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ECONOMIC VALUATION OF MANGROVE ECOSYSTEM IN UJUNG LOE DISTRICT BULUKUMBA REGENCY

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Abstract

This study aims to analyze the potential utilization and economic valuation of mangrove forest ecosystems. This study was conducted in Manyampa Village, Ujung Loe District, Bulukumba Regency, South Sulawesi Province. Samples were selected using a purposive sampling method, involving 20 pond fish farmers, 20 crab catchers, and 20 tourists. The study employed both descriptive quantitative and qualitative data analysis methods. This study indicates that the mangrove forest in Manyampa Village covers 27 hectares; however, only 7 hectares are currently utilized. Direct benefits such as mangrove fruits, wood products, and protective functions against abrasion, storm surges, and saltwater intrusion. Indirect benefits such as fish-shrimp-crab habitat, nutrient sources, environmental education, and ecotourism. The direct benefit value of the economic valuation of the mangrove ecosystem is IDR 4,562,963,185.00 per hectare per year. The indirect benefit value from milkfish (bandeng) cultivation in ponds is estimated at IDR 741,925,000.00 per hectare per year, and the value of coastal fishermen's catch is IDR 11,910,000.00 per hectare per year. The economic value of ecotourism in the mangrove forest ecosystem is estimated at IDR 89,250,000 per hectare per year. The mangrove forest ecosystem in Manyampa Village has an estimated economic value of IDR 5,406,048,185 per hectare per year. Given the total area of 27 hectares, the overall annual economic value of the mangrove forest is approximately IDR 145,963,300,995.

Keywords*: Economic; Ecosystem; Mangrove; Valuation.*

INTRODUCTION

The mangrove forest ecosystem in Indonesia has many benefits that are very important for the environment, economy, and society. Indonesia has the largest mangrove forest area in the world, with a total area estimated at around 3 million hectares, which covers around 23% of the total global mangrove area (Febriansyah et al., 2018; Kasihiw et al., 2024). Mangrove forests are critical coastal ecosystem defenders, serving as effective carbon sinks, providing protection against seawater intrusion, and helping to mitigate the effects of coastal erosion (Syah et al., 2019; Rinika et al., 2023). This function holds significant importance given the growing challenges of climate change. Consequently, it is vital to focus on the sustainable conservation of mangrove forests to ensure lasting benefits (Sulaiman, 2023).

Mangrove forests offer ecological advantages, serving as a habitat for numerous species of plants and animals. Fish, bird, and mammal species rely on these forests for breeding and shelter (Zulfandi et al., 2023; Setyowati et al., 2023). Mangrove forests offer important living and breeding grounds for fish and shrimp, which are key to the marine food chain and contribute significantly to the income of local fishermen (Pahlevi et al., 2023; Amelia et al., 2018). Protecting and conserving this area can help enhance biodiversity, which in turn holds significant potential for the development of sustainable fisheries in the future (Abadi et al., 2022; Latupapua et al., 2023). Moreover, mangrove forests contribute to preserving water quality by filtering and absorbing contaminants (Rinika et al., 2023; Biru et al., 2021).

Mangrove forests provide numerous social and economic benefits. Coastal communities often rely on mangroves as a source of income through sustainable fishing and other fishery-related activities (Syah et al., 2019; Nur et al., 2021). Mangrove forests can also be developed as ecotourism destinations that not only provide job opportunities but also increase public awareness of the importance of mangrove forest conservation (Yudhanti et al., 2019; Mucharomah et al., 2024). Through ecotourism development, communities can gain direct economic benefits and at the same time support the preservation of natural resources (Solikhah,

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2021). Furthermore, mangrove forests help to alleviate disasters by functioning as natural barriers, minimizing the impact of tsunamis and flooding (Takarendehang et al., 2018; Maolani et al., 2023). Planting mangroves in disaster-prone areas has been shown to reduce damage caused by large waves and seawater intrusion (Theadiva et al., 2023; Al Haqiqi & Widyastuty, 2023). This adds significant value to coastal resource management and protection for communities living near the coastline (Suyadi et al., 2021).

Despite their substantial benefits, mangrove forests in Indonesia face serious threats from human activities, including land conversion for agriculture, settlements, and industrial development (Winarso, 2019; Rafdinal, 2022). This environmental degradation highlights the urgent need to enhance environmental awareness and strengthen conservation efforts through active community participation (Nurasia et al., 2021; Purwanti et al., 2020). Educational programs aimed at increasing public awareness of the importance of mangroves are expected to increase involvement in conservation activities (Solikhah, 2021; Hismayasari et al., 2022). Several studies have shown that increasing public knowledge contributes to reducing destructive activities and promoting sustainable management (Pratama & Widodo, 2018).

