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Original Article

Ecosystem services-based mangrove forest with management model strategies, sustainability of coastal natural resources

Serviços ecossistêmicos de florestas de manguezal com estratégias de modelo de manejo, sustentabilidade dos recursos naturais costeiros

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Abstract

The purpose of this research is to examine; Ecosystem Services Based Mangrove Forest with Management Model Strategies, Sustainability of Coastal Natural Resources. This research design uses systematic review namely library research that examines quality and critical journals, which have been filtered with inclusion criteria and uses several Google Scholar, Pubmed, Science Direct and Research gate databases as literacy in this study. A search of 2018-2023 articles returned 17,000 keyword results. Ecosystem Services Based Mangrove Forest with Management Strategies, which were filtered into 10 journals according to the theme and analyzed by reviewing them. Ecosystem Services Based Mangrove Forest with Management Strategies. The research results show that mangrove ecosystem services with an area of 88,556 ha was Rp 6,961,126,186,194 year-1 (US$ 467,974,555.06 year-1) or Rp 78,607,444 ha-1-1 (US$ 5,284.5 ha-1year-1). Ecosystem Services Based Mangrove Forest with Management Strategies, that there are three main components that must be considered in efforts to manage and utilize mangrove ecosystems and coastal natural resources, namely; 1) social activity(social processes) provide socialization or understanding to the community about the importance of protecting mangrove forests and the benefits that the community will receive 2) the economy(economic processes) take advantage of the existing potential by planting mangrove trees, and 3) the natural resources themselves(natural processes) Mangrove forest management includes establishing protected forest areas for mangrove forest conservation so that they are well maintained and sustainable. From the socio-economic, cultural and human aspects, natural resources are needed to be able to continue their lives, on the other hand, the existence or sustainability of coastal natural resources is very dependent on human activities as the main users of natural resources.

Keywords: ecosystem, service-based, mangrove, forest, management, strategies, sustainability, coastal, natural resources.

Resumo

Este estudo analisa os serviços ecossistêmicos fornecidos por florestas de manguezal e propõe estratégias de manejo para a sustentabilidade dos recursos naturais costeiros. A metodologia utilizada foi a revisão sistemática, ou seja, pesquisa bibliográfica que examina periódicos críticos e de qualidade, revisados por pares em bancos de dados como Google Scholar, Pubmed, Science Direct e Researchgate. Uma pesquisa de artigos de 2018-2023 retornou 17.000 resultados com as palavras-chave "Serviços Ecossistêmicos de Florestas de Manguezal com Estratégias de Manejo". Após filtragem de acordo com o tema, foram analisadas 10 publicações científicas. Os resultados da pesquisa mostraram que os serviços ecossistêmicos de mangue com uma área de 88.556 ha foram de Rp 6.961.126.186.194 ano-1 (US$ 467.974.555,06 ano-1) ou Rp 78.607.444 ha-1-1 (US$ 5.284,5 ha-1ano-1). O estudo também identificou três componentes principais a serem considerados no manejo e utilização dos ecossistemas de manguezais e recursos naturais costeiros: 1) a atividade social (processos sociais) proporciona socialização ou compreensão à comunidade sobre a importância de proteger os manguezais e os benefícios que a comunidade receberá; 2) a economia (processos econômicos) aproveita o potencial existente plantando árvores de mangue; e 3) os próprios recursos naturais (processos naturais). O manejo dos manguezais inclui o estabelecimento de áreas florestais protegidas para a conservação das florestas de manguezais, para que sejam bem mantidas e sustentáveis. Do ponto de vista socioeconômico, cultural e humano, os recursos naturais são necessários para poder continuar as suas vidas. Por outro lado, a existência ou sustentabilidade dos recursos naturais costeiros está muito dependente das atividades humanas, uma vez que o ser humano é o principal usuário desses recursos.

Palavras-chave: ecossistema, baseado em serviços, manguezal, floresta, manejo, estratégias, sustentabilidade, costeiro, recursos naturais.

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1. Introduction

Mangroves provide a vast ecosystem for living things such as fish, shrimp, and communities (Niagara et al., 2021). Coastal development has changed land use, resulting in a massive conversion of mangroves into settlements. This also damages mangrove ecosystems so that they interfere with environmental and socio-economic functions (Hofmeister et al., 2019). The role of mangrove ecosystems is closely related to the quality of seawater close to the coast (Kelleway et al., 2020) because mangrove conversion will have an impact on commercial fisheries throughout the surrounding area as well as on their economic value. Mangrove ecosystems play an important role ecologically and economically because they have substantial services for humans and the environment (Lee et al., 2019) such as household needs (forest products and various mangrove products), livelihoods, coastal protection, habitat provision, storm protection, and water quality maintenance (Strain et al., 2022).

