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Resin trees of Mount Gede Pangrango photo by Ricky Martin

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Degradation level of mangrove forest and its reduction strategy in Tabongo Village, Boalemo District, Gorontalo Province, Indonesia

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Abstract. *Katili AS, Ibrahim M, Zakaria Z. 2017. Degradation level of mangrove forest and its reduction strategy in* Tabongo Village, *Boalemo District, Gorontalo Province, Indonesia. Asian J For 1: 18-22.* This research aimed to assess the degradation level of mangrove forest and to develop strategy to reduce the degradation level. The overall research duration was 1 year, focusing on identification of mangrove forests degradation level, exploration of mangrove vegetation structure and preparation for mangrove degradation reduction strategy. The research was located in Tabongo Village, Dulupi Sub-district, Boalemo District, Gorontalo Province. The method used in the research was explorative survey, while the data analysis was done with quantitative descriptive analysis. The collecting method used was point quarter centered meter (PQCM) method. The degradation level of mangrove forest was analyzed by standard criteria of mangrove destruction according to Ministerial Decree of State Minister for The Environment (Kepmen. LH) No. 201 in 2004. Results showed that there are 4 species of mangrove plants in Tabongo Village, Dulupi Sub-district namely *Rhizophora apiculata* Blume, *Rhizophora mucronata* Lamk., *Ceriops tagal* (Perr) C.B.Rob, and *Bruguiera* which included in the Rhizophoraceae family. *Rhizophora apiculata* had the highest IVI value at the stage of tree and sapling, while *Rhizophora mucronata* Lamk had the highest IVI value at the stage of seedling. Tabongo mangrove area was a Scrub or dwarf forest type generally. This type was classified as a typical mangrove found in low edges. The mangrove condition in the coastal area of Tabongo Village, Boalemo, was categorized as broken (TNS_1 = 210). While based on Assessment of criticality level of mangrove land based on the way teristris, formula was categorized as not broken (TNS_2= 330). The reduction strategy that could be implemented to recover the quality of mangrove areas include (i) the assessment of the importance of the mangrove areas with regard to their ecological and economic value, (ii) quality improvement of mangrove habitat, (iii) educational approach by making the mangrove areas as learning media and source, and (iv) empowerment of people living around the mangrove areas.

Keywords: Coverage value, degradation, density, mangrove forest

INTRODUCTION

Coastal areas have at least three important ecosystems: mangrove forests, coral reefs, and sea grass beds. These ecosystems create functional systems both biologically, physically and chemically. Mangrove forest ecosystems serve as habitat of various marine organisms for feeding and living their live stages from larvae to adulthood, while coral reef ecosystems serve as habitat of various species of fish and other marine biota needed by humans (Onrizal et al. 2009, 2017; Utina 2012). Mangrove ecosystem is a coastal wetland forest located in the intertidal zone in estuaries, deltas, creeks, lagoons, swamps, mud especially in tropical and subtropical areas. As one of the natural resources in coastal areas, mangrove forest community has various benefits in ecological, physical, economic and social aspects. In addition to providing biodiversity, mangrove ecosystems also act as genetic pools and support the entire life system around it (Irwanto 2007).

Mangroves are halophytic plants that cannot live in salt-free circles. Arief (2003) states that mangroves are halophytic vegetation or plants that have a high adaptability to salinity and must live in such environmental conditions, thus called obligate halophytes plants. Mangroves are natural resources found in many coastal areas. Some experts define the term "mangrove" differently, but basically refer to the same thing: mangroves are plants in tidal areas and live as communities. Mangroves are also defined as distinctive littoral plant formations in tropical and subtropical sheltered beaches (Noor 2012).

Mangroves have very wide benefits in terms of ecological, biological and economic aspects. Ecological functions include maintaining coastal stability and as a bird habitat, biological functions as natural hatcheries for fish, shrimp and plankton-eating marine biota as well as manmade fish hatchery areas, while economic functions as recreation areas and timber sources. According to Bismark et al. (2008), mangroves, as other forest vegetation, have a role as absorber of carbon dioxide (CO_2) from the atmosphere. Donato et al. (2012) stated that mangroves are known to have high assimilation ability and C absorption rate. It is supported by a research in 25 mangrove sites along the Indo-Pacific indicating that mangroves are one of the richest carbon forests in the tropics, containing about

1,023 Mg of carbon per hectare which was far high compared to the average carbon stock of other forest types in the world. This is certainly related indirectly to the mangrove ecological function. Mangroves absorb some of the carbon in the form of CO_2 and use it for the process of photosynthesis, while others remain in the atmosphere. Ilmiliyana (2012) states that over the last decade CO_2 emissions increased from 1,400 million tons per year to 2,900 million tons per year. This increasing of CO_2 in the atmosphere will trigger a global climate change.