South Sulawesi Province is one of the regions with the largest mangrove forest areas, covering approximately 46,717 km², and has a coastline stretching around 2,500 km. As such, the region has significant potential for coastal and small island resources, including coral reefs, mangroves, beaches, and estuaries. Mangrove ecosystems in South Sulawesi cover about 12,278 hectares, which accounts for approximately 2% of Indonesia's total mangrove area. (Saru et al., 2018). Data from the 2021 Environment and Forestry Service of Bulukumba Regency showed that Bulukumba had a potential mangrove area of 882.44 hectares, with actual mangrove cover amounting to 282.54 hectares. The mangrove species found in this area include Rhizophora, Avicennia, Bruguiera, Sonneratia, Nypa, and Ceriops. In Bulukumba Regency, the largest mangrove area is located in Ujung Loe District, covering 183.51 hectares, and there is a mangrove ecotourism area located in Manyampa Village. This study aims to analyze the potential utilization and economic valuation of mangrove forest ecosystems in Manyampa Village, Ujung Loe District, Bulukumba Regency, South Sulawesi Province.

RESEARCH METHODS

Research Type and Design

This study employs a descriptive research approach using both quantitative and qualitative methods. The research design is a survey method aimed at obtaining data related to past or present events, including beliefs, opinions, characteristics, behaviors, and relationships between variables. Data were collected through observation, interviews, or questionnaires, and the results of the study are generally intended to be generalized.

Location and Time of Research

This research was conducted in Manyampa Village, Ujung Loe District, Bulukumba Regency, South Sulawesi Province, from April to June 2023. The sampling technique used was purposive sampling, involving the selection of 20 pond fishermen, 20 crab catchers, and 20 tourist visitors, resulting in a total sample size of 60 respondents. The data collected consisted of both quantitative and qualitative data, obtained from primary and secondary sources. Primary data were collected directly from respondents through interviews using questionnaires and through direct field observations. Secondary data were gathered from relevant websites, institutions, and literature that support and complement the primary data.

Data Analysis Technique

The data were analyzed using both quantitative and qualitative descriptive methods. The economic value of the mangrove forest ecosystem refers to the potential and utilization of the

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forest, which includes direct economic benefits such as fruit, timber, protection against coastal abrasion, and resistance to saltwater intrusion, as well as indirect benefits including habitat for fish, shrimp, and crabs, nutrient supply, environmental education, and ecotourism. To answer this research problem, the following data analysis methods are used:

1) To analyze the potential and utilization of the mangrove forest ecosystem in Manyampa Village, descriptive analysis was used.
2) To calculate the economic value of the mangrove forest ecosystem, the following formula is used:

   TEV = UV + NUV
   UV = DUV + IUV+ OV
   NUV = EV + BV
   So that:
   TEV = (DUV + IUV + BV) + (EV + BV)
   Description:
   TEV = Total Economic Value, UV = Use Value, NUV = Non Use Value, DUV = Direct Use Value, OV = Option Value, EV = Existence Value, BV = Bequest Value

   Each of these values is defined based on all the benefits obtained from the mangrove ecosystem studied. Each of these values is as follows:

   Direct Use Value (DUV)

   The formula used to obtain the direct benefit value is the total direct benefit value, as follows:
   TDB = DB1 + DB2 + DB3 + …+ DBn
   Description:
   TDB= Total Direct Benefits, DB1 = Direct Benefits of Fish, DB2 = Direct Benefits of Crab, DB3 = Direct Benefits of Wood, DBn = Other Direct Benefits.

   Indirect Benefits

   Indirect benefits from mangrove forests are obtained from the ecosystem indirectly such as coastal abrasion prevention and others. The indirect benefits of mangrove forests as coastal abrasion prevention can be seen from the cost of making breakwaters along the coastline adjacent to the conservation area location.

   Benefits of Existence

   These benefits can be formulated as follows:
   $BE = \sum_{i=1}^{n}(BE_i)\ /n$
   Description:
   BE = Benefits of Existence, BEi = Ecosystem benefits from respondent i, n = Number of respondents.

   Selected Benefits

   Selected benefits in the mangrove forest ecosystem in Manyampa Village can use the benefit transfer method, by assessing the estimated benefits from other places (where resources are available), and then the benefits are transferred to obtain a rough estimate of environmental benefits. This method is approached by calculating the benefits of biodiversity in this mangrove area.

