Sumatra Journal of Disaster, Geography and Geography EducationJune, 2022. Vol.6. No.2. pp. 36-41
Disaster, Geography, Geography Education http://sjdgge.ppj.unp.ac.id/index.php/Sjdgge
ISSN : 2580 - 4030 (Print) **2580 - 1775** (Online), Indonesia

A ESTIMATION OF BLUE CARBON (BC) POST-DEVELOPMENTOF MANDEH REGIONS

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ABSTRACT: The Mandeh regions is one of the coastal and marine ecosystems in the Province of West Sumetera. Mandeh regions has mangrove forests, seagrass beds and sizable coral reefs. Nowadays, Mandeh regions has been completed in the development, especially in development of road access to increase the acceleration of the development of Mandeh tourist destinations as a new destination in West Sumatra. However, in that development, it turns out that it has affected many forest ecosystems and coastal and marine ecosystems, one of which is the reduction of blue carbon which is one of the ways to mitigate climate change. Therefore, this research is very important to do considering the impact of development on the coastal and marine ecosystems. This research is the first study conducted in the Mandeh regions with a focus on estimatingblue carbon stored in mangrove forests and coral reefs. This study aims to determine and analyze the blue carbon contained in the Mandeh regions after the development, especially the opening of roads. The results showed that from 1999 to 2019 there was an ecosystems degradation which caused a decrease in carbon stocks. Estimated carbon stock in the mangrove ecosystem is around 257 Mg.C / Ha and coral reefs 3291 g.C / m2. Estimated carbon stock is not much different from other studies in Indonesia, thus after the opening of the roadin Mandeh regions does not significantly affect mangrove ecosystems and coral reefs, so that ocean carbon uptake, is still quite large.

Keywords: Blue Carbon, Mandeh Region

1. INTRODUCTION

As one of the developing countries that have the largest tropical forests in the world, Indonesia is an important country that can reduce emissions from deforestation and forest degradation, as well as through carbon sequestration. In addition to carbon sequestration through forests, Indonesia also has coastal and marine ecosystems that are capable of absorbing and storing more carbon than forests known as Blue Carbon. The ability of coastal and marine ecosystems has made its role recognized in tackling climate change [1]. However, the coastal blue carbon ecosystem is one of the most threatened ecosystems on Earth, with around 340,000 to 980,000 hectares of this ecosystem being destroyed every year [2] . It is estimated that up to 67% and at least 35% and 29% of the total global mangrove forest coverage, tidal swamps, and seagrass beds, sequentially, have been lost. If this continues at a steady rate, 30-40% of tidal swamps and seagrass beds and almost all unprotected mangroves will disappear within the next 100 years [3]

Mandeh regions is one of the coastal and marine ecosystems in the Province of West Sumetera. Mandeh regions has mangrove forests, seagrass beds and sizable coral reefs. The three coastal and marine ecosystems are the key to blue carbon [4] . The carbon that is retained in coastal ecosystems' sediments throughout geological timescales and sequestered by such ecosystems is known as "blue carbon" [5]. Mangroves, seagrasses, and saltmarshes are widely known for their capacity to store carbon, and conservation efforts are increasingly focusing on preserving these ecosystems as a method to reduce high CO2 emissions [6]. The carbon stored as blue carbon is not stored for centuries like a forest, but thousands of years as long as in normal conditions [7]. Currently, the development of Mandeh regions has been completed, especially the construction of road access to improve the acceleration of the development of Mandeh tourist destinations as a new destination in West Sumatra. The road construction will improve road connectivity starting from Teluk Kabung - Sungai Pisang – Sungai Nyalo - Mandeh - Carocok – Tarusan.

