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ECONOMIC VALUATION OF MANGROVE CARBON STOCK ON PAYUNG ISLAND, BANYUASIN REGENCY, SOUTH SUMATRA PROVINCE

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KEYWORDS
Economic valuation; carbon stocks; mangrove; Payung Island; Banyuasin; South Sumatra.

ABSTRACT
This study aims to conduct an economic valuation of mangrove carbon stocks found on Payung Island, Banyuasin Regency, South Sumatra Province. Mangroves are coastal ecosystems that play an important role in storing carbon and providing ecological and socio-economic benefits to local communities. The research method used is a field survey and analysis of the latest data on carbon content in mangrove ecosystems. In addition, interviews were also conducted with relevant stakeholders to understand the economic benefits generated from mangrove ecosystems, such as income from the fisheries sector, tourism, and conservation efforts. The results of this study are expected to provide information about the economic value of mangrove carbon stocks on Payung Island. The implications of this research are expected to be used as a basis for decision making related to mangrove ecosystem management and preservation. In addition, this research can also provide a better understanding of the importance of mangrove conservation as a valuable natural resource, both in terms of environment and economy.

INTRODUCTION

Mangroves are one of the important coastal ecosystems because they function as a buffer area between the marine and terrestrial environments and have an important role in maintaining human survival. One of the benefits provided by mangrove ecosystems is their ability to absorb carbon dioxide (CO_2) from the atmosphere. Absorption of CO_2 by mangroves through the process of photosynthesis and storage in the form of carbon stocks in plant tissues. Therefore, mangroves are considered as one of the solutions in reducing greenhouse gas emissions (Pidgeon, et al. 2020).

Based on the agreement contained in the Paris Climate Agreement 2015 at the UNFCCC Conference of the Parties (COP-21), countries in the world including Indonesia must reduce carbon emissions in the future with the main aim of reducing global warming. Each country is encouraged to take concrete actions in the form of integration in mitigation and adaptation efforts to reduce carbon emissions in the context of sustainable development nationally and sectorally (Santoso, 2015).

On an international scale, one of the efforts to curb the rate of deforestation and forest degradation has been agreed through the REDD+ (Reducing Emissions from Deforestation and Degradation Plus) program. REDD+ is a program that provides funding to forest areas that have been successfully defended from the rate of destruction. The concept of REDD+ specifies countries that receive funding to protect their forests from deforestation and degradation in order to function as climate change mitigation in the form of carbon sinks and carbon stocks produced from production and consumption patterns elsewhere in the world. Funds in the form of these incentives will be provided based on the estimated calculation of carbon that can be absorbed and stored in REDD+ activities (Syafruddin et al. 2018).

Reducing CO_2 emissions through various forest vegetation is urgently needed. Mangrove ecosystems have the ability to absorb CO_2 like other forest ecosystems, so mangrove forests have a role to reduce carbon dioxide concentrations in the air (Windarni et al. 2018) and are able to store 10x more carbon than other ecosystems (Lestariningsih et al., 2018). Carbon dioxide uptake is closely related to tree biomass. This shows that mangrove ecosystems are able to play a role in efforts to mitigate and change world climate (Lestariningsih et al., 2018).

Payung Island in Banyuasin Regency, South Sumatra Province is one of the locations that has a sustainable mangrove ecosystem and has the potential to be a significant source of carbon stocks. However, until now there has been no research that conducts economic valuation of mangrove carbon stocks on Payung Island. Economic valuation of mangrove carbon stocks is needed to provide a view of the economic value of mangrove ecosystems as natural resources that can be used sustainably.

Several previous studies have been conducted to measure mangrove carbon stocks in various regions in Indonesia. For example, research conducted by UNEP (United Nations Environment Programme) in 2009 showed that mangroves in the Southeast Asian region have an average carbon stock of 1.023 tons of carbon per hectare. Meanwhile, research conducted by (Alongi, 2014) shows that mangroves in the Australian region have an average carbon stock of 920 tons of carbon per hectare. In addition, there are also studies that measure the economic value of mangrove ecosystems. For example, research conducted by Saifullah and Rosiana (2019) shows that the economic value of mangrove ecosystems in the Karimunjawa National Park area reaches Rp 196.557.720.000 per year.