RESULTS AND DISCUSSION

Potential Utilization of Mangrove Forest Ecosystems in Manyampa Village

The existence of mangrove forests in Bulukumba Regency is an important component in maintaining the balance of coastal ecosystems and providing socio-economic benefits for local

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communities. Mangrove forests serve as natural coastal barriers against abrasion and provide habitats for various species of flora and fauna with both ecological and economic value, such as fish, shrimp, and crabs (Solikhah, 2021; Handayani et al., 2023). The potential of mangrove forest ecosystems in direct benefits includes their use as firewood, alternative food ingredients derived from mangrove fruits (which can be processed into products such as chips and dodol), natural barriers against coastal abrasion, and protection from tornadoes and saltwater intrusion. Meanwhile, the indirect benefits of mangrove forest ecosystems include supporting aquaculture activities such as milkfish (bandeng) (**Table 1**), fish, and shrimp pond cultivation, as well as providing essential habitats for crabs. This can happen because the roots of mangrove trees are a hiding place for other animals, and the litter of leaves, fruits, and branches of mangrove trees when they fall and undergo a decomposition process after being destroyed will become a good source of nutrients for pond cultivation needs and for the coastal environment. The potential benefits of choice are alternative approaches to deciding on an object that can provide education and inspiration, which means choosing a mangrove ecosystem object as a tourist destination, and can have a positive value in building scientific insight.

Table 1. Utilization of Milkfish Cultivation in Manyampa Village

No.	Land Area (ha)	Production (kg)	Price (IDR/unit)	Value (IDR/year)
1	1.0	430	25,000	10,750,000
2	1.2	560	25,000	14,000,000
3	1.5	320	25,000	8,000,000
4	2.0	310	25,000	7.750,000
Total	**5.7**	**1.620**	**-**	**40,500,000**
Average	**1.425**	**405**	**25,000**	**10,125,000**

Source: Primary Data Analysis, 2023.

Table 1 shows that milkfish cultivation in ponds in Manyampa Village, Ujung Loe District, Bulukumba Regency, which has an average pond area around the mangrove forest of around 1.425 hectares, can produce 405 kilograms, with a revenue value of IDR 10,125,000.00. Research results show that mangroves can produce fishery products that support local people's livelihoods through environmentally friendly fishing and fisheries cultivation (Nur et al., 2021); (Djunaidi et al., 2019). Mangroves have the potential to generate significant economic value, which can be used to support the lives of surrounding communities (Nugraha et al., 2023; Djunaidi et al., 2019; Paringsih et al., 2018).

Mangrove forests in coastal areas provide a rich habitat for various species of fish, shrimp, and crabs, which are the main targets of fishing. In this ecosystem, mangroves function as spawning grounds for various types of fish and shrimp. This shows the importance of mangroves in maintaining the sustainability of fish and shrimp populations, which have a positive impact on the catches of local fishermen (Ratna et al., 2024; Santoso et al., 2019). One of the businesses being developed is tiger prawn aquaculture (**Table 2**).

Table 2. Utilization of Tiger Prawns (*Penaeus monodon*) Cultivation in Manyampa Village

No.	Land Area (ha)	Production (kg)	Price (IDR/unit)	Value (IDR/year)
1	1.0	420	75,000	31,500,000
2	1.3	524	75,000	39,300,000
3	1.5	320	75,000	24,000,000
4	2.0	300	75,000	22,500,000
Total	**5.8**	**1.564**	**75,000**	**117,300,000**
Average	**1.45**	**391**	**75,000**	**29,325,000**

Source: Primary Data Analysis, 2023.

Table 2 shows that the cultivation of tiger prawns in ponds in Manyampa Village, Ujung Loe District, Bulukumba Regency, with an average land area of 1.45 hectares, has a production

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of 391 kg, so the value of the income obtained reaches IDR 29,325,000.00. Research shows that ponds adjacent to mangrove forests are able to provide higher yields compared to ponds separated from this ecosystem (Rafdinal, 2022). In addition, the presence of mangroves can improve the water quality needed by marine biota, thereby increasing pond productivity (Sanbein et al., 2023).