In recent decades, mangrove ecosystems have been under constant pressure due to diverse human activities and high rates of population growth. Indonesia is known as the country with the largest mangrove forest in the world, with an area of 3,112,989 ha or 22.6% of the world's mangrove forest area (Mayarni et al., 2023). On the other hand, Indonesia's mangroves also experience the highest deforestation rate (Saputra et al., 2020), with total deforestation in the last three decades of 40%, caused by logging, land conversion for agriculture, shrimp and lianya ponds (Sari et al., 2021). The use of mangroves to meet community needs tends to be intensive and not in accordance with conservation principles. The rapid expansion of shrimp ponds has raised environmental issues about the conversion of ecologically important mangrove areas. Deforestation of mangroves and expansion of aquaculture have resulted in the occurrence of sedimentary organic matter in recent decades. They can change the quality of ocean waters (Jennerjahn et al., 2022). This impact is felt by coastal residents, especially by fishing communities who depend on mangroves for their lives (Hidayat and Dessy, 2021). Several studies show that mangrove and fishery ecosystems have a strong linkage, especially in supporting economic activities in the fisheries sector, not only in capture fisheries but also marine aquaculture in coastal areas (Oktamalia et al., 2018).

In Indonesia, it is an archipelagic country with more than 17,504 islands and surrounding 95,181 km of coastline (Purwanto et al., 2022). Indonesia has 3.1-3.7 million hectares of mangrove forest area or more than 20% of the world's mangrove forest area with high species diversity. Thelargest concentration of mangrove forests is in Papua and Sumatra (Vincentius, 2020). In addition, areal potential for planting mangrove species is around 7.8 million hectares (Vincentius, 2020). Indonesia's mangroves have a special function because they are located between terrestrial and marine ecosystems, and support various types of human needs, especially for local communities in mangrove forests and their surroundings This fact shows that the potential of mangrove ecosystems in Indonesia is quite large today (Kusmana and Sukristijiono, 2016; Sofian et al., 2019)

In current conditions, local governments face problematic problems related to mangrove activities (Wahyudin et al., 2020). There are concerns from fishermen, crab hunters, and marine farmers about declining income, which is thought to be related to the increase in shrimp ponds in Indonesia (Vincentius, 2020). All have an important role and involve many parties and community groups who depend on shrimp ponds, fishermen, marine cultivation, and the existence of mangroves (Kinasih and Purnaweni, 2019). Mangroves have an indispensable role to play as a balancer. Authorities will need strategies to manage them so that all fisheries and economic activities that rely on ecosystem services can run sustainably (Ismail et al., 2021).

As an ecosystem, mangroves are known to have various ecological functions (Islam and Bhuiyan, 2018). In mangrove management that is beneficial to the economy and ecology, the main problem faced in mangrove forest management is determining the optimal level of management, viewed from both forms of benefits (economic and ecological) (Wahyudin et al., 2020).

In this study, we aim to conduct a comprehensive analysis of the complex constraints faced in mangrove ecosystem management and provide strategic recommendations for sustainable mangrove management in Indonesia. We try to fill the gap between existing policies and implementation at a significant field level. for constructive mangrove management and to support Indonesia's blue carbon agenda.

2. Methods

The method used in writing this article is systematic review, which is literature research that critically examines knowledge, ideas, or even findings in quality health journals, compiled and compiled theoretically and methodologically for a particular topic (Sugiyono, 2016) . The strategy used in article search is to use research articles that match the topic in the Google Scholar, Pubmed, Science Direct and Researchgate data base.

This systematic review is limited to literature searches in the last 5 years using the keyword "Ecosystem Services Based Mangrove Forest with Management Strategies" which is detailed as follows: "Ecosystem Services" " Mangrove Forest" "Management Strategies" with question determination following PICO techniques. Where every question P is mangrove with or without strategi, I is mangrove conservation n, C is conservation management, O is pprocesses Ecosystem Services Based Mangrove Forest with Management Strategies. The inclusion criteria in this literature review are full-text articles, in Indonesian and English published in the last 5 years, research articles It includes two or more search keywords in the database. The flow of journal review is adjusted to the following Figure 1.

Full-text articles are examined to select research journals that match the sample inclusion criteria. A total of 10 articles were obtained that met the relevant inclusion and abstract criteria for analysis on *Ecosystem Services Based Mangrove Forest with Management Strategies* (Table 1).

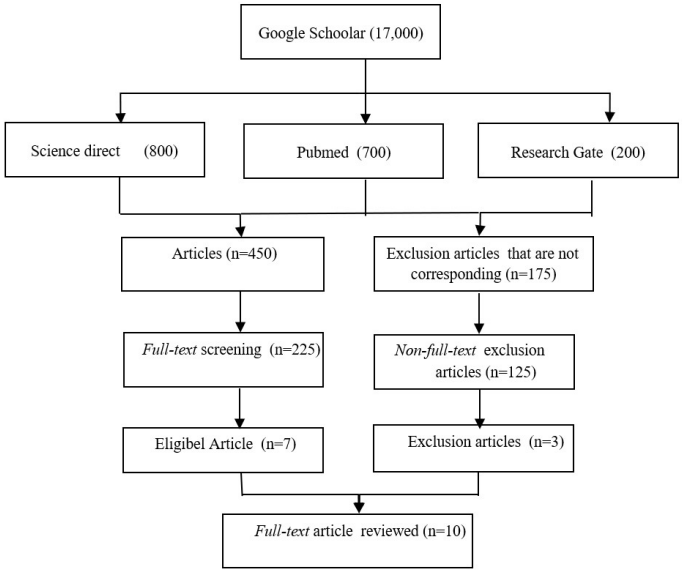

Figure 1. Search results and article selection.

Table 1. Previous research is reviewed.

