Ecosystem mangrove management in urban area: case study mangrove Kali Adem Jakarta Indonesia

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Abstract. Mangrove forests are part of coastal ecosystems that have a high level of vulnerability when faced with urban areas. The Kali Adem mangrove forest is one of the mangrove rehabilitation sites in the urban area. Rehabilitation efforts were initiated by Komunitas Mangrove Muara Angke (KOMMA) and PT. Pembangkit Jawa Bali-Unit Pembangkitan (PT PJB-UP) Muara Karang in 2010. The location was initially a garbage pile that was successfully cleared and planted with 37,000 mangrove seedlings. Administratively the site is located in Pluit, Penjaringan District, North Jakarta City, DKI Jakarta Province. Primary data were collected from field observation and interviews. In addition to that, secondary data, such as the high-resolution satellite World View's image was utilized to analyze the dynamic of the landscape. Data analysis was carried out with qualitative descriptive methods to determine the influence factor of the successfulness of rehabilitation efforts. According to this study, the success of rehabilitation efforts in Kali Adem was influenced by several main factors including land stability, the certainty of land ownership, availability of mangrove seeds, and stakeholder involvement. Kali Adem biophysically formed from the sedimentation process and has the potential to disappear, the stability of the land must be maintained by the physical structure. The certainty of land ownership is one of the eligibility criteria for rehabilitation efforts. The availability of mangrove seeds is one of the factors that will determine the success of mangrove management. Mangrove management requires cooperation and participation by all levels of government and the involvement of the parties. Through the synergy of these factors, Kali Adem has successfully become an ecotourism area called Eco-marine Tourism.

Keywords: Eco-marine tourism, Mangrove management, Urban mangrove.

1. Introduction
Major cities in Indonesia are generally located in the coastal area where the mangrove ecosystem potentially can be found. Mangrove ecosystem located between the land and the sea that is rich in natural resources that can meet people's needs provides life support services, such as fishery, trading, housing, industrial activities, and so on. The function of the mangrove ecosystem is to muffle the waves and the winds, shoreline protectors from abrasion, natural sediment traps, produces variations of detritus, nursery ground, feeding ground, and as a spawning ground for various coastal fish reef biota. The other

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benefits of the mangrove ecosystem are providing good wood for charcoal (fuel) and building construction materials, ecotourism activities, and pollution biofilter that came from the land area.

Mangrove ecosystem is a part of the coastal ecosystem that has a high level of vulnerability, from human activities such as fisheries, aquacultures, industries and residential development. Another threat that can affect the sustainability of mangrove is reclamation, mining, and natural causes such as storms and abrasions [1]. Furthermore, mangrove that intersects with the coastal areas has more conversion threats as the result of the population pressure to meet the economic and residential needs. So, its sustainability is very vulnerable to environmental changes [2]. Because of the complexity of the mangrove ecosystem, its management requires cooperation and participation by all levels of government and the involvement of the parties [3].

Jakarta is the capital city of Indonesia with its population up to 10.4 million [4]. The population itself will drive an escalation in the need for land. Limitation of the land area in the capital city makes many people look for alternatives to expand the residential areas in various directions, such as Bogor, Depok, Tangerang and The North of Jakarta. Attempts to expand the residential areas to the south which clashed with natural constraints is Puncak Area which is a buffer zone for water resources. Attempts to expand the residential areas to the north is one of the most feasible alternative solutions by reclaiming the coastal zone. To realize that matters its needs to be balanced with an escalation in ecological capacity, by establishing a new mangrove ecosystem so the ecological function of coastal ecosystems can be maintained [5].

The north coast of Jakarta still leaves a mangrove ecosystem, including Muara Angke Wildlife Reserve, Kapuk Angke Protected Forest, and Kapuk Angke Production Forest which adjacent to the beach. However, the area is also not exempt from the changes in the function of the surrounding land [6]. The North Coast of Jakarta has encounter pollutions, exploitation of excessive natural resources, and habitat degradation due to development in coastal areas and the high seas [7]. In the 1940s, the north coast area of Jakarta had a mangrove area as thick as 2-7 km. However, currently, the mangrove area is only a thin line, separated along the shoreline due to the land conversion. On the east side, there are remaining Angke-Kapuk Protected Forests and Muara Angke Wildlife Reserve which are very species-poor and damaged due to pollution of chemical waste, municipal waste, hydrological changes and, sedimentation, so that ecologically it can be said to have no role in the ecosystem of Jakarta Beach and the Java Sea. Previously, a coastal reclamation had been carried out in the Ancol area in the 1960s. Reclaimed land is used for industrial, residential and recreational purposes. The mangrove conversion for residential needs was also carried out in the 1990s on Kapuk Beach. Restoration of mangrove forests on the north coast of Jakarta is impractical due to development pressures that tend to turn off the habitat [5][8]. Therefore, it is necessary to rehabilitate the existing mangrove forest location and the addition of the location of the mangrove forest around the north coast of Jakarta.