This study aimed to conduct an economic valuation of mangrove carbon stocks on Payung Island, Banyuasin Regency, South Sumatra. In this study, measurements of carbon stocks in mangrove plants will be carried out and calculation of the economic value of these carbon stocks. The data collected will be used to develop strategies for sustainable management of mangrove ecosystems and reduce greenhouse gas emissions. In addition, this research is expected to contribute efforts to mitigate climate change and maintain the sustainability of mangrove ecosystems on Payung Island, Banyuasin Regency, South Sumatra.

METHOD RESEARCH

Identify the research site

The study was conducted on Payung Island, Banyuasin Regency, South Sumatra Province with coordinates 2º 22' 51,00" S and 104º 55' 16,00" E. This island was chosen because it has a sustainable mangrove ecosystem and has the potential to be a significant source of carbon stocks.

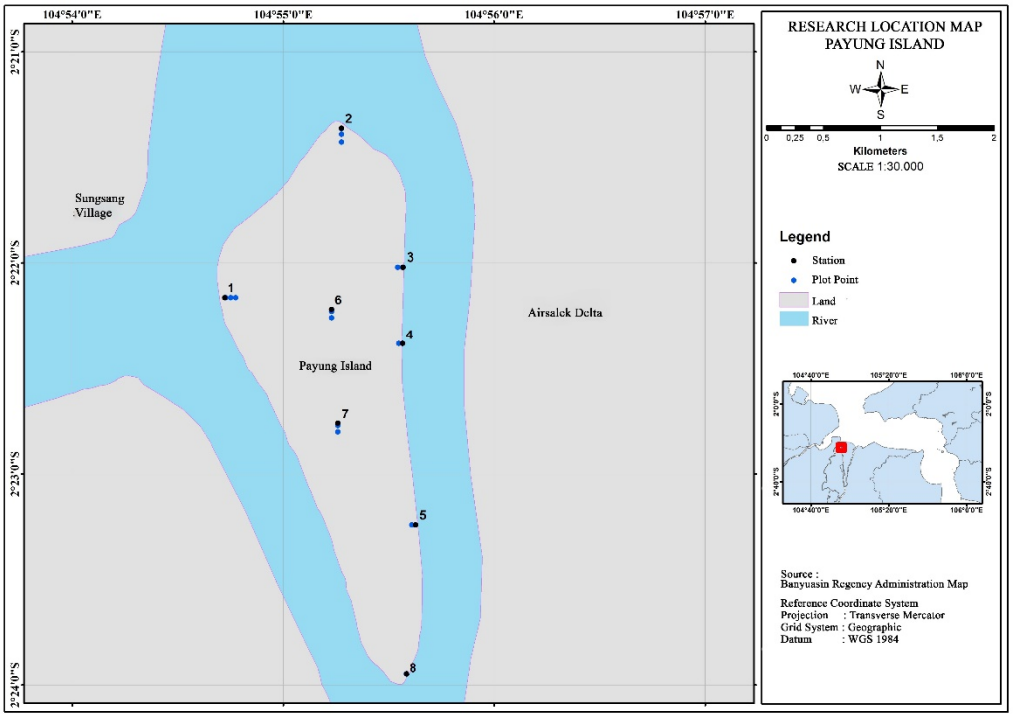

Figure 1
Map of Research Location Station

Data collection

Data collection is carried out using primary data and secondary data. Primary data are obtained from surveys and direct measurements while secondary data are obtained through literature study methods. Secondary data collected include books, records and reports containing data on carbon stocks in mangrove plants including stand biomass, root biomass to sediments on Payung Island.

Measurement of mangrove carbon stocks

Measurement of carbon stocks in mangrove plants is carried out using a non-destructive method, namely measuring the diameter and height of mangrove trees. The collected data is used to calculate the biomass and carbon content in it.

Determination of the economic value of mangrove carbon stocks

In this study, the replacement cost calculated is the cost of replacing carbon dioxide absorbed by mangroves on Payung Island based on prices in the *voluntary market*. This value is formed because of the desire to reduce greenhouse gas emissions without obligation, for

example a non-governmental organization that certifies carbon offsets in order to participate in protecting the environment (Easteria et al., 2022).

Data analysis

The collected data is analyzed using Microsoft excel software to calculate carbon stocks and multiplied by the average selling value of carbon globally.