No	Identity	Summary
1	**Title:** Evaluation of coastal wetland ecosystem services based on modified choice experimental model: A case study of mangrove wetland in Beibu Gulf, Guangxi	**Aim:** evaluation of coastal wetland ecosystem services based on a modified experimental model: A case study of mangrove wetlands in Beibu Bay, Guangxi
	Authors: Nie et al. (2023)	**Method**: *Field Research*, Experiment
	Publish: A Journal for the Study of Human Settlements Established at the UN Habitat Conference, Vancouver, 1976.	**Result**: In 2021, the total value of mangrove wetland ecosystem services in the Beibu Bay area is 1.181 billion yuan. In the modified CE model, both the improvement of the questionnaire and the improvement of the utility equation contribute to an increase in the validity of the evaluation results; their level of contribution is the same. Regarding the preferred model, based on correction, people's willingness to pay a per capita value for strengthening mangrove protection is (in order): increased biodiversity, mangrove forest cover, water quality, and landscape appreciation. The related values are 53.89-yuan, 47.00-yuan, 35.46-yuan, and 17.29-yuan, respectively. The results provide a scientific basis for the formulation of policies for ecological management of coastal wetlands by the government.
2	**Title**: The External, Internal Factor and Ecosystem Services to Support Mangrove Rehabilitation Planning in North Coast of Jakarta	**Aim**: external, internal and ecosystem services factors to support mangrove rehabilitation planning on the north coast of Jakarta.
	Authors: Hilmi et al. (2023)	**Method**: This research method uses IFAS analysis, EFAS and Buchard analysis.
	Publish: Proceedings ICMA-SURE- International Conference On Multidisciplinary Approaches For Sustainable Rural Development	**Result**: Emangrove cosystems are ecotourism, conservation, wildlife sanctuaries, tidal flood reduction, abrasion and accretion, intrusion reduction, land subsidence reduction, economic income, fisheries and pond activities, pond activities, and social. benefits. Mangrove rehabilitation strategies are weaknesses-opportunities strategies (minimizing weaknesses, seizing opportunities, and avoiding threats. Mangrove rehabilitation planning strategies are mangrove rehabilitation, mangrove revitalization, supporting the creative economy, developing greenbelts, increasing human resources and developing blue carbon.
3	**Title:** Ecosystem services valuation using InVEST modeling: Case from southern Iranian mangrove forests	**Aim**: ecosystem using InVEST modeling: The case of Iran's mangroves Selatan.
	Authors: Dashtbozorgi et al. (2023)	**Method**: Qualitative with model INVEST using land use and land cover maps to estimate habitat quality
	Publish: Regional Studies in Marine Science	**Result**: Thequality of mangrove habitat has decreased significantly despite the increased area. The target habitat area increased by 586.45 ha while the first two quality categories, including poor and low classes, increased. Based on habitat quality assessments in 2010, the two classes of poor, low habitat quality, are estimated to be around 0.72, and 8.42 ha, which changed to 3.04 ha, and 9.72 ha respectively in 2021. The output map obtained in this study can help local managers and decision makers to have an idea of what is happening to the quality of the target ecosystem and can help them adopt more effective management strategies for the conservation of these ecosystems.

Table 1. Continued...

