

## Valuation of Mangrove Ecosystems to Income of Coastal Communities: An Overview of Economic Benefits in Sidodadi Village, Teluk Pandan District, Lampung

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Article Info :	ABSTRACT
Accepted: 29-11-2025 Approved: 10-12-2025 Published: 1-1-2026	Coastal communities in Indonesia face increasing environmental and economic challenges, particularly in regions dependent on mangrove ecosystems for their livelihoods. While mangrove forests provide critical ecosystem services including coastal protection, biodiversity support, and direct economic resources, their comprehensive economic contributions remain inadequately quantified. This study aims to analyze the influence of mangrove ecosystems on coastal community welfare by systematically evaluating direct and indirect economic benefits in Sidodadi Village, Teluk Pandan District, Lampung Province. The research employs descriptive analysis utilizing secondary data from literature studies, government reports, and scientific publications. Economic valuation applies the Total Economic Value (TEV) framework, aggregating Direct Use Value (DUV) and Indirect Use Value (IUV) to capture the full spectrum of ecosystem contributions. Findings reveal that DUV from firewood collection, shrimp farming, fish catches, and crab cultivation totals IDR 1,571,507,000 annually. The IUV, quantified through replacement cost method for coastal protection infrastructure, reaches IDR 3,386,276,000, representing 70% of total value. Consequently, the comprehensive TEV amounts to IDR 4,844,198,500 per year. These results have significant implications for coastal zone management, demonstrating that mangrove ecosystems generate substantial economic returns exceeding direct extraction values. Furthermore, mangrove-based ecotourism development presents additional opportunities for communities to diversify income sources while promoting conservation and sustainable resource management practices.
<b>Keywords:</b> Mangrove ecosystem; coastal community welfare; total economic value (TEV); direct use value; indirect use value.	

### INTRODUCTION

Mangrove forests, often known as coastal forests, brackish forests, or mangrove forests, are tropical coastal ecosystems whose vegetation is predominantly adapted to live in an identical muddy environment and influenced by sea tides. Indonesia, which is known as a tropical island country, has the largest mangrove area in the world, about 27% of the total area of global mangroves and 75% of the total area in Southeast Asia. 120 million

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hectares of mangrove forests are spread across various regions of Indonesia, especially in Sumatra, Papua, and Kalimantan ([Kusmana, 2014](#); [Lusmeilia Afriani, 2020](#)).

Mangrove ecosystems have good ecological, biological, and economic benefits. From an ecological point of view, mangroves are very important to maintain coastal stability and function as an essential habitat for birds. Its biological benefits include its function as a source of nutrients for fish, shrimp, and plankton biota. Economically, mangroves can be used as a location for fish pond cultivation, recreational areas, and wood sources. In addition, mangroves have an ecological function as an absorber of *carbon dioxide* ( $CO_2$ ) from the atmosphere, most of which are used for temporary photosynthesis and others remain in the atmosphere ([Farahisah et al., 2021](#)).

The function of the mangrove forest ecosystem is divided into three main aspects, namely, physical, biological, and economic. Physically, mangroves play a large role in maintaining the coastline and protecting the coast from erosion (abrasion) caused by waves. Mangrove forests also have a function to reduce storms and waves, mangrove areas are important areas as spawning areas for various communities for anthropods, such as shrimp, crabs, and shellfish, as well as for chordata groups. In addition, mangrove forests are also areas for shelter, nesting, and breeding for various types of animals. This biodiversity includes the potential of medicinal plants that are not widely known. Other benefits for coastal communities that can be felt directly or indirectly are very large, so that this area plays an important economic asset ([Permata et al., 2021](#)).

The existence of conservation areas or protected parks for mangrove forests has a very important role because it is able to support social and economic progress for communities in the surrounding coastal areas ([Srihermanto et al., 2022](#)). Economic factors are the main drivers of mangrove forest land conversion due to its flat and sloping topography. This characteristic attracts people to develop various businesses such as agriculture, fisheries, and industry. In addition, opening access to mangrove areas is much easier and cheaper than mountainous areas. The strategic location around the river mouth also makes this area very vulnerable to changing functions, driven by the high dependence of the community to occupy the area ([Rachmansyah et al., 2023](#)).