Mangrove forest in the Kali Adem is one of the mangrove rehabilitation which was initiated by Muara Angke Mangrove Community (KOMMA) and PT. Jawa Bali-Generating Unit (PT PJB-UP) Muara Karang in 2010. The location was initially in the form of a 1.5 ha garbage pile. In 2010, the location was successfully cleaned and planted with 27,000 mangrove seedlings. At present, these activities have embraced the elements of the surrounding community through empowerment both economically and socially. The strategic step further requires a continued follow-up of rehabilitation activities in the context of managing ecotourism. Therefore, it is necessary to identify the variables that can follow up on these activities. This study aims to find out and identify various variables related to mangrove rehabilitation activities within the framework of ecotourism-based mangrove management at the Ecomarine Muara Angke located in North Jakarta. Thus, information from this research is expected to be one of the guides in the rehabilitation and management of mangrove ecosystems in urban areas.

2. Methods

The research site located in the Kali Adem mangrove area which is administratively in Pluit Village, Penjaringan District, North Jakarta City, DKI Jakarta Province. The method of data collection is done by field observation and interviews with snowball techniques. Data analysis using descriptive qualitative
methods. Qualitative descriptive analysis conducted by revealing events or facts, circumstances, phenomena, variables and circumstances that occur when the research takes place by presenting what actually happened and interpreting and describing the data concerned with the situation that is happening, attitudes and views that occur in a community, the contradiction between two or more conditions, the relationship between variables that arise, differences between existing facts and their influence on a condition. Dynamics analysis of coastal changes conducted by detecting changes in an object by observing it at different times [9]. This involves the ability to measure temporal effects using multitemporal data sets, in this case, high-resolution satellite image data is available on the Google Earth application (Digital Globe). Map of the research location presented in Figure 1.

Figure 1. Map of Research Location

3. Result and Discussion

3.1. The Coastal Dynamics in Kali Adem
Based on multi-temporal analysis by satellite imageries with 2003 as a baseline identified initially the Kali Adem was still in the water body (figure 2) which was part of the coastal area of the Jakarta bay and associated with river estuary, and the mangrove area was not identified. The land grows simultaneously with the dynamics of land conversion in the development process, but sometimes it does not only grow, on the other hand, but there is also a land lost due to abrasion. The existence of the mangrove ecosystem is inseparable from the dynamics and pressures of development, both the pressure from the sea and the land, from the land such as from transport materials such as sediments, garbage, and pollutants through rivers.
In 2004, the growth of the built-up area was identified in the land area and its garbage accumulation of garbage that seemed like a land. In the following years, the expansion of the built-up area continued to increase, even in 2014 the existing aquaculture area was identified as the built-up area. Until now (2018), the size of mangrove vegetation’s area with the habitus tree in the research area is quantified at 0.6 ha. Figure 2 shows the visualization of the dynamics of landscape changes at the Kali Adem estuary.
3.2. The Lesson Learned Mangrove Management in Kali Adem

Rehabilitation activities in the Kali Adem area include planting with the right type and technique, maintaining mangrove stands, breakwater construction, and waste management. Mangrove planting using native species found in the region to planting mangrove, especially *Rhizophora mucronata*, *Avicennia officinalis*, and *Sonneratia caseolaris*. Beside easy to obtain the regeneration, it has been ecologically proven to be able to adapt to the research area. The uses of non-native types of mangrove areas are not recommended and should be avoided.

The development of a breakwater was carried out in the Kali Adem area, on the area that faces the sea which has strong waves directly. In those areas above and the area in front of the mangrove towards the sea, sediment trap embankments should also be made. The success of planting depends not only on the accuracy of the types and techniques that been used but also on the success in handling the waste. Considering the condition of waste in this area is very alarming and becomes a threat to the balance of a coastal ecosystem, the effort to handle waste must be taken seriously and integrated with the development in other DKI Jakarta areas. The ecological pressure that occurs come from resident activities that utilized the natural resources and its surroundings. Therefore, the efforts to overcome waste in this area cannot be separated from waste management efforts in other areas that contribute waste to Jakarta Bay water. The lessons that can be learned regarding mangrove management in Kali Adem which is geographically located in urban areas are influenced by several factors, namely: land stability, the certainty of the land status, availability of the mangrove seeds, the involvement of other parties.

