

**MANGROVE COVER CHANGES
ALONG THE COAST OF DUMAI CITY.
RIAU PROVINCE-INDONESIA**

THESIS

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SUMMARY

Mangroves are unique and valuable coastal ecosystem that occur throughout the tropics and subtropics occupying around 180,000 square kilometers around the world and cover 60 to 70 percent of the coastline of the tropical region. Mangroves forest is estimated to be 3.98 per cent of all forest types in Indonesia and found mostly in the eastern coast of Sumatra, coastline of the Borneo and the largest part in Papua. In the eastern side of Sumatra Island, Riau Province, mangrove forest is distributed along the coast line and in islands such as; Rupat, Dumai, Bengkalis, Merbau, Rangsang, Kundur, Batam and Bintan. The pressures of increasing population, and the resulting expansion of agriculture and industrial and urban development, have destroyed a significant proportion of the mangrove forest in Dumai city. Reliable and timely information is therefore required in order to monitor and manage the remaining mangrove resources.

An analysis of mangrove cover changes of Dumai city between 1989 to 2005 has been carried out from February 2008 until March 2009. The objective the study were; 1) To monitor mangrove cover changes in the last two decades, 1989-2005, 2) ; to study main factors governing mangrove cover changes and, 3) to study the economic impact of mangrove cover changes on fishermen

communities. It employed quantitative and qualitative method of analysis. Quantitative method using remote sensing and geographic information system had been done to monitor mangrove cover changes in the last two decades. Remote sensing using Landsat TM 5 satellite images acquired on July 9th 1989 and February 28th 2005 were utilized to extract general land cover and mangroves cover maps. A GPS-guided field investigation was carried out by using 30 sample points. The result of field work supported the interpretation of Landsat TM images and delianation of the general land cover types and mangrove areas. The field observations provided independent reference data for the accuracy assessment. The qualitative analysis using descriptive method used to answer the second and third objectives. Primary data were derived from in-depth interview with key-informants by using semi-structured questionnaire. Key-informants and fishermen helped to determine major factors drives the changes and identified specific sites where mangrove management had been established and also helped to describe the economic impact of changes to fishermen communities. Secondary data were in the form of government documents, project reports, maps, and report on previous relevant studies to the research topics and were used to analyze the existing projects or anthropogenic activities in mangrove area and its implication to mangrove changes.

Mangroves in Dumai had depleted from 4520.9 hectares in 1989 to 2971.5 hectares in 2005 or around 1549.3 hectares were lost during the last 16 years. Result of analysis shows that mangroves distributes mainly along the coastlines of three sub-districts, they are Dumai Barat, Medang Kampai and Sungai Sembilan. Sungai Sembilan Sub-district posses 4129.37 hectares mangroves in 1989 which

later remains 2867.41 hectares in 2005. There are also mangroves in Dumai Timur sub-district but their existence was very little, only 2.83 hectares 1989 and 2.50 hectares in 2005. Factors affecting mangrove cover changes in Dumai can be divided into two major factors, human-induced and natural factors (abrasion). Human-induced factors consist of industrial and port development, timber extraction for charcoal industry, road construction, conversion of mangroves to plantation and agricultural area, and conversion of mangroves to shrimp ponds. The effect of sea pollution/contamination and waste to mangrove cover changes is not significant. Economic impact of mangroves cover changes on fishermen communities among other were: the reducing of captured fishes and other coastal animals. Conversion of mangrove into other land use also has impacted on loss of capture area for fishermen. All together, it reduces the income of fishermen. At the end, they have to find another source of alternative income or migrate to another island.

This study also suggests that in term of remote sensing approach there is a need to study mangroves cover changes using higher resolution data such as SPOT, IKONOS, and QUICKBIRD to increase the accuracy of quantitative analysis. There is also a need for an integrated study concerning mangroves changes. Local government should be more careful in plotting the next land use plan since changes are normally takes place according to the spatial planning prepared by local government. Government must consider the carrying capacity of the environment, sustainability of natural resources and the relationship between developments with income of local people. Local government should carefully set up new regulation which prohibits illegal logging for charcoal making since

people who works as labor in collecting mangrove trees are mostly poor community. Local government should provide direction, guide, and alternative source of income for the community's survival. There should be a forum for fishermen overall of Dumai city as a medium to communicate, discuss, and to plan fisheries development program in the future. They can discuss with related government agencies concerning potential project to be implemented. This forum should allow the fishermen to exchange news and latest information concerning fisheries and their problems. In terms of mangroves restoration, local government or related NGOs and POs must empower local people in their project. Together with local government, fishermen, NGOs and POs have to look for alternative source of income for the fishermen.