No	Identity	Summary
4	**Title**: Exploring the policy and institutional context of a Payment for Ecosystem Services (PES) scheme for mangroves in southwestern Madagascar **Authors**: Rakotomahazo et al. (2023) **Publish**: Marine Policy	**Aim**: explores the policy and institutional context related to Ecosystem Service Payment (PES) implemented in the mangroves of Southwest Madagascar **Method**: Semi-Structured Interview **Result**: Bahwa land use, fisheries, and environmental planning policies related to mangrove management are coherent with the framework and support the implementation of PES. The lack of a clear legal framework and coordination between sectoral ministries, weak government organization due to political instability, and limited local government capacity are major challenges to the implementation of PES schemes in mangroves.
5	**Title**: Strategy to Strengthening Forest Farming for Sustainable Mangrove Forest Management in the Coastal Area, Deli Serdang, Indonesia **Authors**: Limbong et al. (2023) **Publish**: Journal of Sylva Indonesiana	**Aim**: Forest Farming Strengthening Strategy for Sustainable Mangrove Forest Management in Coastal Areas, Deli Serdang, Indonesia **Method**: qualitative with interviews; while the analysis method used is SWOT analysis. **Result**: the result of the Internal Factor Analysis Summary (IFAS) analysis with a strength factor value of 0.054 and a weakness factor value of 0.47. From the calculation of the internal environment score (IFAS) value, namely the strength factor minus the weakness factor, the value of x horizontal axis 0.054-0.047 = 0.007 is obtained. Based on the results of the External Factor Analysis Summary (EFAS) analysis, the opportunity factor has a value of 0.054 with the threat has a value of 0.047. The results showed that the external calculation score (EFAS), namely the opportunity factor (opportunity) minus the threat factor, obtained the Y value vertically. The identification of internal (IFAS) and external (EFAS) factors shows that the institutional development position of forest farmer groups in coastal areas is in quadrant one (I) or is in an aggressive position that supports the SO (aggressive development strategy) development strategy.
6	**Title:** Ecosystem Services of Mangrove Forests: Results of a Meta-Analysis of Economic Values **Authors**: Getzner and Islam (2020) **Publish**: International Journal of Environmental Research and Public Health	**Aim**: Assessing the Role of Coastal Biodiversity Conservation towards Sustainability and Environmental Concern in the Mangrove Ecosystem of South Malang, Indonesia. **Method**: *Field Research* and Observationon **Result**: Kis substantially wide in value. This range cannot be adequately explained by the various study differences, since the explanatory power of econometric estimates is low. The main factors that influence the value of ecosystem services are the method of elisitation, the type of ecosystem services considered, and the conservation status of each mangrove as a Ramsar site. The results emphasize the significant economic value of mangrove ecosystem services and the importance of conservation management. However, those results also warn against direct transfer of benefits between sites. The substantial diversity of specific locations and countries guarantees the application of separate original assessment studies.
7	**Title**: Economic Valuation of Mangrove Ecosystem Services in Sembilang National Park of South Sumatra, Indonesia **Authors**: Agustriani et al. (2023) **Publish**: Journal of Hunan University Natural Sciences	**Aim**: Economic Valuation of Mangrove Ecosystem Services in Sembilang National Park, South Sumatra, Indonesia **Method**: Questionnaire and Interview **Result**: That the mangrove ecosystem with an area of 88,556 ha is Rp. 6,961,126,186,194 year-1 (US$ 467,974,555.06 year-1) or Rp. 78,607,444 ha-1year-1 (US$ 5,284.5 ha-1year-1). The annual benefit value for provision, regulation, support, and cultural services is IDR 267,301,712,200, IDR 6,401,520,094,447, IDR 292,120,962,048, and IDR 183,417,500, respectively. The value of the benefits of regulatory services (coastline protection and carbon sequestration) dominates the TEV of mangrove ecosystems in the SNP. To avoid the loss of value of mangrove services, conservation and restoration must receive high priority in mangrove management and planning in the future. The results of this study can be used as basic data for local governments in managing mangrove ecosystems through the establishment of a mangrove working group in South Sumatra Province. Therefore, the novelty of the study lies in the first economic valuation in the SNP using the TEV approach, as illustrated.
8	**Title**: Potential Loss of Ecosystem Service Value Due to Vessel Activity Expansion in Indonesian Marine Protected Areas **Authors**: Fauzi et al. (2023) **Publish**: International Journal of Geo-Information	**Aim**: Potential Loss of Ecosystem Service Value Due to Expansion of Ship Activities in Indonesian Marine Protected Areas. **Method**: This research comprehensively covers three main aspects: vessel zone expansion modeling, marine ecosystem service value (MESV) modeling, and MESV potential loss in the MPAs. Figure 2 illustrates the research framework. **Result**: Indonesia's marine neritic zone has an ecosystem services value of USD 814.23 billion, of which USD 159.87 billion (19.63%) is within the MPA. However, the increase in ship activity that occurred in 2013-2018 has the potential to cause a loss of ecosystem service value of USD 27.63 billion in 14 protected areas. These results can assist policymakers in determining priority conservation areas based on the threat of ship activity and the value of ecosystem services.

Table 1. Continued...

No	Identity	Summary
9	**Title**: Economic value of mangrove ecosystem services in the coastal area of Bintan Island, Indonesia	**Aim**: The economic value of mangrove ecosystem services in the coastal area of Bintan Island, Indonesia
	Authors: Arkham et al. (2023)	**Method**: Survey using questionnaires on fishermen, tourists, tour managers, and the surrounding community. It also collects some secondary data to support data analysis.
	Publish: Research Square	**Result**: The estimated economic value of mangrove ecosystem services is Rp. 135,663,899,478.30 / year from a mangrove area of 4,354.11 ha. The economic value consists of the provision of services by 61%, regulatory services by 21%, supporting services by 2%, and cultural services by 16%. This estimate can be used as the basis for mangrove conservation policies and strategies and community welfare, as well as considerations in making claims related to damage to the coastal and marine environment due to oil spills and others that often occur in Bintan.
10	**Title**: Economic analysis of management option for sustainable mangrove ecosystem in Tangerang District, Banten Province, Indonesia	**Aim**: An Economic Analysis of Sustainable Mangrove Ecosystem Management Options in Tangerang Regency, Banten Province, Indonesia.
	Authors: Marlianingrum et al. (2019)	**Method**: Total Economic Value (TEV) is formulated as follows: TEV = PS + SS + RS + CS.
	Publish: IOP Conference Series: Earth and Environmental Science	**Result**: Analysis of 2017 data on mangrove ecosystems in Tangerang Regency, Banten shows that the total economic value of mangrove ecosystems per hectare is Rp. 49,260,590.16. Analysis of optimal resource allocation can be concluded that the optimal mangrove area is 415.89 ha with a total economic value of IDR 20,486,986,843.00. The conversion of mangrove ecosystems into several land changes will have an impact on the habitats that live in them and also have a negative impact on the income of coastal communities who use them, so they must be managed carefully. Economic valuations based on ecosystem services can improve the sustainable management of mangrove ecosystems and provide welfare for coastal communities that use them.