RESULTS AND DISCUSSION

Characteristics of Mangrove Ecosystem on Payung Island

Payung Island in Banyuasin Regency, South Sumatra has an area of ± 490 hectares based on the Decree of the Minister of Forestry No. 866 / Menhut-II / 2014, which is dominated by mangrove forests which are estimated to live in more than 50% of the area of Payung Island (Hermialingga et al., 2020). The mangrove ecosystem on Payung Island has varied mangrove species including Avicennia *alba, Avicennia* marina*, Bruguiera sexangula*, Excoecaria agallocha*, Kandelia candel*, *Nypa fruticans, Rhizophora apiculata, Sonneratia caseolaris, Xylocarpus granatum with a* biodiversity index (H') value of 1.21 (Hermialingga et al., 2020). The characteristics of mangrove ecosystems on Payung Island that affect carbon availability are species type, soil fertility level, and hydrological conditions (Hermialingga et al., 2020).

Mangrove Carbon Stock on Payung Island

Data on the estimation of carbon stocks in mangrove land on Payung Island are presented on Figure 2.

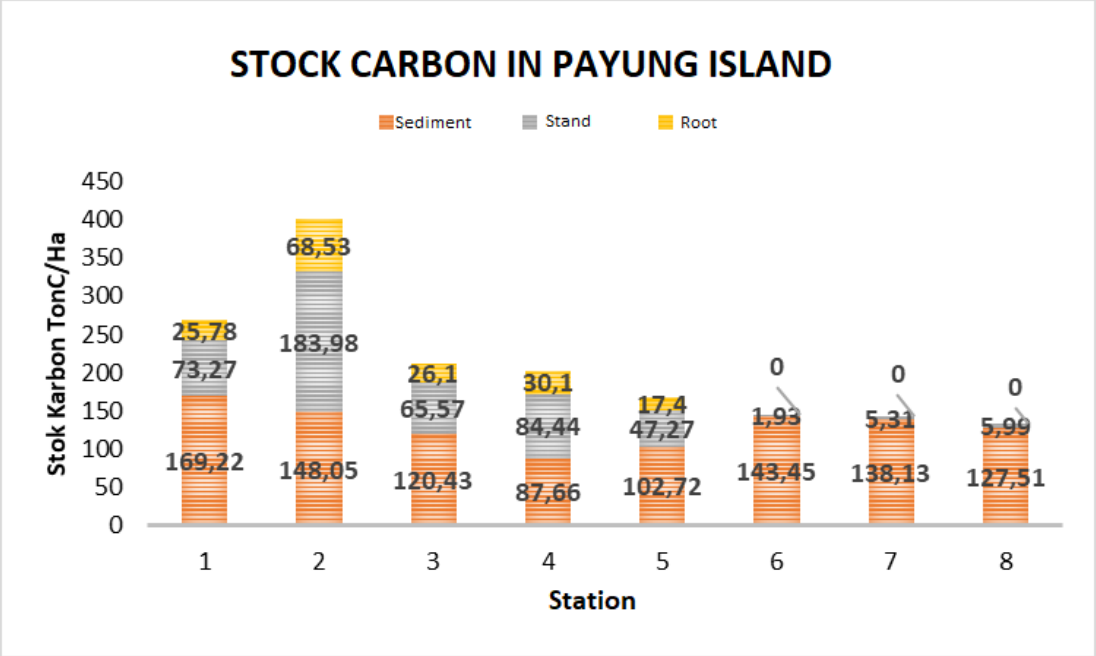

Figure 2
Payung Island Carbon Stock Value Graph

The total mangrove carbon stock at each Payung Island station is the result of the accumulation of three components, namely carbon stock in stands, carbon stock in roots and carbon stock in sediments. Shown in Figure 1 the largest total carbon stock value is at station

2 at 400,56 tons C / ha, then station 1 is 268,27 tons C / ha, station 3 is 212,1 tons C / ha, station 4 is 202,2 tons C / ha, station 5 is 167,39 tons C / ha, station 6 is 145,38 tons C / ha, station 7 is 143,44 tons C / ha, and station 8 is 133,5 tons C / ha. At station 2 the value of carbon stock becomes the highest due to the additional value of biomass of the upper stand and roots which is also high. Based on these three components, the sediment component is able to store more carbon than the upper and lower stands (roots).