Economic Valuation of Mangrove Forest Ecosystem in Manyampa Village

Direct Benefits

Mangrove ecosystems provide various direct benefits, including mangrove fruits, wood products, and protective functions against coastal abrasion, storm surges, and saltwater intrusion. Firewood is commonly harvested by local communities from mangrove trees. Assuming a moderate extraction rate of approximately one bundle per tree, with a tree density of 2,500 trees per hectare and a price of IDR 7,500 per bundle, the estimated economic value of firewood is around IDR 18,750,000 per hectare. The direct benefit value of mangrove forests as abrasion protection through the replacement cost approach. Estimation of the value of mangrove forests as abrasion barriers. The coastline of Manyampa Village stretches for 5 kilometers, along which lies a mangrove ecosystem covering an area of 27 hectares. If the economic valuation of mangroves is estimated at IDR 1 billion per kilometer per year, then the total value for the 5-kilometer stretch is IDR 5,000,000,000 per year. When distributed proportionally over the 27-hectare mangrove area, the estimated economic value of the mangrove ecosystem is approximately IDR 185,185,185 per hectare per year (**Table 3**).

Table 3. Economic Valuation of the Direct Benefits of Mangrove Ecosystem in Manyampa Village

Description	Assumed Basis	Value (IDR/year)
Firewood (bundles)	2,500 bundles × Rp 7,500	18,750,000
Abrasion barriers (km)	Rp 1Billion/km × distribusi 27 ha	185,185,185
Strom Surges	Proportional valuation of structural damage protection	2,500,000,000
Seawater intrusion barriers	Estimation of prevention costs	2,778,000
	Total	**4,562,963,185**

Source: Primary Data Analysis, 2023.

The number of houses in Manyampa Village is 250 units, with an estimated selling price of IDR 270 million per unit. Therefore, the total property value amounts to IDR 67,500,000,000. The mangrove forest in Manyampa Village covers an area of 27 hectares. One of the ecological functions of mangroves is to prevent saltwater intrusion. In general, coastal areas frequently experience freshwater scarcity. In Manyampa Village, particularly in Luppung Hamlet, where the mangrove area is located, the 250 houses benefit from this protective function. Assuming the average cost of freshwater per household is IDR 30,000 per month, each household spends IDR 360,000 annually. For all 250 households, the total annual value of freshwater is IDR 90,000,000. When distributed over the 27-hectare mangrove area, the estimated economic value of this saltwater intrusion prevention function is approximately IDR 3,333,333 per hectare per year. If the total housing value protected by the mangrove forest is IDR 67.5 billion, and assuming the forest's protective function extends over a 25-year period, then the annualized economic value of this protection is around IDR 2.7 billion per year, or approximately IDR 100,000,000 per hectare per year.

Indirect Benefits

Mangrove forests serve not only as habitats for various marine biota, but also as important economic resources for coastal communities. Mangrove ecosystems act as environmental buffers, protect coastal areas from erosion, and support economic sustainability through fishing and cultivation activities of marine biota such as fish, shrimp, and crabs (Gufron et al., 2024; Hirmawan et al., 2020). Manyampa Village is a village that has 6 hamlets, namely Mampua, Alaraya, Dongi, Luppung, and Tanah Eja Hamlets. Manyampa Village has a fishpond area of

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511.50 hectares, which is located in four hamlets: Luppung, Dongi, Alarayya, and Tanah Eja. Luppung Hamlet has the largest fishpond area, covering 180 hectares, followed by Dongi Hamlet with 160 hectares.

Fish and shrimp farming in mangrove areas, commonly known as silvofishery, has been shown to effectively enhance economic potential and support ecosystem sustainability simultaneously (Rahmah et al., 2023).This method enables communities can gain economic benefits not only from fisheries production but also from sustainable mangrove forest management. The implementation of silvofishery is not only economically beneficial but also contributes to environmental conservation by optimally utilizing the functions of the mangrove ecosystem (Arfan et al., 2023). Table 4 shows that the value of milkfish cultivation in pond land is IDR 191,875,000.00, while the value of tiger prawn cultivation is IDR 550,050,000.00. The total economic valuation of mangroves is IDR 741,925,000.00 per hectare per year.

Table 4. Value of Pond Cultivation in Manyampa Village

Description	Production (kg)	Price (IDR/unit)	Value (IDR/year)
Milkfish	7,675	25,000	191,875,000
Tiger prawns	7,334	75,000	550,050,000
Total	**15.009**	**-**	**741,925,000**
Average	**7,504.5**	**-**	**370,962,500**

Source: Primary Data Analysis, 2023.

In addition, Table 5 shows that the economic value of fish catches along the mangrove coastline is IDR 2,250,000.00, shrimp catches are valued at IDR 3,360,000.00, and crabs at IDR 6,300,000.00. The total economic valuation of mangroves from these coastal fishing activities amounts to IDR 11,910,000.00 per year. Furthermore, studies in various regions have shown that crab fishing in mangrove areas contributes significantly to the income of coastal households. Through sustainable fishing practices, crabs provide not only a stable source of income but also meet strong market demand at both local and regional levels (Muhaimin et al., 2022). The economic potential of crabs can be further enhanced by developing crab-based processed products, which would increase their market value and create additional employment opportunities at the community level (Ferdian et al., 2021).