Mangrove forests and surrounding ecosystems are often destructed as the population increases and the need for economic improvements gained from mangrove forests. However, Indonesian mangroves are declining over time (Onrizal 2010; Ilman et al. 2016). On the other hand, the utilization of mangrove forests is increasing, especially the fishery sub-sector that use the forest for pond cultivation, mining, or other development activities that do not take the side effects into account (Pramudji 2000).

One of mangrove areas in Indonesia was located in the coastal area of Dulupi Sub-district, Boalemo District, Gorontalo Province. This mangrove ecosystem continued to be under pressure due to various community activities around the mangrove forest area. Local residents have utilized mangrove forests for various uses such as fish hatcheries, living areas, and farming areas. This land conversion within the mangrove forest area resulted in diminution of mangrove forest area. One of the degradation causes was land clearing or forest conversion into hatchery area. In addition to conversion, degradation also occurred due to intensive utilization of mangrove for fuel and building materials. This study aimed to obtain a database of the degradation level of mangrove forests, exploring mangrove species, and assess a strategy to reduce the degradation level.

MATERIALS AND METHODS

The study was located in Tabongo Village, Boalemo District. Explorative survey method was used in this study. Data collected in the form of primary data and secondary data. The primary data collection was done by identifying all mangrove species in the research site and measuring the mangrove density level using the Point-Centered Quarter Method (Figure 2), based on Dahdouh-Guebas and Koedam (2006). Tabongo Village has 178.67 ha mangrove area (Figure 1). Based on data from report of environmental status Gorontalo Province on 2013, the degraded mangrove area in Dulupi Sub-district was 13.05 Ha, with 9.52 Ha of damage area located in Dulupi village and 3.53 Ha in Tabongo Village. The result of calculation would then be confirmed with standard criteria of mangrove damage based on MoF (2005). Importance Value Indices (IVI), Species Coverage (Ci) and Relative of Species Coverage (RCi) were calculated for each stages of mangrove trees.

RESULTS AND DISCUSSION

Results

There were 4 species of mangrove trees found at the research location in Tabongo Village, Dulupi Sub-district, namely *Rhizophora apiculata* Blume, *Rhizophora mucronata* Lamk., *Ceriops tagal* (Perr) C.B.Rob, and *Bruguiera gymnorrhiza*. All of them were found in stages of tree, sapling and seedling.

Importance Value Index

At tree stage, *Rhizophora apiculata* had the highest IVI value (49.55%) compared to all species. The second highest IVI was *Bruguiera gymnorrhiza* (49.16%), followed by *Rhizophora mucronata* Lamk (48.048%). *Ceriops tagal* was recorded as the lowest IVI, i.e. 46.88%.

The composition of IVI at sapling stage is similar to tree stage, where *Rhizophora apiculata* had also the highest IVI value (50.88%) at sapling stage, following by *Bruguiera gymnorrhiza* (50.47%) and *Rhizophora mucronata* (49.87%). Ceriops tagal was also recorded as the lowest IVI (49.84%). At the seedling stage, *Rhizophora mucronata* was recorded as species with the highest IVI (81.30%), followed by *Rhizophora apiculata* (73.65%) and *Bruguiera gymnorrhiza* (70.74%). Similar to tree and sapling stage, *Ceriops tagal* was also recorded as the lowest IVI (69.99%). Based on this result, the mangrove community in this area is *Rhizophora apiculata-Rhizophora mucronata* that they might be the characteristic of mangrove vegetation in the area.

Rhizophora apiculata and *R. mucronata* are recorded as the most important and widespread species of mangrove plant (Noor et al. 1999, Onrizal and Mansor 2016; Onrizal et al. 2017). The dominance of these two mangrove species can reach up to 90% of the vegetation growing in one location and optimal growth occurs in deep flooded areas, as well as on humus-rich soil, and they also bloom throughout the year. The research conducted by Soeroyo and Achmad (2002) showed that species in Rhizophoraceae family was dominating the front zone of mangrove forest in the region of Sulawesi. This is relevant to the results of this research, which that the family had a relatively big role in the mangrove community and these two species were the main vegetation in the area.

