Nutrient amount mangrove ecosystem in Bedono, Sayung district, Demak regency

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Abstract. The mangrove ecosystem in Bedono in some places is damage, which is caused by the erosion of the ocean current and wave. In the beginning it was the residential areas which were abandoned by residents some decade ago. These area store the organic and mineral material. The research aimed to found sediment/soil texture shore and to find out the contents of organic material (Carbon), Nitrogen, Phosphate and Potassium/Kalium in the sediment and water in the mangrove areas. These research was conducted from February – June 2017. This research used descriptive method. The samples were taken by purposive sampling, include 3 station are Morosari (A), Tambaksari (B) and Senik/Rejosari (C). Each station was determined by three places sampling systematically. The sediment sampling were taken at a depth 10 cm and the sampling water were taken in the same places. The analysis of sediment/soil texture were carried out in the Soil Laboratory Civil Engineering Faculty, University of Diponegoro in Semarang and analysis soil and water were carried out in the Soil Laboratory, Agriculture Faculty, Gadjah Mada University in Yogyakarta. The result of the research showed that soil texture in Morosari including the kind of dusty loam texture. In Tambaksari including the kind of sandy loam to dusty loam texture., in Senik/Rejosari including sandy loam texture. The result of the research showed that the nutrient contents at the sediment in the Bedono village indicated the organic material 6,21 % (low), organic carbon 3,75 %, the dissolved organic carbon 0,09 % (low), the total nitrogen 0,20 %, and the dissolved nitrogen 8,66 ppm (low), the available phosphate at the sediment 24,73 ppm (medium) and the dissolved phosphate 0,095 ppm only the June, in February and April undetect. potassium/kalium content at the sediment was 3,75 me/100 gram (low) and the dissolved pottasium/kalium in the water was 66,93 ppm (medium). Mangrove genera in Bedono are Avicennia and Rhizophora it was associated with same mollusc species, and the dominant macrobenthos in Bedono are Cassidula sulculosa and Natica fasciata.

1. Introduction
Mangrove forests in ecotone are among of the most productive and biologically important ecosystems of the world because they provide important and unique ecosystem goods and services to human society and coastal and marine systems [1]. The ecotone zone between land and sea or ocean, towards the land is still affected by sea or ocean activities and towards the sea or ocean is still affected by activities on land. Mangrove ecosystem in Bedono guarded and controlled by the village/rural community and mangrove forest as ecotourism. Strategies to achieve the extent and quality of protected mangrove area are as follows: enhancement of protected forest area, gradual recovery altered protected areas, gradual shifting reserves and protected forest, restrictions on the development of regional infrastructure around protected areas, and the determination of forest area of at least 30% of total watershed area [2].
Most of the Indonesian water coast lowland and covered by mangrove or tropical forest, sometimes coastal zone formed bordered by rocky sand or soft coral and is located behind the outskirts of the reef. Mangrove forest is a tropical coastal zone ecosystem that are dominated by a few species of trees as *Avicennia* sp and *Rhizophora* sp, which are typical or shrubs that have the ability to grow in salty or intertidal water. The mangrove ecosystem has an important role in the chain nutrients cycle so that maintained the balance of the biological cycle in these water and as a proliferate place for various species of mollusc, crustacean, annelid, fishes, snakes, birds and mammals. as well as the economical function as a place of recreation, aquaculture land and producing raw materials of industrial such as rayon, paper, dyes, and pharmaceuticals (dysenteries, fever, kidney stones, gonorrhoea and other). Besides that, mangrove acts also as an absorber of carbon dioxide, the filtrate waste, inhibiting the intrusion of seawater and global climate change [3]). Also, anthropogenic activities frequently introduce elevated concentrations of heavy metals and organic pollutants into estuary water / river mouth [4]. The support mangrove ecosystem managers in their difficult task to protect this vulnerable ecosystem. In order avoid further negative effects for the mangrove ecosystem of this protected area, the pollution load must be decreased in the future [5]. Otherwise phenomenon happens from time to time the shoreline the real evidence of the existence of geomorphic processes like sedimentation/accretion and erosion [6]. An integrated approach to overall estuarine and coastal management, which uses traditional ecological knowledge and engages iwi in long time monitoring of these dynamic ecosystem [7].