However, in that development, many forest ecosystems and coastal and marine ecosystems were evidently affected. Forest ecosystems have to be cut down so that the number has decreased and the abundance of yellow soil (material) from the road construction affects the exposed marine and coastal ecosystems, resulting in changes in the bottom water ecosystem around the development site. Unresolved damage of mangrove ecosystem

will cause losses to other aspects such as reducing coastal areas, reducing numbers of fish and biodiversity loss. Changes in coastal and marine ecosystems not only occur in mangrove forests and seagrass beds, but also have an impact on coral reefs. Coral reef ecosystems in these waters are covered by soil for long periods (days) and can cause coral reef destruction.

2. RESEARCH AND METHODS

The research was conducted in the Mandeh Region, Pesisir Selatan Regency, the objects of the research are mangrove and coral reefs. The data used in this study were Landsat 5 Imagery in 1999, Landsat 7 in 2009, Landsat 8 in 2019. Data analysis was performed by using transform algorithm by Lyzenga to the supervised classification method for the classification process and field survey using line intercept transects to observe the condition of coral reefs and mangroves. By multiplying the area by the value of carbon stocks derived from the findings of literature studies, mangrove forests' and coral reefs' capacity to absorb carbon (C) is determined. The instructions for estimating carbon emission factors published by [5] on carbon stock accounting (Tier 2), where the data utilized is based on data from national or local research areas, are modified to fit this methodology.

3. RESULTS AND DISCUSSION

Mangrove is one of the blue carbon parameters, because of its role in utilizing CO2 for photosynthesis and storing it in the form of biomass and also in sediments [8]. As a result of carbon sequestration, mangroves store carbon in biomass, both on the substrate (stems, leaves and twigs) and under the substrate (roots). Moreover, the mangrove part that has become litter, can be buried in the substrate as carbon stocks in the sediment. According to [9], mangroves store 3 more carbon than almost all other forests on earth. Meanwhile according to [10], Indonesia's mangrove ecosystem is able to absorb carbon in the air as much as 67.7 Mt per year. The amount of carbon content is influenced by the ability of the tree to absorb carbon from the environment through the process of photosynthesis, which is known as the sequestration process [11].

In general, the composition of mangrove plants in the Mandeh regions was dominated by Rhizophora sp type. According to [12] Rhizophora type mangrove has a higher adaptability compared to other types. Based on the results of research conducted in the Mandeh Region in 1999-2019 using Landsat satellite imagery, which was then followed by groundcheck to the field, it was known that there was an area change of mangrove plants. The area change based on Table 1 shows that from 1999 to 2009 there was an area which had decreased as much as 76 Ha. Furthermore, from 2009 until 2019, mangroves forest has been increasing through various mangrove reclamation and conservation activities, resulting an increase in area of 11 Ha. Thus, from 1999 to 2019, the decrease of mangrove plants was 64 Ha. Furthermore, in Table 1 it is also known that the coral reefs in the Mandeh Regions from 1999 to 2009 has also decreased by 7 Ha, while from 2009 to 2019, with various coral reef reclamation activities and increased public awareness of the benefits of coral reefs, then an increase by 14 Ha has occured.

Changes in mangrove and coral reefs area can be seen in Figures 1 and 2, where the largest mangrove area is located in the south of the Mandeh regions exactly on Nagari Mandeh and Ampang Pulai, while the distribution of coral reefs is located around the Nagari Sungai Pinang and Nagari Mandeh. A decrease in mangrove area caused by low awareness and public knowledge about the benefits that can be provided by mangrove plants. Whereas, if the community can use it well, mangroves are not only used as a tourist attraction, but also preventing the abrasion and storing carbon, also used as a source of life. This is because of there are lots of marine biota that live around mangroves.

Carbon reserves describe how big a tree is in storing carbon. The size of carbon storage in a vegetation depends on the amount of biomass contained in trees, soil fertility and the absorption capacity of the vegetation [8]. According to Heriyanto and Subandono [13] carbon content in plants illustrates how large the plant can bind CO2 from the air. Plants absorb CO2 from the air and then convert it into organic matter through the photosynthesis process used for growth. Therefore, changes in the number and area of plants can directly affect the amount of carbon stock available.