The theoretical foundation of this research is grounded in ecosystem service valuation theory, which posits that natural ecosystems provide both tangible and intangible benefits to human societies. According to the Total Economic Value (TEV) framework developed by ([Andersson et al., 2018](#)), ecosystem services can be categorized into use values (direct and indirect) and

non-use values (option, bequest, and existence values). This framework has been widely applied in coastal ecosystem valuation studies globally, providing a systematic approach to quantify the economic contributions of natural resources to local communities. The TEV approach is particularly relevant for mangrove ecosystems, which simultaneously provide multiple ecosystem services including coastal protection, fishery support, carbon sequestration, and livelihood opportunities (Nayana C, 2024).

Previous empirical studies on mangrove ecosystem valuation have revealed varying economic values depending on geographic location, ecosystem condition, and valuation methodologies employed. For instance, (Yunus et al., 2023) estimated the TEV of mangrove forests in North Sumatra at IDR 2.3 billion per hectare, emphasizing the dominance of indirect use values over direct benefits. Similarly, research in East Java by (Ahmed, 2017) demonstrated that mangrove ecosystems contributed significantly to local fishermen's income through enhanced fish and crab catches, with economic values reaching IDR 3.5 billion annually.

International studies, such as Ferraro et al., (2012) in Vietnam and A Gabb, (2019) in Mexico, have consistently shown that mangrove conservation generates substantial economic returns through ecosystem services. However, these studies predominantly focus on direct resource extraction and fishery values, while often underestimating or excluding the socio-economic impacts of ecotourism development and community welfare enhancement. Furthermore, previous research tends to present descriptive economic valuations without critically analyzing the limitations of market-based approaches in capturing non-market values, particularly cultural and social benefits that are crucial for coastal communities' resilience.

Despite the extensive literature on mangrove ecosystem valuation, significant gaps remain in understanding the comprehensive relationship between ecosystem services and community welfare, particularly in the context of emerging ecotourism initiatives. Existing studies predominantly quantify economic values through traditional resource extraction perspectives, neglecting the transformative role of ecotourism in diversifying income sources and altering community livelihoods. Moreover, there is insufficient critical synthesis examining how the interplay between direct use values (such as firewood and aquaculture products) and indirect use values (such as coastal protection) collectively contributes to sustainable community development.

Specifically, limited research has been conducted in Lampung Province, particularly in Sidodadi Village, Teluk Pandan District, where unique socio-ecological conditions and recent ecotourism developments present distinct

valuation challenges. This research gap is particularly critical given the increasing pressure on mangrove ecosystems from land conversion and the urgent need for evidence-based conservation strategies that demonstrate clear economic benefits to local communities. Additionally, previous studies have not adequately addressed the methodological limitations inherent in TEV approaches when applied to dynamic coastal systems where ecosystem services and human dependencies continuously evolve.

The novelty of this research lies in its integrated approach to mangrove ecosystem valuation that combines traditional economic assessment with critical analysis of socio-economic transformation induced by ecotourism development. Unlike previous studies that predominantly focus on either economic valuation or social impacts in isolation, this research examines the synergistic relationship between ecosystem services, economic valuation, and community welfare enhancement in a specific context where ecotourism is emerging as a complementary livelihood strategy.

Furthermore, this study contributes to the methodological advancement of TEV applications by critically examining the avoided cost approach for indirect use value assessment specifically in the Sidodadi Village context, providing insights into the practical challenges and opportunities of implementing ecosystem service valuation in data-constrained settings. The research also offers empirical evidence from an understudied region (Lampung Province), thereby expanding the geographic knowledge base of mangrove ecosystem services in Indonesia and contributing to more nuanced conservation policy recommendations that account for local socio-ecological specificities.