Carbon stocks in mangroves on Payung Island in this study obtained an average yield of 209.11 tons C / ha and a total carbon stock of 1.672 tons C / ha. The largest carbon stock is found in sediment components with an average of 129,65 tons C / ha, followed by the average value of stand biomass of 58,47 tons C / ha, and the average value of root biomass of 33,58 tons C / ha. The average total value of carbon stocks in this study is relatively greater when compared to other studies in line such as Ati et al. (2014) in Miskam Bay, Tanjung Lesung which is 83,25 tons C / ha, then it is also greater than the total carbon storage of mangroves research Rahmah et al. (2015) on the coast of Banda Aceh City which is 89,24 tons C / ha, and greater when compared to the results of mangrove carbon stocks in the research of Ihsan et al. (2017) in Probolinggo which is 28,89±51,07 Mg/ha and the value of carbon stocks in this study is not much different from the research of (Kepel et al., 2019) in North Sulawesi which is 98,16±345,24 MgC/ha.

However, the total average value of carbon stocks in this study is smaller than the research of (Murdiyarso et al., 2015) in Sembilang National Park, which is 1.307,9 MgC / ha, this can be because the mangroves in TNS are much larger and older than Payung Island mangroves and their area is much wider. This difference in carbon stock can be caused by differences in the number of transects or plots in data collection, differences in mangrove species composition, biomass, organic carbon content, soil type, and interval differences in the use of sediment samples. In addition, changes and differences in climate in each region such as rising temperatures, increasing frequency of extreme weather and changes in rainfall patterns can affect carbon stocks in mangrove forest.

Economic Valuation of Payung Island Mangrove Carbon Stock

Economic valuation is a method to determine a quantitative value of goods and/or services provided by ecosystems and their contribution to the welfare of mankind (Lahjie et al., 2019). Carbon content has economic value. The calculation of the economic value of carbon in upper biomass, lower biomass (root) and mangrove sediment in the Payung Island area can be seen in Table 1. The calculation of the economic value of carbon can be done by calculating the total carbon stock in 490 hectares of Payung Island mangrove area multiplied by the global average carbon selling value of US$ 3-7 / ton (*ecosystem marketplace* data), assumed at US$ 5 / ton C (Rp 15.000 per US $ 1).

Table 1
Calculation of the Carbon Economic Value of the Payung Island Area

No.	Part	Total value of carbon stock	Total value of Payung Island carbon stock	The economic value of carbon Payung Island
1.	Stand biomass	467,76 tonC/ha	229.202 tonC	Rp 17.190.180.000
2.	Root biomass	167,91 tonC/ha	82.276 tonC	Rp 6.170.692.500
3.	Sediment	1.037,17 tonC/ha	508.213 tonC	Rp 38.115.997.500
TOTAL		**1.672,84 tonC**	**819.692 tonC**	**Rp 61.476.870.000**

Based on calculations, it is found that the total carbon economic value on Payung Island reaches Rp. 61.476.870.000, The results of this analysis show that carbon storage is an added value in ecosystem services that have great potential in world carbon trading because Indonesia is an archipelagic country with a long coastline so that it has the potential to be the largest carbon stock producing country. If from the average calculation of each hectare of mangrove land there are 1.000 tons of C, then if there are 3,3 million hectares of mangrove land in Indonesia, it can be projected that the carbon stock owned can reach 3,3 billion tons C with a carbon economic value of at least Rp 245 trillion.

Economic Value of Mangrove Carbon Stock on Payung Island

Based on economic valuation analysis, the economic value of mangrove carbon stock on Payung Island is Rp 125.463.000 per hectare or around Rp 75.000 per ton of carbon. The economic value comes from the contribution of mangrove carbon stocks in reducing greenhouse gas emissions and the economic value derived from the potential utilization of mangrove carbon stocks as renewable energy sources and industrial raw materials.

CONCLUSION

This study provides important information about the economic value of mangrove carbon stocks on Payung Island, Banyuasin Regency, South Sumatra. With the economic valuation of mangrove carbon stocks, it is expected to be one of the considerations in making sustainable mangrove management policies. In addition, this research also contributes to efforts to mitigate climate change and maintain the sustainability of mangrove ecosystems on Payung Island, Banyuasin Regency, South Sumatra. The value of mangrove carbon stock on Payung Island is 819,682 tons C with an economic value valuation of Rp 61.476.870.000 or Rp 125.463.000 per hectare.

Based on the results of this study, mangrove management strategies can be implemented on Payung Island through strengthening the role of the community in mangrove ecosystem management, community empowerment in mangrove planting and sustainable management of mangrove ecosystems. In addition, the development of bioenergy production technology from mangroves can also be an alternative to sustainable mangrove management.

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