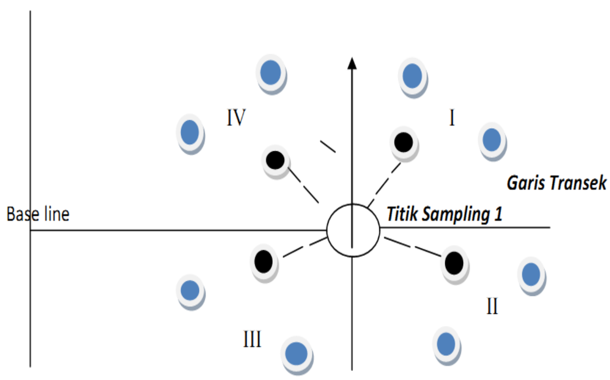

Figure 2. Point-centered quarter meter (PCQM) method

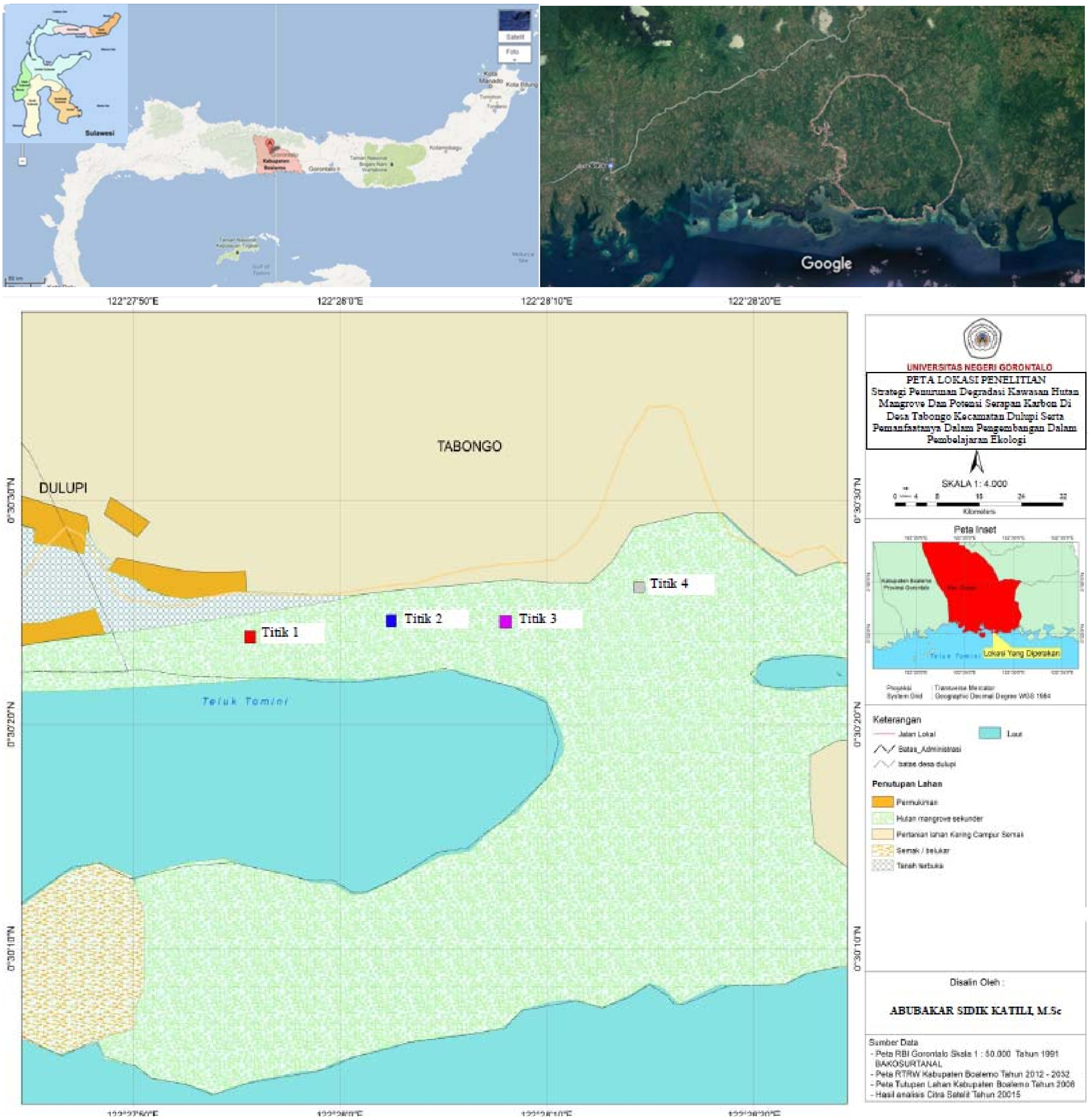

Figure 1. Research site in Tabongo Village, Boalemo District, Gorontalo Province, Indonesia