Based on the identified research gap, this study aims to: (1) quantify the Total Economic Value (TEV) of mangrove ecosystems in Sidodadi Village by systematically calculating both Direct Use Value (DUV) and Indirect Use Value (IUV) using the market price approach and avoided cost method; (2) analyze the influence of mangrove ecosystem services on the economic welfare of coastal communities, with particular attention to income generation from direct resource extraction (firewood, fishery products) and indirect benefits (coastal protection); (3) critically evaluate the socio-economic impacts of emerging mangrove ecotourism on community livelihood diversification and welfare enhancement; and (4) provide evidence-based recommendations for sustainable mangrove conservation policies that balance ecosystem preservation with community economic development needs.

The demonstrated linkages between ecosystem services and community income can inform the design of Payment for Ecosystem Services (PES) schemes and community-based conservation programs that align economic

incentives with conservation objectives. Furthermore, the research findings can guide local government planning in Lampung Province, particularly in developing sustainable coastal management policies that integrate conservation priorities with community development goals. For coastal communities, the evidence on ecotourism's socio-economic benefits can encourage broader participation in conservation initiatives while diversifying livelihood strategies to reduce vulnerability to traditional resource exploitation. Finally, this research contributes to achieving Indonesia's commitment to mangrove conservation under the Nationally Determined Contributions (NDC) framework by providing empirical justification for increased investment in coastal ecosystem protection and restoration programs.

## RESEARCH METHOD

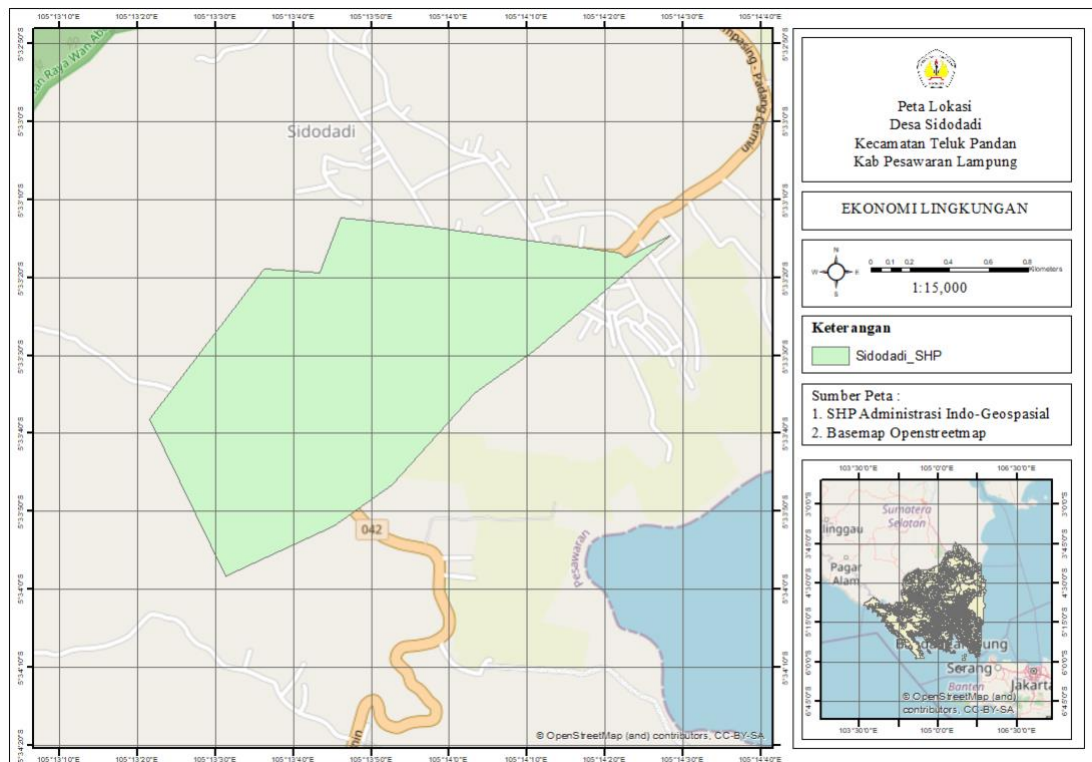


Figure 1. Map of Sidodadi Village

### Research Site

This study was conducted in Sidodadi Village, which is located in Teluk Pandan District, Pesawaran Regency, Lampung Province, Indonesia. The village is situated along the coastal area of Lampung Bay, characterized by extensive mangrove forest ecosystems that stretch along the shoreline. Sidodadi Village was selected as the research location based on several