3. Discussion

Indonesia is an archipelagic country with more than 17,504 islands (28 large islands and 17,475 small islands) with an estimated coastline length of 95,181 km, which is overgrown with mangroves from several meters to several kilometers. An estimated 3.2 million hectares grow widely on five major islands (Java, Sumatra, Kalimantan, Sulawesi, Papua) with diverse community types consisting of about 157 species (52 species of trees, 21 species of shrubs, 13 liana species, seven species of palms, 14 species of grasses, 8 species of herbs, 3 species of benalu, 36 species of epiphytes, 3 species of ferns) (Kusmana and Sukristijiono, 2020).

In response to the huge loss of mangroves, several regulations on mangrove conservation and management were enacted in Indonesia. Law Number 5 of 1990 concerning the Conservation of Biological Natural Resources and their Ecosystems became the basis for the concept of mangrove conservation in Indonesia. According to Law No. 27 of 2007 which was amended into Law No. 1/2014, concerning the Management of Coastal Areas and Small Islands, Indonesia allows logging practices in mangrove areas that comply with the preservation of coastal ecological functions. The issuance of this policy was followed up by Presidential Regulation Number 73 of 2012 concerning the National Strategy for Mangrove Ecosystem Management, which regulates mangrove forest management norms, standards, principles, criteria, and indicators. The government also issued Presidential Regulation Number 73 of 2015 concerning the Implementation of Management of Coastal Areas and Small Islands at the National Level with the aim of managing coastal areas and national small islands in a harmonious, synergistic, integrated, and sustainable manner (Anggraeni, 2017).

There are two key sectors that play an important role in mangrove management in Indonesia, namely the forestry and fisheries and marine sectors. The forestry sector is authorized to manage all state mangrove forests, while mangroves outside forest areas are the authority of the fisheries and marine sector (Kathiresan and Bingham, 2001). Therefore, existing mangrove management policies are generally influenced by the interests and authorities of the two sectors which sometimes conflict and overlap (Damastuti et al., 2022). Complex social and economic conditions in mangrove areas, accompanied by unclear boundaries between different authorities, have created overlaps in law enforcement and responsibility between government institutions (Chow, 2018). To manage mangrove ecosystems sustainably and improve the welfare of coastal communities (Suman, 2019), effective policy implementation must be supported by various action plans or strategies prepared based on strategic issues in the concept of sustainable development (Basyuni et al., 2018) . However, there are major challenges in mangrove management that must be overcome with specific strategies and require programs as a measure of achieving sustainable mangrove management goals (Arifanti, 2020).

Communities play a key role in determining the success of sustainable forest management (Makowski and Finkl, 2018). The dependence of coastal communities on these ecosystems can encourage them to restore and preserve them using their local wisdom (Camacho et al., 2020). Willingness to participate in an activity is also correlated with education level and income; those with higher levels

of education and more stable incomes become more easily involved and can play a role as key community actors in mangrove restoration and protection activities (Mafi-Gholami et al., 2020).

From a socio-economic perspective, sustainable mangrove management is fraught with challenges due to (a) different understandings of the value and benefits of mangrove ecosystems and the urgency of rehabilitation efforts; (b) local involvement has not been optimal; (c) the majority of families living around mangrove ecosystems are classified as low-income families; (d) the sustainable use of mangrove ecosystems has not been developed; and (e) high population growth rates and economic needs have triggered changes in land use and land cover (Biswas et al., 2018). Problems in understanding the ecological value of mangroves can lead to the conception that damage or loss of mangrove resources is not always considered a loss (Abidin et al., 2021). Community participation in mangrove management becomes difficult to achieve, on the contrary, participation is easier to ensure when the benefits to be received can be felt directly, locally, and tangibly (Rafique, 2018). Therefore, information about the benefits/values of mangrove forests both directly and indirectly needs to be disseminated to increase public awareness of the ecological role of mangrove forests (Yando et al., 2021).

Special strategies are also needed, such as offering several incentive scheme options, to increase the willingness of communities to engage in mangrove management. Law enforcement and compliance are other challenges in encouraging community participation. Unclear sanctions/penalty mechanisms lead to low levels of compliance (Hasnanda et al., 2018). Local willingness to participate in mangrove management depends on (1) effective law enforcement; (2) accountable and transparent financial management; (3) fair distribution of profits; (4) rights and obligations of equitable distribution; (5) co-financing from the government or project; (6) annual income level; (7) and whether one's livelihood depends directly on mangroves (Biswas et al., 2018).

In the end, incentives should not only encourage local communities to replant new mangroves, but they should also maintain newly planted and old mangroves (Gaoue and Yessoufou, 2019). The form of community involvement in mangrove management varies depending on regional conditions and community typology (Mozumder et al., 2018). One example of mangrove management that pays attention to community participation in mangroves is widely known as community-based mangrove management (CBMM) (R,odríguez 2018). CBMM is currently needed to ensure the success of mangrove resources and is considered an important factor in minimizing disturbance while ensuring sustainable use of mangrove resources. The community is also involved in mangrove rehabilitation projects, for example providing mangrove seedlings, working in mangrove nurseries, and planting mangroves (Reis Filho et al., 2019).