Table 5. Value of Catch Results in Coastal Mangrove Ecosystems in Manyampa Village

Description	Production (kg)	Price (IDR/unit)	Value (IDR/year)
Fish	75	30,000	2,250,000
Shrimp	56	60,000	3,360,000
Crab	90	70,000	6,300,000
Total	**221**	**-**	**11,910,000**
Average	**73.67**	**53,333.33**	**3,970,000**

Source: Primary Data Analysis, 2023.

Value of Other Option Benefits

The role of ecotourism as one way to utilize mangrove forests has also been the focus of several studies. In Surabaya, ecotourism development has been shown to not only increase income for local communities but also contribute to environmental conservation (Putri et al., 2024). Community involvement in mangrove forest management through ecotourism schemes can provide incentives for them to be actively involved in the conservation and protection of ecosystems (Awali et al., 2023). Other benefits analyzed in this study are the benefits of mangrove forest ecosystem tourism in Manyampa Village (Table 6).The ecotourism value of the mangrove forest area in Manyampa Village for the ticket value is IDR 10,500,000.00, the food value is IDR 63,000,000.00, while the drink value is IDR 15,750,000.00. The total economic value of mangroves is IDR 89,250,000.00 per year.

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Table 6. The Benefits of Ecotourism in the Mangrove Forest Area in Menyampa Village

Description	Visitors (person/unit per month)	Price (IDR/unit)	Value (IDR/year)
Entry ticket	175	5,000	10,500,000
Food	175	30,000	63,000,000
Drinks	175	7,500	15,750,000
Total	**525**	**42,000**	**89,250,000**
Average	**175**	**14,000**	**29,750,000**

Source: Primary Data Analysis, 2023.

One form of community participation in maintaining the sustainability of mangrove forests in Bulukumba Regency can be seen from various programs that involve the community in conservation. Community participation in maintaining Luppung mangrove ecotourism is quite good, including planning and implementing conservation activities supported by farmer groups and village governments (Handayani & Sugiarti, 2022; Handayani et al., 2023). Community contribution in planning and implementing conservation activities is very important to maintain the mangrove ecosystem, which is threatened by mining activities, land conversion, and pollution (Handayani et al., 2023; Nur et al., 2021).

Benefits of Existence

Research in East Lombok Regency shows that mangroves function as a resource that drives local economic development, although its economic value has not been fully measured (Sukuryadi & Johari, 2023). This is in line with findings in North Bolaang Mongondow Regency, which emphasize the importance of mangroves in providing natural resources and their important role in the balance of coastal ecosystems (Hairunnisa et al., 2018). Elsewhere, a study of mangrove forests in Rokan Hilir showed that the total economic value of mangrove forests reached IDR 98,697,950,594, with significant contributions from direct and indirect benefits (Warningsih et al., 2020).

The benefit value of the existence of the mangrove ecosystem in Manyampa Village, Ujung Loe District, Bulukumba Regency is known using the Contingent Value Method (CVM). The total value of the existence of the mangrove ecosystem in Manyampa Village, with an area of 27 hectares is IDR 145,963,300,995 per hectare per year. The results of research in Lansa Village show that the annual economic value of the mangrove ecosystem can reach IDR 4,363,929,000 (Takarendehang et al., 2018).

CONCLUSIONS AND SUGGESTIONS

The mangrove forest in Manyampa Village, Ujung Loe District, Bulukumba Regency covers an area of 27 hectares, and only about 7 hectares are utilized. The existing mangrove forest has the potential to include: direct benefits (fruit, wood, abrasion resistance, saltwater intrusion) and indirect benefits (fish-shrimp-crab habitat, nutrient source, environmental education, ecotourism). The direct benefit value of the economic valuation of the mangrove ecosystem is IDR 4,562,963,185.00 per hectare per year. The indirect benefit value from pond-based aquaculture, including milkfish (bandeng) and tiger prawns, is estimated at IDR 741,925,000.00 per hectare per year, and the value of coastal fishermen's catch is IDR 11,910,000.00 per hectare per year. The ecotourism benefit value in the mangrove forest ecosystem has an economic value of IDR 89,250,000.00 per hectare per year. The total economic value of the mangrove forest ecosystem in Manyampa Village, with an area of 27 hectares is IDR 5,406,048,185.00 per hectare per year. The existence of the mangrove forest ecosystem should be utilized in a balanced manner between socio-cultural, economic, and environmental sustainability.

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