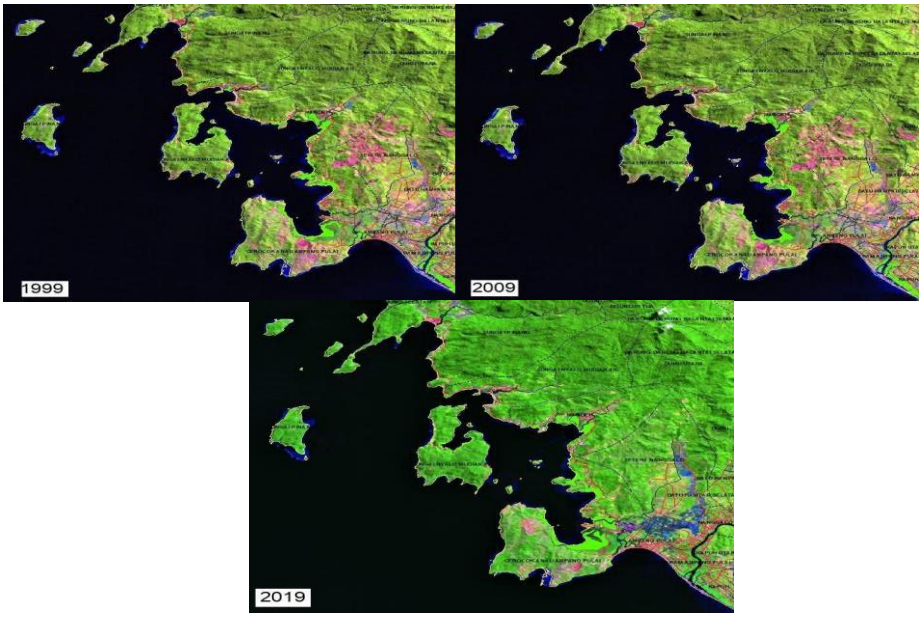

Fig 1. Changes in Covering Land of Mangrove in the Mandeh

Tabel 1. Changes in Land Cover in the Mandeh

Land cover area (Ha)	Year				
	1999	2009	Changes (1999-2009)	2019	Changes (2009- 2019)
Mangrove	306.713716	230.5662356	76.1474804	241.9010976	-11.334862
Coral Reefs	130.4173808	122.4721233	7.9452575	137.1531845	-14.6810612

Source: Results of data analysis, 2019

According to Table 2, the carbon stocks in mangrove plants in the Mandeh region decreased between 1999 and 2009 before increasing in 2019. The same is similar for coral reefs, which fell from 1999 to 2009 before increasing once more in data 2019 (257 Mg.C / Ha mangrove and 3291 gC / m2 coral reef). The estimated carbon stocks are not much different from previous studies, which were mentioned for the Ciasem-West Java mangrove. A. marina-dominant plants with carbon deposits of 182.5 MgCha-1 [14] and above 200 MgCha-1 in Bintuni, Timika, and Sembilang [15]. According to Murdiyarso et al. [16], mangroves may store 20 Pg of carbon globally, with 70–80 Pg of that stored as organic matter in the soil. While the carbon stores of coral reefs range between 1500 and 4500 grams of carbon per square meter [17]. Because coral reefs and mangrove habitats were not greatly impacted after the Mandeh area's roads opened, there was still a sizable amount of carbon absorbed by the ocean. Therefore, if degraded, blue carbon can increasethe process of global warming [18] [19]. Blue carbon is stored in mangrove land, thus giving a positive influence on coastal, marine, and terrestrial environmental conservation [20] [21].