Mangrove forest management is an important aspect in efforts to preserve the environment in coastal areas. In social activities (social processes) it is necessary to provide socialization or understanding to the community about the importance of maintaining mangrove forests. In research (Limbong et al., 2023), mangroves can be used directly or indirectly by communities/farmer groups around the coast. However, with the rampant forest destruction that occurs, communities or farmer groups need to be equipped with capacity building about the importance of mangrove ecosystems and their impact on their livelihoods. This study aims to identify the condition of mangrove forests in the research area and determine the institutional development strategy of forest farmer groups in coastal areas in the Production Forest Management Unit. The research method used is qualitative method with interview; while the analysis method used is SWOT analysis. Based on the results of the Internal Factor Analysis Summary (IFAS) analysis with a strength factor value of 0.054 and a weakness factor value of 0.47. From the calculation of the *internal environment score* (IFAS) value, namely the strength factor minus the weakness factor, a horizontal x axis value of 0.054-0.047 = 0.007 is obtained. Based on the results of the *External Factor Analysis Summary* (EFAS) analysis, the opportunity factor has a value of 0.054 with the threat has a value of 0.047. The results showed that the external calculation score (EFAS), namely the opportunity factor (opportunity) reduced by the threat factor, obtained the Y value vertically. The identification of internal (IFAS) and external (EFAS) factors shows that the institutional development position of forest farmer groups in coastal areas is in quadrant one (I) or is in an aggressive position that supports the SO (aggressive development strategy*)*.

Research (Dashtbozorgi et al., 2023) as one of the most fertile ecosystems on earth, mangrove forests provide many goods and services for mankind. Mangroves are located in southern Iran on the coast of the provinces of Sistan and Baluchistan, Hormozgan and Bushehr, which includes two species Harra (*Avicennia marina*) and Chandal (*Rhizophora mucronata*) The purpose of this study is to describe the condition of mangrove forests *using Integrated Valuation of Ecosystem Services and Tradeoffs* (InVEST) between 2010 and 2021 from the southern coast of Iran. The INVEST model uses land use and land cover maps to estimate habitat quality. The source of the threat, the maximum distance of impact, the state of degradation, and sensitivity to the threat were also estimated with local expert opinion for each type of land cover. Urban and rural development, road networks, docks, oil and non-oil industries, agriculture, and aquaculture activities, were identified as sources that threaten the long-term survival of mangroves. The output map of the INVEST habitat quality model includes habitat degradability and quality maps, which are classified into four categories: poor, low, medium, and high, to better understand quality changes. The results show that the quality of mangrove habitat has decreased significantly despite the increased area. The target habitat area increased by 586.45 ha while the first two quality categories, including poor and low grades, increased. Based on habitat quality assessments in 2010, two habitat quality classes are poor, low, estimated at around 0.72, and 8.42 ha, which changed to 3.04 ha, and 9.72 ha respectively in 2021. The output maps obtained in this study can help local managers and decision makers to have an idea of what is happening to the quality of target ecosystems and can help them adopt

more effective management strategies for the conservation of these ecosystems.

Research (Arkham et al., 2023) mangrove ecosystem in Bintan Regency provides many benefits both directly and indirectly for the surrounding community. Mangrove ecosystem services are also diverse and play a role in the adaptation and mitigation process in facing climate change. Oil pollution that occurs every year in Bintan Regency has a negative impact both ecologically and economically. This study aims to estimate the value of mangrove ecosystem services in the East and North Coast Areas of Bintan Island that can be used as a basis for management of the area. The data collection method used is a survey using questionnaires on fishermen, tourists, tour managers, and the surrounding community. It also collects some secondary data to support data analysis. The results of the study stated that the estimated economic value of mangrove ecosystem services was Rp. 135,663,899,478.30 / year from a mangrove area of 4,354.11 ha. The economic value consists of the provision of services by 61%, regulatory services by 21%, supporting services by 2%, and cultural services by 16%. This estimate can be used as a basis for mangrove conservation policies and strategies and community welfare, as well as consideration in making claims related to damage to coastal and marine environments due to oil spills and others that often occur in Bintan.

In the benefits of economic processes, mangroves have a very important role to support the productivity of the habitat in them. In research (Nie et al., 2023) that in e valuation of the value of coastal wetland ecosystem services is very important for scientific development and effective use of coastal wetland resources. It has beenproven that the addition of attribute cut-offs in the preferred experimental evaluation (CE) framework increases the validity of evaluation results. However, whether this increase is due to an increase in questionnaires or an increase in utility equations is indistinguishable from this framework. In this study, a cut-off modified selection model was used to assess two key elements of the modified selection model that differed from the traditional model. This is a CE questionnaire that leads to a cut-off and a CE utility equation that incorporates a cut-off. Each pair of elements is analyzed separately. Both are used to evaluate the impact of the validity of the results, and quantitatively evaluate the value of mangrove wetland ecosystem services in the Beibu Bay area, Guangxi, China. The results showed that: In 2021, the total value of mangrove wetland ecosystem services in the Beibu Bay area was 1.181 billion yuan. In the modified CE model, both the improvement of the questionnaire and the improvement of the utility equation contribute to an increase in the validity of the evaluation results; Their contribution rate is the same. Regarding the preferred model, based on correction, the public's willingness to pay a per-capita value for strengthening mangrove protection is (in order): increased biodiversity, mangrove forest cover, water quality, and landscape appreciation. The corresponding values are 53.89-yuan, 47.00-yuan, 35.46-yuan, and 17.29-yuan, respectively.