Degradation level of mangrove

According to MoF (2005), with used formula TNS1 = (Jpl x 45) + (Kt x 35) + (Kta x 20). Based of calculation in tree and sapling stage, the mangrove condition in the coastal area of Tabongo Village, Boalemo, was categorized as broken (TNS_1 = 210). While based on Assessment of criticality level of mangrove land based on the way teristris, with formula TNS_2 = (Tppl x 30) + (N x 25) + (Np x 20) + (L x 15) + (A x 10),was categorized as not broken (TNS_2= 330).

Discussion

The mangrove coverage on research site showed a significant degradation. This condition might be influenced by the ongoing natural succession process and the use of land for various activities such as the fish hatcheries, living areas, and the cutting of mangrove wood for buildings and firewood. The degradation of mangrove coverage can cause mangrove litter production to decline and bring a negative impact on nutrient cycles in the region. According Supriharyono (2007) that the fertility of mangrove forest affected by the decomposition of mangrove leaf litter and the level of sedimentation that occurred. This means that the lack of mangrove coverage also causes the sedimentation process of materials containing nutrients carried by the river flow becomes less. While that mangrove roots can retain the materials that enter the mangrove forest. Reduced mangrove coverage causes less and even loss of mangrove roots, causing rich-nutrient materials in mangrove will be lowered. This condition further can increased to the ecological value of mangrove. Mitra (2013) revealed that mangroves have immense ecological value. They protect and stabilize the coastal zone, fertilize thecoastal waters with nutrients, yield commercial forest products, support coastal fisheries and providea surprising genetic reservoir that are thesources of several bioactive substances and extracts having high medicinal values. Furthermore Mitra (2013) said, there are three main factors the nursery role of the mangrove habitat, i.e ; levels of water turbidity, tidal mixing, and the physical and structural complexity of the habitat.

The condition of mangrove coverage in Tabongo Village, Boalemo was seriously damaged at the tree level. The same condition was also seen at the sapling level. Given the facts and conditions of existing mangrove area of Tabongo Village, Boalemo it can be predicted that after a period of time the ideal condition of mangroves in this area will continue to decrease significantly.

Based on empirical data descriptions of observations at the research sites, the sustainable reduction strategy of mangrove degradation needed to be done by combining the ecological interests (conservation of mangrove forest) with the socio-economic interests of the people around the mangrove area. Thus the strategy applied would be able to overcome the socio-economic problems of society as well as planning the development of regional spatial. One of things that can be done for example is maintaining the natural conditions of mangroves and making its ecosystem as a buffer zone, while still involving the people around mangrove areas. Other ways to reduce mangrove degradation level that can be done is growing mangrove seedling and replanting the damaged area; introduction of various species of mangrove and its use through learning activities in schools around the mangrove area; and also hatcheries management while considering the suitability of environmental factors such as the type of substrate and salinity. Thus the strategies that can be implemented in order to recover the quality of mangrove areas are (i) Assessment of the importance of the mangrove areas with regard to their ecological and economic value, (ii) Improving the quality of mangrove areas, (iii) Educational approach by making mangroves as learning media and resources in schools and incorporating learning material of mangrove in the national curriculum of Basic Education as part of the local curriculum in schools around the mangrove area, (iv) Local society empowerment which can be done by society management activities through reforestation, training, and counseling, and non-formal education.

In conclusion, Tabongo mangrove area was a scrub or dwarf forest type generally. This type was classified as a typical mangrove found in low edges. According MoF (2005), the mangrove condition in the coastal area of Tabongo Village, Boalemo, was categorized as good-very dense due to its density of >1,500 trees/ha for the sapling stage, while for the value for tree stage was 767.45/ha which was categorized as damage-sparse due to its density < 1000 trees/ha. Based on the relative coverage values of each mangrove species, the conditions were in the damage criteria due to the coverage value of <50%/ha. The reduction strategy that could be implemented to recover the quality of mangrove areas include (i) the assessment of the importance of the mangrove areas with regard to their ecological and economic value, (ii) improving quality of mangrove habitat, (iii) educational approach by making the mangrove areas as learning media and source, and (iv) empowerment of people living around the mangrove areas.

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