3.2.1. Land Stability

The location of Kali Adem located in the mouth river. Rivers in the tropics area carrying a large number of sediments during the rainy season as high sedimentation events [10,11]. The estuary is characterized by large spatial and temporal variations in flow velocity, flow direction, suspension load, and the related processes of sedimentation and erosion due to an action of river flows or sea tides [12]. Based on the spatial analysis identified that the location of Kali Adem biophysically formed from the sedimentation process and has the potential to disappear again at any time if the stability of the land is not maintained by the physical structure or the presence of mangrove vegetation. The ability of mangroves to maintain coastal stability attached to the conditions of quality and quantity of mangrove forests or in the meaning of the function of protected mangrove forests will decrease if the condition of mangrove forests also decreases, both in quantity and in quality. Also, the existence of this area is in urban areas, in fact, the presence of waste has a negative influence on the quality of the ecosystem. However, based on field observations there are interesting things about the existence of waste in this region. In addition to giving a negative influence on the quality of biophysical waste in this region has a role in terms of land stability. The growth of land that is currently a land where mangroves grow is inseparable from the role of garbage which acts as a stimulus for trapping sediments and mangrove substrates.
3.2.2. Land Status. Based on the analysis of multitemporal satellite imagery the Kali Adem region is a land that formed from an arising land. Based on the Ministry of Agrarian and Spatial Planning Regulation No. 17 of 2016 [11] concerning Land Arrangement in Coastal Areas and Small Islands. Land arising is a land formed naturally because of the deposition process in rivers, lakes, beaches, and or arising islands and the control of land is controlled by the state. Actually, the Kali Adem area was land owned by the DKI Jakarta Provincial Government which was managed by the Muara Angke Commodity Mangrove (KOMMA). The certainty of land ownership is one of the eligibility criteria for rehabilitation efforts. There are 3 land eligibility criteria in rehabilitation attempts, namely: (1) The land has good environmental conditions as a growing media, such as being free from large waves; (2) The land has legal aspects or clear permits from related parties to be planted or rehabilitated, both on private land and state land; (3) The spatial plan of land utilization, in this case, a land can be classified as feasible if the land is not planned for other uses, for example, residential development, dock, etc [14]. The status and certainty of land ownership in rehabilitation efforts in urban areas is very important. Uncertainty in the status of land can make rehabilitation efforts acts temporarily without any sustainability.

3.2.3. Involvement of Stakeholders to Rehabilitation Activities. The history of Kali Adem locations begins with the concerns and awareness of the people around the area about the importance of mangrove ecosystems. In line with this, the Muara Angke Mangrove Community (KOMMA) was formed. KOMMA initiated the nature conservation movement in 2009-2010 by planting mangroves on the banks of the Kali Adem River. Then in 2011 KOMMA collaborated with PT. PJB UP Muara Karang implements and empowers the community as a form of social responsibility. Over time the DKI Jakarta Provincial Government has revoked this activity. The activities that have been carried out include in 2011 is planting 1,000 mangrove seedling, in 2012 the establishment of mangrove nursery locations, in 2013 was carried out pioneering the manufacture of food from pedada (Sonneratia alba), and in 2014-2018 mangrove planting was carried out with 37,000 seedlings.
3.2.4. Availability of Mangrove Seeds. The availability of mangrove seeds is one of the factors that will determine the success of mangrove management [15] in an urban area. The main obstacle of mangrove management in urban areas is the availability of mangrove seeds for planting and rehabilitation. Kali Adem location is an area associated with the Muara Angke Wildlife Reserve and the Kapuk Angke Protection Forest which is the location where mangrove seed is available. The area is a formal conservation area in the mainland area of DKI Jakarta. The formation of mangrove forests throughout the area is affected by tides. This regional association is an important point in the sustainability of efforts to rehabilitate mangroves in urban areas.

4. Conclusion
Mangrove management in urban areas is not easy to implement. Several factors need to be considered in management including land stability, the certainty of land ownership, availability of mangrove seeds,
and involvement of the stakeholders. Kali Adem biophysically formed from the sedimentation process and has the potential to disappear, the stability of the land must be maintained by the physical structure. The certainty of land ownership is one of the eligibility criteria for rehabilitation efforts. The availability of mangrove seeds is one of the factors that will determine the success of mangrove management [15]. Mangrove management requires cooperation and participation by all levels of government and the involvement of the parties [3]. All factors must work together to maintain the presence of mangroves in urban areas which currently have a big threat to disappear. Through the synergy of these factors, Kali Adem has successfully become an ecotourism area called Eco-marine Tourism that has a diversity of flora and fauna.

5. References
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