CHAPTER I

INTRODUCTION

1.1 Research Background

Mangroves are unique and valuable coastal ecosystem that occurs throughout the tropics and subtropics, occupying around 180,000 square kilometers around the world and cover 60 to 70 percent of the coastline of the tropical region. Mangroves forest or mangals are defined as unique type of forest which lies along the coastal or the estuarine area which is influenced by the tide. Mangroves forest develops where wave action is absent, sediments accumulate, and the mud is anoxic. They extend from landward to the highest vertical tidal range, where they may be only periodically flooded. The dominant plants are mangroves which include 8 families and 12 genera dominated by *Rhizophora*, *Avicennia*, *Bruguiera*, and *Sonneratia*. Growing with them are salt-tolerant plants, mostly shrubs. Mangals reach the greatest development and have the most species in the Indo-Malaysian region (Smith and Smith, 2003). Mangrove forests have a vital role for a healthy ecosystem. Functionally mangroves support a range of wildlife and fisheries resources, supply a range of commercial products and provide a number of ecological services.

Indonesia is the world's largest archipelago state, with 17,508 islands, 81,000 km of coastline, and a marine area of 5.8 million square kilometers (Nontji, 1987). Mangroves forest is estimated at 3.98 per cent of all forest types in Indonesia (Nonjti, 1987). The total area of mangrove in Indonesia is 3,627,119 ha and is mostly found in; the eastern coast of Sumatra, coastline of the Borneo,

and the largest part in Papua. In Sumatera, mangrove forest is distributed in the eastern coast of Lampung (397,000 ha), eastern coast of North Sumatera (17,000 ha), western coast of Bangka Island (195,000 ha), eastern coast of Aceh (50,000 ha), eastern coast of South Sumatera (60,000 ha) and in Riau (75,000 ha) (Hardjosentono, 1978). In the year of 2000 mangroves in Indonesia are 2,930,000 hectares, which is the biggest mangroves forest in the world (FAO, 2008).

In the eastern side of Sumatra Island, Riau Province, mangrove forest is distributed along the coast line and in islands such as Rupat, Bengkalis, Merbau, Rangsang, Kundur, Batam and Bintan. Riau province posses 234,517 ha of mangrove forest and concentrated in three districts with details 29% (66,920 ha) in Bengkalis, 14% (31,697 ha) in Kepulauan Riau district and the larger proportion 57% (135,900 ha) in Indragiri Hilir District. In a decade (1987-1997) the destruction of mangrove in Riau has reached 43,935 ha (18.7%) (Riau Provincial Forestry Service, 1997).

Mangrove in Dumai now is subjected to economic development where various activities and projects have been implemented in mangrove area. Industrial and urban development, charcoal making, and agricultural activities are major factors responsible for mangrove cover change in Dumai city. The conversion of mangroves into other types of land use clearly threatened mangroves ecosystem and fauna which depend on mangrove forest as their habitat. Industrial development also contaminates water with liquid and solid waste. Extraction of mangroves for woods and charcoal making lead to the continoues depletion of mangrove.

Mangrove maps have been used for three general management applications; resource inventory and assessment, change detection, and the selection and inventory of aquaculture sites (Thu and Populus, 2007). Examples application of remote sensing for resource inventory and assessment are; the application of Landsat data to study mangrove ecologies in Ghana by Coleman, Manu and Twumasi (Undated), and ecological assessment and strategies for the management of mangroves in Brisbane Water-Gosford, New South Wales, Australia (Harty and Cheng, 2003). While the example for selection and inventory of aquaculture sites is the assessment of the impact of shrimp aquaculture in Northeast Brazil (Zitello, 2007).