Mangrove species distribution in Bangladesh coastal indicated that *Avicennia*, *Exoecaria*, *Rhizophora* and *Ceriops* can grow in the high saline zone or polyhaline zone as well as in mid and even in low saline zone. Genera *Aegiceros*, *Aegialitis*, *Bruguira* and *Rhizophora* are present in only the mid saline or mesohaline zone and are not as prevalent in other saline zone, whereas *Nypa* and *Heritiera* are recognized as low salinity indicator genera which show high abundance in oligohaline to mesohaline zones [8]

Mangrove forest in Central Java located on the north coast and south coast but the most extensive is in Karimunjawa and Segara Anakan. The existence of mangrove *Avicennia*, *Rhizophora* in the northern coast dynamically changing. The damage of mangrove forest in Demak regency reached 1.162 Ha, or about 23.11 percent of the total area, and the damage of mangrove forest in Sayung district reached 748 Ha from the mangrove forest in the District of Sayung reached 2.945 Ha [Forest Department].

Material and energy recycling in mangrove ecosystem started from the biomass of mangrove. Biomass production at a certain time is very difficult to measure and varies. The contributions of mangrove as a source of carbon as a food source depends on the number of leave that fall off as litter. Litter submerged off carbon that could be available directly utilized by plankton and the rest is broken down by fungi and microbes. Litter is not directly weathering but it crumbled by animals called macrobenthos as detritivores, the existence of third benthic accelerate decomposition. The presence of crumbled fauna such as crabs, snails and annelid will help accelerate the destruction of the litter. Among different ecosystems, wetlands often represent the largest carbon pool because of their anoxic conditions and thus play a vital role in cycles. Southeast Asian peatlands account for the most importance carbon sink, representing 68.5 PgC or 77% of global tropical peatlands [9].

Environmental factors affecting the seasonal variations in different phytoplankton species varied, water temperature, total nitrogen, total phosphor and ammonia nitrogen appeared to be the most dominant[10]. The study aims to estimate organic carbon, nitrogen (N), phosphate (PO4) and potassium (K) in sediment and soluble.

2. Methods
The study was carried out during February – June 2017 in the coastal zone Bedono, Sayung district, Demak regency. The Bedono coastal zone is about 5 km long that is the estuary where 9 rivers which have headwaters of residential areas and ricefields and some from aquaculture areas. Sampling sediment/soil and water from 3 station/location point from Morosari (A), Tambaksari (B) and Senik/Rejosari (C).
Nutrient analysis was conducted at the Soil Laboratory, Faculty of Agriculture, Gadjah Mada University, Yogyakarta. Analysis nutrients include organic Carbon, N total, available Phosphate (PO4) and available Potassium (K). Sediment/soil texture was conducted at soil Laboratory, Departement of Civil Engineering, University of Diponegoro in Semarang. For this analysis the samples from each station / location point taken from sediment/soil and water samples. Data analysis was carried out by descriptive analysis.

3. Results and discussion

The conditions of mangrove soil from each station in Bedono based on the results of laboratory analysis were found different types soil texture of three station/location. In Morosari (Station A), the soil textures were composed of particles with composition of sand 22.45 – 36.20 percent; dust 57.48 -69.43 percent silt, and 3.36 – 10.07 percent loam, including the kind of dusty-loam texture. In Tambaksari (Station B) the textures were composed of particle of coarse sand 0 – 18.30 percent, sand 10.65 – 68.40 percent, dust/silt 13.30 – 64.00 percent, and loam 0 – 25.35 percent, including sandy loam to dusty loam texture. In Senik (Station C) the soil were composed of particle of coarse sand 0 – 17.90 percent, dust (silt) 0.80 – 81.54 percent, and loam 0 – 22.21 percent, including sand texture to loam, it showed the differences in the formation of land and level of sea and river influenced on the ecosystem. Loam texture soil is a rich soil consisting principally of a mixture of sand and clay, together with silt and humus, it has the good qualities of both sand and clay, but not their bad qualities.

The texture classes of this soil is suitable for the growth of the mangrove plant *Avicennia marina* and the muddy places are also suitable for the growth of *Rhizophora mucronata*. The existence of *Avicennia marina* on the end borders on the shoreline is very threatened a stand of *Avicennia marina* mostly. The most possibility is the falling off mangrove tree, if it came down, the roots was ripped from the ground and interfered on the absorption of soil nutrients, the other thing that the stand on the end of the beach will receive so much pile of sand brought by sea water, the pile sand will interfere the root breath of *Avicennia marina* spreading around the stand of mangrove, it cause the mangrove leaves getting pale green, even the older leaves turning into yellowish.