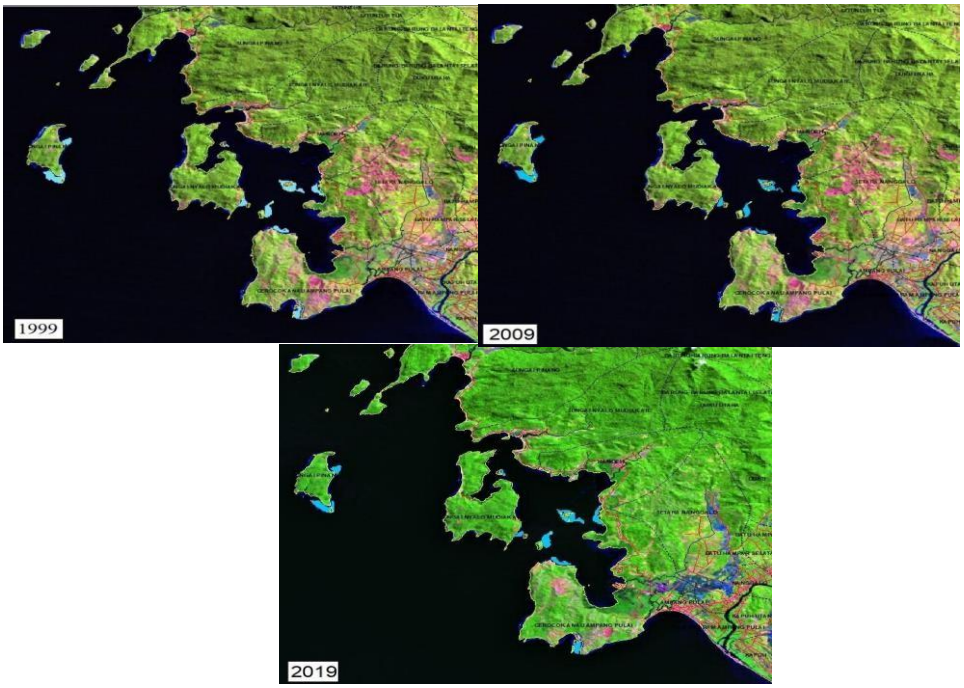

Fig 2. Changes in Covering Land of Reefs in the Mandeh

Table 2. Carbon Reserves in the Mandeh

Carbon Reserves	Year				
	1999	2009	Changes (1999-2009)	2019	Changes (2009-2019)
Mangrove (Mg C/ha)	313.7681315	235.869259	77.8988725	247.4648229	-11.5955639
Coral Reefs (g C/m2)	3130.017139	2939.330958	190.686181	3291.676428	-352.34547

Source: Results of data analysis, 2019

The ability of coastal ecosystems like mangroves and coral reefs to absorb and store significant amounts of blue carbon from the atmosphere and ocean has led to increased awareness of these ecosystems importance in combating climate change [1]. In a comparison of blue carbon ecosystems around the world, which are thought to absorb 42 billion t of CO^2eq [22], the blue ecosystem in Korea is estimated to absorb 1.01 million t CO^2eq [23], the blue ecosystem in Abu Dhabi is 39.16 million t CO^2eq, and the blue ecosystem in Indonesia is 138.23 million t CO^2eq. According to the findings of the aforementioned study, coastal blue carbon habitats are the most endangered on Earth, with 340,000 to 980,000 hectares of this environment being lost each year [2].

4. CONCLUSION

The Mandeh regions is one of the coastal and marine ecosystems in the Province of West Sumetera. The Mandeh regions has extensive mangrove forests and coral reefs. The results showed that from 1999 to 2019 there was a decline in ecosystems which caused a decrease in carbon stocks. Estimated carbon stock in the mangrove ecosystem is around 257 Mg.C / Ha and coral reefs 3291 g.C / m2. Estimated carbon stock is not much different from other studies in Indonesia, so that after the opening of roads in the Mandeh regions, it does not significantly affect mangrove ecosystems and coral reefs, so that carbon uptake from the sea is still quite large.

5. REFERENCES

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