosphere [11]. Nitrogen can be said to be a charged nutrient. Apart from being absolutely necessary, it can easily be lost or become unavailable to plants. The unavailability of N from the soil can be done through the leaching process of NO^{3-}, denitrification of NO^{3-} to N_2, volatilization of NH_4 + to NH^{3+}, fixed by minerals or consumed by soil microorganisms.

There is a very real difference (Highly significance) (P> 0.01) between nitrogen nutrients in the coastal area of Jenu, Tuban Regency and nitrogen nutrients in the Mangrove Ecotourism Wonorejo Surabaya. The differences in the two coastal areas of are due to several reasons, one of which is due to the large number of inorganic waste and visitors so that decomposing bacteria cannot carry out the nitrification process. It is an enzymatic oxidation process of converting ammonium compounds into nitrate compounds carried out by certain bacteria. One of the factors that determines the high nitrification process is the number of bacteria found in the soil [12]. The amount of inorganic waste will affect the number of bacteria that carry out nitrification.

The results of the phosphorus test from samples taken from two regions ranged from 0.021ppm - 0.043ppm. The highest phosphorus content of the two regions is at point B3 (0.021ppm), while the lowest phosphorus content is at point A6 (0.043ppm).

Table 2. Phosphorus content test results

Location Point (Jenu Coast)	P (ppm)	Location Point (Wonorejo Ecotourism)	P (ppm)
A_1	0.036	B_1	0.032
A_2	0.041	B_2	0.038
A_3	0.027	B_3	0.021
A_4	0.032	B_4	0.029
A_5	0.039	B_5	0.032
A_6	0.043	B_6	0.038

The data on the nutrient content of phosphorus in table 2 were analyzed by means of the T-test (unpaired comparison). The results of the T-test analysis (unpaired comparison) with a confidence interval of 95% showed that there was no difference (non-significance) between the phosphorus nutrient content found in the coastal area of Jenu, Tuban Regency and Ecotourism Mangrove Wonorejo Surabaya.

The nutrient content of phosphorus in this study had different results at each point (table 2). The highest phosphorus nutrient content in the coastal area of Jenu, Tuban Regency is located at point A6 (0.043 ppm), while in the Ecotourism area of Wonorejo Surabaya it is located at points B2 (0.038 ppm) and B6 (0.038 ppm). The highest nitrogen nutrient content of the two research areas was at point A6 (0.043 ppm). The high phosphorus element at point A6 is caused by soil sediment that still contains rock. The lowest phosphorus nutrient content is at point B3 (0.021 ppm). This is because the location of point B3 has muddy sediments. Phosphorus can be found in water, soil and sediments. Unlike other material compounds, the phosphorus cycle cannot be found in air which has high pressure. This is because phosphorus is usually liquid at normal temperatures and pressures. It mainly cycles back through water, soil and sediment. Phosphorus exists in two forms, namely organic phosphate compounds (in plants and animals) and inorganic phosphate compounds (in water and soil). Organic phosphate (P) from dead animals and plants is broken down by a decomposer into inorganic phosphate. Inorganic phosphate dissolved in groundwater or sea water will erode and settle in marine sediments. Therefore, phosphate is abundant in rocks and fossils. Phosphates from rocks and fossils erode and form inorganic phosphates dissolved in ground and sea water. This inorganic phosphate will then be absorbed by the plant roots again. This cycle is repeated continuously. Phosphorus is present in bound form as Ca^{-} phosphate, Fe^{-} or Al^{-} phosphate, phytate or protein. Bacterias that play a role in the phosphorus cycle: *Bacillus*, *Pesudomonas*, *Aerobacter aerogenes*, *Xanthomonas*. Microorganisms (*Bacillus*, *Pseudomonas*, *Xanthomonas*, *Aerobacter aerogenes*) can dissolve phosphor so that it is readily absorbed by plants.

There was no significant difference in the phosphorus nutrient content ($P < 0.05$) between the phosphorus nutrients in the coastal area of Jenu, Tuban Regency and the phosphorus nutrients in the Ecotourism Mangrove Wonorejo Surabaya. There is no significant difference in the two coastal areas of Jenu and Ecotourism Mangrove Wonorejo due to several reasons, one of which is that the mangrove habitat is both muddy, slightly rocky, where mud can affect carbon oxidation, nitrification, denitrification, and biological elimination of phosphorus.

Table 3. pH Measurement Results

Location Point (Jenu COast)	pH	Location Point (Wonorejo Ecotourism)	pH
A_1	7.4	B_1	7.1
A_2	7.6	B_2	6.9
A_3	6.8	B_3	6.9
A_4	7.2	B_4	6.7
A_5	7.3	B_5	7.1
A_6	7.9	B_6	7.0

The results of pH measurements in table 3 shows that the pH at the 12 research points from the two locations was not much different, ranging from 6.7-7.9. The highest pH test result is at point A6 (7,9), while the lowest pH test result is at point B4 (6,7). The results of the salinity measurement shown in Table 5.4 represents the salinity from each point varies widely, ranging from 22-33ppt. The highest salinity test results are at point A1, A4, A5, A6 (33 ppt), while the lowest salinity test result is at point B1 (22 ppt). At low pH soil, nitrate ion is absorbed more quickly by plants than ammonium ion, meanwhile at high pH soail, Ammonium ion is absorbed by plants faster than nitrate ion and at neutral pH absorption. The process occurs in balance [13].

Table 4. Salinity Measurement Results

Location Points (Jenu Coast)	Salinity (ppt)	Location Points (Wonorejo Ecotourism)	Salinity (ppt)
A_1	33	B_1	22
A_2	32	B_2	23
A_3	32	B_3	23
A_4	33	B_4	30
A_5	33	B_5	31
A_6	33	B_6	31

Salinity is one of the factors that determines the development of mangroves, so that the zoning of each mangrove habitat is different according to local environmental conditions. Based on the research, the salinity in the two research areas has a range of 32 - 33 ppt for the Jenu coast of Tuban Regency, and 22 - 31 ppt for the Mangrove Ecotourism Wonorejo Surabaya. This is because the research location is influenced by fresh water from rivers. The number of rivers that flow into the sea, cause the salinity to be lower, and conversely, the fewer rivers that flow into the sea, the higher the salinity [6].

4. Conclucion

The result of this research is that the coastal area of Jenu, Tuban Regency has a better potential for mangrove growth than in the mangrove ecotourism area of Wonorejo Surabaya, as evidenced by the higher nitrogen content in the coastal area of Jenu, Tuban Regency. It is necessary to do further research on nutrients that can support mangrove growth, so that the development of mangrove area is expected to be more rapid based on the area potential and important functions of mangroves in the fisheries sector.

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