The lifting off process of the *Avicennia marina* root system from the ground due to the current in a certain time period will decease it. Moreover, the erosion by the ocean current in a particular season with wave and strong winds cause the felt down of mangrove. It should be considered by controlling the wave and current of sea water. Due to the frequent having tides (the sea water rise and fall), sinking on muddying land, and also deflecting current for reclamation in north of Semarang getting more destruction in area of Bedono, Sayung district. Demak regency. So the process of controlling sea current has to do more.

The content of nutrients in the form of organic Carbon, a highest organic total in Morosari (A) 9.09 %, and organic Carbon sediment 5.11 percent in Tambaksari (B) was optained medium score, and in Senik (C) was optained lower score (Table 1). Soluble Nitrogen approximately 0.09 - 0.10 %, that Nitrogen is stored in solid form.

The content of organic Carbon was high in sediment, it indicated that the mangrove ecosystem in Bedono beach got organic matter from the mangrove vegetation and obtained some supplies organic material from the residence, existing birds in the mangrove area and the died Gastropods. Even, the organic Carbon were obtained from streams surrounded the beach.

The content of organic carbon was possibility occurred short flooding time and falling sea water during all day than in any other month like February. The organic carbon concentration in February 2017 in Morosari showed weak relationship with salinity. Such low relation with salinity indicates that Morosari is the site of significant organic cycle, in which internal input and removal of organic material exceed the effect of mixing during the rainy season. These are several processes responsible for such distribution, for examples, the removal of a fraction of the riverine of organic Carbon soluble at low salinities and the addition of organic carbon soluble at intermediate salinity within the Morosari bay/estuarine. The addition of litter in Morosari is obtained from the Sayung river flow, and in Morosari the position is more indented like a bay / estuarine which is protected from big waves due to a breakwater
that protects the shore from erosion. The type of mangrove found in Morosari is dominated by the *Rhizophora mucronata* type, in Morosari it is directly adjacent to the village and the community mostly disposes of household waste near the mangrove area, and the texture of the seabed does not contain much sand and tends to be muddy, so many *Rhizophora mucronata* are suitable for life. On a muddy beach. Estimates of the litter production from Morosari may be applied to mangrove elsewhere in Indonesia provided that the influence of those differences in mangrove biomass, canopy height and density, and nutrient availability, and the effect that might have on mangrove productivity are taken into account. In Bengkulu total carbon stored in the stand of mangrove was 1.853 ton/ Ha [11]. In marine and brackish habitats, the accumulated of exported macrophytodetritus or litter can be found everywhere, from the littoral zone to the deepest canyon and at all latitudes. The accumulations of exported macrophytodetritus are typically comprised of dead of photosynthetically active plant remains but can also contain material of terrestrial origin (trees parts or other terrestrial plants) that are washed into the sea [12].

**Table 1.** The analysis average result of organic material, organic carbon, nitrogen, phosphate and potassium in sediment and soluble water.

| Station | Analysis Result Average Organic Total (%) | Organic Carbon (%) | Soluble Nitrogen Sediment (%) | Soluble Phosphate Sediment (ppm) | Soluble Phosphate Sediment (ppm) | Soluble Kalium Sediment (me/100g) | Soluble Kalium Sediment (me/100g) |
|---------|------------------------------------------|-------------------|-------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| A       | 9.09                                     | 5.11              | 0.09                          | 0.26                            | 8.05                            | 14.19                           | 0.023                           | 3.74                           | 55.93                           |
| B       | 6.29                                     | 3.53              | 0.09                          | 0.17                            | 9.81                            | 37.82                           | 0.049                           | 4.13                           | 72.12                           |
| C       | 3.24                                     | 2.60              | 0.10                          | 0.16                            | 8.11                            | 22.19                           | 0.212                           | 3.63                           | 72.33                           |
| X       | 6.21                                     | 3.75              | 0.09                          | 0.16                            | 8.66                            | 24.75                           | 0.095                           | 3.75                           | 66.93                           |