considerations. First, the area possesses significant mangrove forest coverage that plays a vital role in protecting the coastline from abrasion and providing ecological services. Second, the local community has a direct dependency on mangrove resources for their economic activities, including fishing, crab cultivation, and the collection of firewood. Third, the village has developed mangrove-based ecotourism, which provides additional economic benefits to the community while promoting conservation efforts. The geographical position of Sidodadi Village, combined with its well-maintained mangrove ecosystem and active community involvement in resource utilization, makes it an ideal case study for examining the economic valuation of mangrove ecosystems and their contribution to coastal community welfare.

### **Research Approach and Literature Background**

This research uses a literature review method. The literature review method includes a series of activities such as collecting bibliographies, reading and recording information, and processing the research materials (Aprilyada et al., 2023). The role or function of the literature review in these types of publications is incorporated into the introduction (Aprilyada et al., 2023).

### **Data Sources and Participants**

The primary data sources for this study consist of secondary data obtained from previous research publications, government reports, and scientific literature related to mangrove ecosystem valuation and coastal community welfare. Specifically, the research participants, in the context of secondary data analysis, include published studies documenting the economic activities of local communities in Sidodadi Village who directly utilize mangrove resources, including fishermen, crab cultivators, firewood collectors, and small-scale entrepreneurs engaged in mangrove-based ecotourism.

The secondary data encompasses detailed information on mangrove forest extent in the study area, community economic activities, production volumes of various mangrove products, prevailing market prices, and indirect benefits such as coastal protection services. Additionally, demographic and socioeconomic data from government statistical reports were incorporated to provide contextual background for the economic valuation analysis. The selection of these data sources was guided by specific criteria including their reliability, relevance to the research objectives, geographical proximity to Sidodadi Village, and ability to provide comprehensive information on both direct and indirect economic values of mangrove ecosystems in similar coastal environments.

### **Research Instruments**

Given the nature of this literature review study, the research instruments primarily consisted of systematic documentation and data extraction tools designed to ensure methodological rigor and consistency. The main instrument employed was a comprehensive literature review protocol, which outlined specific criteria for selecting relevant publications, accessing appropriate databases, and evaluating the quality of secondary sources. A structured data extraction matrix was developed to systematically collect information from each source, capturing key variables such as study location characteristics, mangrove forest area and species composition, types of economic activities undertaken by local communities, production volumes of different mangrove products, prevailing market prices for these products, valuation methods employed, and calculated economic values.

This matrix ensured consistency and completeness in data collection across multiple sources while facilitating comparative analysis. Additionally, bibliographic management tools were utilized to organize, categorize, and track the collected literature based on thematic areas including direct use values, indirect use values, socioeconomic impacts, and conservation strategies. The Total Economic Value (TEV) framework served as the primary analytical instrument, providing a structured conceptual approach to categorize and systematically calculate the different types of values associated with mangrove ecosystems. Furthermore, standard economic valuation formulas and equations were employed as computational instruments to derive Direct Use Value (DUV) through market price approaches and Indirect Use Value (IUV) through replacement cost methods from the collected secondary data.

### **Data Collection and Analysis Procedures**

The data collection procedure followed a systematic, multi-stage approach designed to ensure comprehensiveness and methodological rigor. In the first stage, a comprehensive literature search was conducted using multiple academic databases, government repositories, and institutional publications to identify relevant studies on mangrove ecosystem valuation in Sidodadi Village and comparable coastal areas within Lampung Province and similar ecological zones. The search strategy employed specific keywords and Boolean operators related to mangrove economic valuation, coastal community welfare, direct and indirect use values, Total Economic Value

approaches, and ecosystem services. In the second stage, the identified literature was systematically screened based on predetermined inclusion and exclusion criteria, with particular attention to geographical relevance, methodological rigor, completeness of economic data, and publication currency.