Research (Agustriani et al., 2023) Assessment of ecosystem services can provide significant improvements for policymakers to monitor changes in mangrove ecosystems in coastal ecosystems. Therefore, this study aims to measure the value of ecosystem services in Sembilang National Park (TNSL), Banyuasin Regency, South Sumatra, Indonesia. Data collection using questionnaires and in-depth interviews with target respondents fishermen, farmers, and stakeholders living in mangrove ecosystem areas. Total Economic Value (TEV) is used as an approach to calculate various mangrove service values. Several methods have been developed to estimate the value of ecosystem services. In this study, the market price method, benefit transfer method, reimbursement method, and travel cost method are applied to estimate the value of benefits for provision, arrangement, support, and cultural services. The results showed that the TEV of mangrove ecosystem services with an area of 88,556 ha was Rp 6,961,126,186,194 year-1 (US$ 467,974,555.06 year-1) or Rp 78,607,444 ha-1-1 (US$ 5,284.5 ha-1year-1). The annual benefit values for provision, arrangement, support, and cultural services are Rp 267,301,712,200, Rp 6,401,520,094,447, Rp 292,120,962,048, and Rp 183,417,500, respectively. The value of the benefits of regulatory services (shoreline protection and carbon sequestration) dominates the TEV of mangrove ecosystems in SNP. To avoid the loss of value of these mangrove services, conservation and restoration must receive high priority in mangrove management and planning in the future. The results of this study can be used as basic data for local governments in managing mangrove ecosystems through the establishment of mangrove working groups in South Sumatra Province. Therefore, the novelty of this study lies in the first economic valuation in the SNP using the TEV approach, as illustrated.

Research Fauzi et al. (2023) Sustainable Development Goal (SDG) number 14 relates to the preservation of sustainable marine ecosystems by establishing marine protected areas (MPAs). However, studies have reported massive damage to Indonesia's marine ecosystems due to pollution of shipping, anchors, and fishing nets. Thus, this study estimates the potential loss of value of ecosystem services due to the expansion of vessel activities in the Indonesian MPA. The study is divided into three stages. The first stage is modeling the expansion zone of vessel activity based on kernel density. The second stage is modeling the value of marine ecosystem services through semantic harmonization, reclassification, and spatial harmonization. The last stage is the overlay of the ship expansion zone model, the marine ecosystem service value model, and the Indonesian MPA. The results of this study show that Indonesia's marine neritic zone has an ecosystem service value of USD 814.23 billion, of which USD 159.87 billion (19.63%) is in the MPA. However, the increase in vessel activity that occurred in 2013-2018 has the potential to cause a loss of ecosystem service value of USD 27.63 billion in 14 protected areas. These results can help policymakers determine priority conservation areas based on the threat of vessel activity and the value of ecosystem services.

Research Marlianingrum et. al. (2019) explains that ecosystems are very important for human life, but until now parts of the ecosystem as resource assets that contribute to the country's economy have not been further evaluated.

Mangrove ecosystem is one of the ecosystems that grows on alluvial deposits in coastal areas and river estuaries. They have a very important role to support fisheries productivity as a habitat for breeding and spawning aquatic biota. Based on these conditions, this research is directed to explore ecosystem services with ecological economic value to improve mangrove sustainability. Analysis of 2017 data on mangrove ecosystems in Tangerang Regency, Banten shows the total economic value of mangrove ecosystems per hectare is Rp. 49,260,590.16. Analysis of optimal resource allocation can be concluded that the optimal mangrove area is 415.89 Ha with a total economic value of Rp20,486,986,843.00. The conversion of mangrove ecosystems into some land changes will have an impact on the habitats that live in them and also have a negative impact on the income of coastal communities that use them, so they must be managed carefully. Economic valuation based on ecosystem services can improve sustainable management of mangrove ecosystems and provide welfare for coastal communities that use them.

Mangrove forest management is an important aspect in environmental conservation efforts, namely the natural resources themselves *(natural processes)* mangrove forest management including yaitu, forming a protected forest area for mangrove conservation to remain well maintained and sustainable (Rodríguez, 2018). Research (Hilmi et al., 2023) Mangrove ecosystems on the North Coast of Jakarta have many services and functions both ecological, social, economic, and service functions, including tidal flood reduction, land subsidence reduction, pollution reduction, ecotourism, and others. However, the mangrove ecosystem on the North Coast of Jakarta has suffered severe damage, so it requires efforts and activities to rehabilitate it. This study aims to develop a strategy for mangrove ecosystem rehabilitation on the North Coast of Jakarta to reduce coastal disasters and support ecosystem services. This research method uses IFAS, EFAS analysis, and Buchard analysis. The results showed that mangrove ecosystem ecosystem services are ecotourism, conservation, wildlife reserves, reduction of tidal flooding, abrasion and accretion, reduction of intrusion, reduction of land subsidence, economic income, fishing and aquaculture activities, pond activities, and social activities. benefit. The mangrove rehabilitation strategy is a weakness-opportunity strategy (minimizing weaknesses, exploiting opportunities, and avoiding threats. The mangrove rehabilitation planning strategy is mangrove rehabilitation, mangrove revitalization, supporting the creative economy, developing greenbelts, increasing human resources, and developing carbon.