Indonesia possesses magnificent mangrove forest which only the most extensive, but they also contain the largest number of species and communities. The Mollusk in Morosari are mainly from *Cassidula cingulata*, *Pythia pantherina* and black crabs, as well as coastal earthworms. The vegetation conditions in Tambaksari are dominated by *Avicennia marina*, if there are several *Rhizophora mucronata*, they are still in the form of seedlings in small amounts and are protected by *Avicennia marina*. The sea waves in Tambaksari are only slightly protected by the breakwater. The Mollusc found in Tambaksari are mainly from *Cassidula cingulata* and *Telescopium telescopium* and Periophthalmus fish. This situation is different from the condition in Rejosari which is not equipped with seawall / breakwater / agroin so that the sea waves directly hit the beach which is overgrown by *Avicenia marina* on the beach front, and mollusc which is directly hit by waves from the *Lithorina scabra* type attached to the logs of *Avicenia marina*, which began to root, and at the back of the Rejosari shore had calmer, muddy waters covered by *Rhizophora mucronata* and mollusc of the *Telescopium telescopium*, *Cassidula cingulata*, *Natica fasciata*, *Cerithidia cingulata*, *Uca* and black crabs, and glodok fish. In coastal east Lombok different with Bedono, the *Strombus* are genus found only in cluster one and three genera found in cluster two and three namely *Chiroreus*, *Littoraria*, *Murex* and *Oliva* [13]. In west coastal area of India have reported low biomass and high density of macrobenthos could be due to the recruitment process, the reported that salinity in the main significant factor influencing the species diversity, population density and biomass of macrobenthos in the estuarine system. The deteriorates the mangrove ecosystem affecting the community structure of macrobenthos with respect to population density [14].

The nutrient content of mangrove waters was in a high score so it was categorized in mesotrophic water in Morosari, Tambaksari dan Rejosari included oligotrophic. In north sea (Jakarta) state that Jakarta Bay was divided into three tropic levels, those were oligotrophic in the open sea, mesotrophic in the inner bay and hypertrophic in the coastal area [2].
The nitrogen content in the sediment of the three observation stations varied greatly and was very low from soluble water and lower than organic carbon. It is assumed that the nitrogen is used or taken up by the root for mangrove growth, this finding is consistent with what was conveyed by K. Which states that the reduction in nitrogen content is proportional to the root abundance of mangroves. Nitrogen in the water is in the form of nitrate, which can be used by plants other than ammonium to support the growth process [15]. Apart from that, the mangrove ecosystem, during high tide the influence of sea water is so dominant, on the other hand, at low tide it is dominated by fresh water from rivers. Generally in a day and night there are 2 times the tide, and 2 times the ebb. Therefore, every day in the estuarine there is a high salinity gradient, the salinity ranges 4 – 35 ‰. So that the species in this mangrove ecosystem have a wide range of salinity against the changes in daily salinity [3]. Salinity at high levels also affect s mangroves, as high salinity reduces the biomass in hydroponically grown Bruguiera gymnorrhiza, and causes denaturing of terminal buds in Rhizophora seedling. Saline interstitial water reduces the leaf area, increases the osmotic pressure of leaf sap, increases leaf area/weight ratio, and decreases total N, P, and K mineral [8].

Phosphate nutrient in the mangrove ecosystem derived from the weathering process of rocks, phosphate is usually deposited for a long time, the average phosphate content in the sea is 0.07 ppm and at sea level it is generally low. Phosphate plays a role in the transfer of energy in plant cells in the form of ATP and ADP. Phosphate in sea water with form of phosphate ions which are needed in the process of photosynthesis and other processes in plants [2]. The phosphate content in the mangrove area during the day is minimal because it is absorbed by mangrove plants, and the phosphate content will be at the maximum level before dawn because at night the plants do not carry out photosynthesis. Changes in phosphate content occur in relation to the season, occurred in February, at that time shows an increased level of the phosphate content, this is correlated with high rainfall in February 2017.

The content of potassium in waters is generally low, this is related to the nature of potassium which tends to form mica and is insoluble in water. Potassium is an essential element for plant growth. Potassium range in marine waters around 380 ppm and content is more than 2000 ppm very dangerous for marine life. Temporal potassium content in Bedono is lower than 2000 ppm, thus allowing for the life of invertebrates and various types of fish. Pacris et al (2020) reveal that the environmental conditions of mangrove waters is largely governed by seasonal change. Hence, understanding the biological, physical, and chemical characteristics of mangrove waters are very important since these influences the aquatic environment specifically mangrove ecosystem [16].

4. Conclusion

The subgrade texture of the beach at Bedono at station A (Morosari) has a dusty loam soil texture, at station B (Tambaksari) has sandy loam textured soil, and at station C (Senik) has type of soil with on the front of beach is sandy textured, and on back with loam textured. The three stations, it is very suitable for mangrove plants, that loam soil is very good for plant growth. The nutrient content of sediment in the Bedono beach, the mangrove ecosystem has high organic carbon content, nitrogen phosphate content and sufficient potassium for mangrove growth. The mangrove graves in Morosari are dominated by Rhizophora mucronata. The mangrove in Tambaksari and Senik which immediately get swept away by the sea waves are dominated by the Avicennia marina species, and the dominant macrobenthos in Bedono are Cassidula sulculosa, Natica fasciata.

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