Studies that met the inclusion criteria were then subjected to detailed quality assessment using established evaluation frameworks. In the third stage, detailed data extraction was performed using the structured matrix, systematically capturing quantitative information including the extent of mangrove forest coverage, production volumes of key products such as firewood, fish, shrimp, and crabs, prevailing market prices for these products, and estimates of ecosystem service values such as coastal protection benefits. The data analysis procedures were implemented in several sequential steps. First, descriptive statistical analysis was conducted to summarize the characteristics of the collected data, including measures of central tendency (mean, median) and variability (standard deviation, range) for economic values across different sources and product categories. Second, the Total Economic Value (TEV) framework was systematically applied to calculate the economic benefits.

This involved computing the Direct Use Value (DUV) by multiplying the harvested quantity of each mangrove product by its corresponding market price, then aggregating these values across all product categories including firewood, shrimp, fish, and crab cultivation. Third, the Indirect Use Value (IUV) was estimated using the replacement cost method, which calculated the hypothetical cost that would be incurred to construct and maintain alternative coastal protection infrastructure (such as seawalls or breakwaters) if the natural mangrove ecosystem were absent. Fourth, the Total Economic Value (TEV) was obtained by summing the DUV and IUV components, representing the comprehensive economic contribution of the mangrove ecosystem to community welfare. Throughout the analysis, data triangulation techniques were employed by systematically comparing findings across multiple independent sources to ensure reliability and validity of the economic valuation results, while potential sources of bias or uncertainty were identified and documented.

### **Analysis Method**

This study uses descriptive analysis as the primary data processing technique (Riyanto & Arini, 2021). Descriptive analysis is a type of research that aims to describe or obtain a significant picture of the characteristics of existing data. This analysis presents the results as they are and is not intended

to draw general conclusions (Kusuma & Mahardi, 2021). The data used in this study is secondary data. Secondary data is information not obtained directly by the researcher from the research subjects, but rather through a second party or readily available source. This data serves as supporting data to complement the primary data. In this study, secondary data sources include books, articles, and other published materials (Hikmatul Hidayah, 2023).

## RESULTS AND DISCUSSION

### 1. The Role of Mangrove Forests

Mangrove ecosystems are composed of diverse trees and shrubs that thrive in the lowest areas or are heavily influenced by seawater. Broadly speaking, vegetation in these ecosystems is classified into two groups: true mangroves and mangrove associations (Sosial et al., 2023). Mangrove ecosystems play a crucial role in the environment. One of the roles of mangrove forests is to provide a variety of massive ecological benefits to coastal zones. Their primary roles include physical protection and filtration. Physically, these ecosystems act as crucial natural buffers, protecting coastlines from the threat of wave abrasion and the impact of strong winds. Meanwhile, as filters, mangroves prevent seawater from entering the land and have the unique ability to capture and neutralize various dangerous pollutants, including heavy metals and other pollutants (Purnamasari et al., 2022). The flat physical characteristics of mangrove forests make them ideal locations for various economic activities, such as agriculture, fisheries, and industry. This is why these areas tend to be converted into economic land (Nanlohy & Masniar, 2021).

Mangrove forests play a crucial socio-economic role for coastal communities. Economically, mangroves are a natural resource that can be directly utilized, such as as an efficient source of firewood and raw materials for crafts and daily household items. Over time, their economic value has increased through the development of ecotourism, making them attractive nature tourism destinations for some. The social role of mangroves is evident in supporting traditional livelihoods, such as fishing and aquaculture, as well as preserving the cultural heritage of coastal communities closely tied to the existence of these forests. Thus, mangrove ecosystems not only protect the environment but also support the economy and social structure of the surrounding communities (Sakti & Fauzi, 2020).