1.2 Research Problems

The pressures of increasing population, and the resulting expansion of agriculture and industrial and urban development, have caused a significant proportion of the mangrove forest to be destroyed. Reliable and timely information is therefore required to monitor and manage the remaining mangrove resources. In many cases however, such data are not available, hence there is a need to study the changes on mangrove cover in Dumai city using remote sensing technique. After evaluating the changes, it is important to study what are the factors behind the changes. Since mangrove forest is very important for sediment and nutrients retention, a nursery, spawning, and feeding ground for fish shrimp and other aquatic animals, the loss of mangrove forest would reduce the fisheries production. Hence there is also a need to study what are the economic impacts of changes to fishermen community. In this regard, there are three research questions to be answered:

1. How was mangrove cover changed in the last two decades?
2. What are the main factors governing mangrove cover changes?
3. What are the economic impacts of mangrove cover changes on poor fishermen community?

1.3 Research Objectives

The objectives of the study are:

1. To monitor mangrove cover changes in the last two decades, 1989-2005;
2. To study main factors governing mangrove cover changes; and
3. To study the economic impact of mangrove cover changes on poor fishermen communities.

1.4 Significance of the Research

The study is expected to increase the awareness of Government, People Organizations, Non Governmental Organizations, and other stakeholders. It may also help in managing sustainable mangrove forest in Dumai city.

1.5 Scope and Limitation of the Research

This study tries to monitor changes in mangrove cover using remote sensing technique. The changes are limited to change in mangrove cover area and the land cover category that can be observed from Landsat TM imageries only. Factors influencing mangrove changes also studied, later the economic impact of mangrove cover changes also considered. Impacts on poor fishermen communities where people are depending on coastal resources to fulfill their need are emphasized in this study.

CHAPTER V

CONCLUSION AND RECOMENDATION

5.1 Conclusion

Mangroves area in Dumai has decreased from 4,520.9 hectares in 1989 to 2,971.5 hectares in 2005 or 1,549.3 hectares were lost during the last 16 years. Mangrove distributes mainly along the coastlines of three sub-districts; Dumai Barat, Medang Kampai, and Sungai Sembilan. Sungai Sembilan Sub-district possessed 4,129.37 hectares mangroves in 1989 which later remains 2,867.41 hectares in 2005. There are also mangroves in Dumai Timur sub-district but their existence was very small, only 2.83 hectares 1989 and 2.50 hectares in 2005.

Factors affecting mangrove cover changes in Dumai can be divided into two major factors, human-induced and natural factors (abrasion). Human-induced factors consist of industrial and port development, timber extraction for charcoal industry, road construction, conversion of mangroves to plantation and agricultural area, and conversion of mangroves to shrimp ponds. The effect of sea pollution, water contamination, and waste on mangrove cover changes is not significant.

Economic impact of mangroves cover changes to fishermen communities is the reducing fish and coastal animals to capture. Conversion of mangrove into other land use also has impact on loss of capture area for fishermen. All together it reduces their income. At the end, they have to find another source of income.

5.2 Recommendation

With technological advancement, studying mangroves cover changes using remote sensing approach can take advantages of recently available higher resolution data to increase the accuracy of quantitative analysis.

There is a need for integrated study concerning mangroves changes, the level of sea pollution and contamination and its relationship with fish population. There is need for deeper economic study regarding fishermen income from time to time. The result of this integrated research can be used as a consideration for decision makers to implement a more strategic way to develop Dumai city without abandoning the potential of the region for local fishermen.

Spatial planning plays a very important role in the development of a city. So government should be more careful in plotting the next land use plan since changes are normally takes place based on the spatial planning. Before plotting, there should be a complete preliminary analysis regarding the suitability of the region. Government must consider the carrying capacity of the environment, sustainability of mangrove resources, and the relationship between developments with local fishermen since the most affected people by mangrove changes are poor fishermen.

One of the factors affecting mangrove cover changes is charcoal making, but until now there's no local regulation which prohibits illegal logging for charcoal making. Local government must be careful in setting up a kind of regulation; there should be different sanction between the owners of the business with local people who works as mangrove wood collectors.

There should be a forum for every fishermen overall of Dumai city, so they can communicate, discuss and plan fisheries progress in the future. They can discuss with related government agencies concerning potential project to be implemented. This forum allows the fishermen to exchange news and latest information concerning fisheries and their problems.

In terms of mangroves restoration, local government or related NGOs and POs must empower local people in their project. Because most of the times local people already known how importance mangroves for the ecosystems is, they know their area better than the others, they know the right timing for planting, and good quality of seedling.

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