Research Rakotomahazo et al. (2023) Although ecosystems have emerged since the 1980s to manage mangrove forest ecosystems, their application to mangroves is still new, and evidence of their effectiveness is questionable against the complex legal status of mangroves. This study explores the policy and institutional context of Payment for Ecosystem Services (PES) applied in the mangroves of Southwest Madagascar. We used Policy content analysis to examine the interaction between Madagascar's sectoral policies and the PES design framework developed under the Reducing Emissions from Deforestation and Forest Degradation (REDD+) mechanism of the United Nations Framework Convention on Climate Change. In addition, semi-structured interviews with national and local stakeholders were conducted to identify i) institutional interactions between PES and mangroves and ii) challenges faced in implementing PES in mangroves. We found that land-use, fisheries, and environmental planning policies related to mangrove management are coherent with the framework and support PES implementation. The lack of a clear legal framework and coordination between sectoral ministries, weak government organization due to political instability, and limited capacity of local governments are major challenges for the implementation of PES schemes in mangroves. This has led to low motivation to collaborate on mangrove conservation efforts among local community members. We emphasize that the existence of mangrove PES initiatives such as those in Baie des Assassins can be a catalyst for Madagascar to develop clear policies, laws, and institutions to support the effective implementation of PES schemes in mangroves.

Research Getzner and Islam (2020) Mangrove forests are essential for maintaining and improving ecosystem services that benefit local and regional communities, and the global environment. Scholars have long studied the merits of mangrove ecosystem services. However, the number of recent primary studies monetizing ecosystem services is somewhat limited. This paper ascertains the value of ecosystem services from 66 primary valuation studies with a total of 250 observations. The results show that the range of values is substantially wide. This range cannot be adequately explained by various study differences, because the explanatory power of econometric estimates is low. The main factors influencing the value of ecosystem services are elicitation methods, the types of ecosystem services considered, and the conservation status of each mangrove forest as a Ramsar site. The results emphasize the significant economic value of mangrove ecosystem services and the importance of conservation management. However, the results also warn against direct benefit transfers between sites. The substantial diversity of specific locations and countries warrants the application of separate original assessment studies.

In the last three decades, increasing understanding of mangroves has significance for the environment and livelihoods has encouraged various rehabilitation initiatives (Lubis and Wahyudi, 2019). The earliest rehabilitation efforts were initiated in the 1960s by Hutan Negara (Marlianingrum et al., 2019). However, *the top-down* strategy implemented has not been stopped by human encroachment into rehabilitated areas (Damastuti and de Groot, 2019). Lack of community participation is thought to be the cause of ongoing disruption (Lewis et al., 2019). Therefore, it is necessary to involve local communities in their rehabilitation and management strategies (Arifanti et al., 2022). Currently, community participation has become the main approach in mangrove rehabilitation and management applied (Setyaningrum et al., 2020). The Ministry of Environment and Forestry, for example, has implemented community-based mangrove rehabilitation activities (Turisno et al., 2018).

Based on the description above, it can be seen that there are several strategies of Ecosystem Services Based Mangrove Forest with Management Strategies, including 1) social activities (social processes) provide socialization or understanding to the community of the importance of maintaining mangrove forests and the benefits obtained by the community 2) economic processes (economic processes) Utilizing the existing potential by making economic benefits, and 3) Natural Resources itself (natural processes) mangrove forest management including yaitu, forming a protected forest area for mangrove conservation so that it is well maintained and sustainable. These three components are bound together and influence each other. From socio-economic, cultural and human aspects need natural resources to be able to continue their lives, on the other hand the existence or sustainability of coastal natural resources is very dependent on human activities as the main users of natural resources.

4. Conclusion

Mangroves are highly productive ecosystems with various social, economic and environmental functions. Mangroves have an important role globally in mitigating climate change, mangrove ecosystems are one of the threatened resources in coastal areas, and mangroves are under intense pressure from competing resource use. If mangrove destruction in Indonesia continues, there will be a loss of ecosystems that have many ecological, social, and economic benefits.

Mangroves in Indonesia have faced direct human-caused threats including deforestation and conversion of forests to other land uses. Despite facing anthropogenic and non-anthropogenic disturbances, mangroves provide great benefits and support livelihoods for millions of coastal communities in Indonesia. On the other hand, maintaining the natural and important function of mangroves in contributing to climate change mitigation and coastal adaptation.

Ecosystem Services Based Mangrove Forest with Management Strategies, that there are three main components that must be considered in efforts to manage and utilize mangrove ecosystems and coastal natural resources, namely; 1) social activities (social processes), 2) economic (economic processes) and 3) natural resources themselves (natural processes). These three components are bound together and influence each other. Local willingness to participate in mangrove management depends on (1) effective law enforcement; (2) accountable and transparent financial management; (3) fair distribution of profits; (4) rights and obligations of equitable distribution; (5) co-financing from the government or project; (6) annual income level; (7) and whether one's livelihood depends directly on mangroves. From socio-economic, cultural and human aspects need natural resources to be able to continue their lives, on the other hand the existence or sustainability of coastal natural resources is very dependent on human activities as the main users of natural resources.

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