Ecotourism in mangrove forests is a sustainable management strategy aimed at achieving two main goals: strengthening the local economy and preserving the environment. This program seeks to increase the income of coastal communities by directly involving them in the operation and

management of tourist areas. Unlike exploitative practices, the concept of mangrove ecotourism is based on conservation principles (Webliana et al., 2023).

Mangrove ecosystems play a vital role as natural carbon sinks, making significant positive contributions to the global environment. Rising CO<sub>2</sub> and other atmospheric gases are driving global warming, leading to rising temperatures and climate changes such as extreme rainfall patterns. More frequent storms and rising sea levels due to thermal expansion and melting polar ice caps all threaten coastal resources. However, protected mangrove forests are able to combat these natural phenomena by converting inorganic carbon into organic carbon stored in their biomass through photosynthesis. Unlike other ecosystems, mangroves uniquely retain most of this organic matter, making them highly efficient carbon sinks rather than sources of emissions. Furthermore, mangroves, with their dense foliage, exhibit a higher carbon sequestration capacity than many other vegetation types, reinforcing their crucial role in mitigating the impacts of climate change (Ketaren, 2023).

## **2. Socio-Economic Impact on Communities Surrounding Mangroves**

Socioeconomic status (sosek) is the position or hierarchy that an individual occupies within a group of people. This position is determined by a combination of factors, such as economic activity, income, educational attainment, age, characteristics of residence, and the type of functional position held within various organizations. Therefore, it can be concluded that socioeconomic status is a marker that reflects the level of social conditions and economic prosperity of an individual within the protection of society. This socioeconomic measurement typically uses various indicators, including parental educational background, age, type of employment, income, quality of the residential environment, ownership of assets or wealth, and level of participation in community groups (Siregar & Darwis Nasution, 2020).

The total economic value (Total Economic Value or TEV) of a mangrove ecosystem in a coastal area is calculated by adding up all the value categories it generates. The components that make up this value include four main categories: direct use value, which comes from the direct use of resources; indirect use value, which includes the ecological service function; option value, which is the potential value of benefits in the future ; and the benefit value of existence (Existence Value), which is based on the intrinsic value of the ecosystem itself (Cahyo Diartho & Luthfi, 2022).

The development of mangrove forest ecotourism will undoubtedly have both positive and negative impacts on the surrounding communities. However, the most significant impact is a shift in mindset among local

residents. People who were previously busy with their daily routines, both at home and away, are now beginning to recognize and capitalize on the new economic opportunities offered by tourism. Consequently, the presence of mangrove ecotourism encourages residents to seek out and capitalize on better opportunities to support and improve their daily needs (Fitria, et al., 2021).

The shift in focus of local communities to capitalize on new economic opportunities from mangrove ecotourism, previously preoccupied with their daily routines, demonstrates the importance of environmental awareness. Therefore, one of the primary efforts to protect coastal areas is understanding the crucial role of mangrove ecosystems and their myriad benefits. To ensure the sustainability of these conservation efforts, a sense of environmental stewardship is essential. As representatives of the future of society, it is crucial for students to be equipped with environmental values from an early age to ensure the continued protection of coastal ecosystems (Putri et al., 2022).

The development of mangrove ecotourism plays a crucial role for two main reasons: improving the economic well-being of the community and serving as an effective strategy to prevent widespread damage to the mangrove ecosystem. It is hoped that this initiative will encourage the progress and sustainability of mangrove forest conservation. Specifically, the implementation of mangrove ecotourism in Pengudang Village has been proven to have a significant positive impact, both on the financial condition and social structure of the residents living around the tourist location (Haidawati et al., 2022).

The development of mangrove tourism areas serves as a catalyst for improving the well-being of village residents. This well-being is achieved through active community involvement in various activities, including the creative economy, agriculture, and other sectors, organized through community groups that support village tourism. Overall, the development of these mangrove tourism areas embodies the integration of local village development initiatives with global sustainable development goals (Apriani et al., 2022).

Essentially, the goal of tourism development is to assign an economic value to all goods and services produced by natural resources. This value is then adjusted or corrected to reflect the real value of these resources from the perspective of the communities that use them (Ersan et al., 2022)

### **3. Total Economic Value of Mangroves in the Sidodadi Village Area**

Total Economic Value is a method of accumulating all the utility (direct) and non-utility (indirect) values of mangrove forest ecosystems that have

been identified and quantitatively measured. The sum of these two types of values is then formulated as follows:

$$\text{NET} = \sum (\text{ML} + \text{MTL})$$

Where

ML = Direct Benefit Value

MTL = Indirect Benefit Value

The total economic value itself is used after all calculations have been obtained (Purnamasari et al., 2022).

#### **4. Direct Benefit Value**

The direct benefits of mangrove forests are the tangible and actual benefits derived by the community. This value includes activities such as timber harvesting, catching various marine products (fish, crabs, shellfish), and tourism. To calculate the value of these direct benefits, a market price approach is used to measure (quantify) their economic value (Bahari Papadak & Oktober, 2022).

##### **a. Benefits of Firewood**

The economic value of firewood is calculated by multiplying the quantity of wood harvested by its equivalent price. This pricing is based on the assumption that one bundle of firewood (from mangrove twigs or trunks) sufficient for two weeks of cooking is equivalent to the price of a 3 kg gas cylinder, which is Rp. 17,000.00. Based on the analysis, the community utilizes firewood with a production volume of approximately 365 bundles/ha/year. Therefore, the total annual value of firewood is Rp. 6,205,000 (Tang et al., 2023).

##### **b. Benefits of Shrimp and Fish**

Communities living near the mangrove area cultivate brackish water fish, particularly shrimp and milkfish, using traditional techniques on land typically ranging from 2 to 6 hectares. They prefer traditional methods, eliminating the need for additional factory feed, resulting in a direct annual benefit of Rp 1,445,302,000 from the shrimp and milkfish (Melo et al., 2023).

##### **c. Benefits of Crab**

The community around the mangrove area also utilizes the land for crab cultivation with a crab production of 1,200 kg and sold at a price of IDR 100,000 so that the income earned per year is IDR 120,000,000 (Rizky et al., 2024).

## 5. Indirect Benefits

Indirect benefits are benefits that are not directly felt. The (Rizky et al., 2024).indirect benefit value is approximately Rp. 3,386,276,000, which is equivalent to 26.66% of the total economic value. This indirect benefit value is specifically obtained from calculating the total costs that should be incurred to build the coastal retaining structure.

## 6. Total Economic Value (NET)

The calculation of the Total Economic Value (NET) of the mangrove ecosystem is based on its use value. This value is divided into two main categories: direct benefits and indirect benefits. Direct benefits include profits from fish farming and firewood, while indirect benefits are derived from the mangroves' role in preventing coastal erosion. The total economic value is Rp. 4,844,198,500.

## CONCLUSION

This study successfully addresses the critical knowledge gap in quantifying comprehensive economic contributions of mangrove ecosystems to coastal community welfare in Sidodadi Village, Teluk Pandan District, Lampung Province. Key findings reveal that Direct Use Value from firewood, shrimp, fish, and crab totals IDR 1,571,507,000 annually, while Indirect Use Value through replacement cost method for coastal protection reaches IDR 3,386,276,000, representing 70% of total value. Consequently, the Total Economic Value amounts to IDR 4,844,198,500 per year, demonstrating that mangrove conservation generates substantial economic returns exceeding alternative land uses.

Based on these findings, policymakers should prioritize mangrove conservation by incorporating ecosystem service values into coastal management strategies and supporting community-based ecotourism through capacity building and infrastructure development. However, this study acknowledges limitations in relying on secondary data, which restricts site-specific precision and real-time seasonal assessment. Future research should employ primary data collection, incorporate non-use values for complete TEV analysis, and conduct longitudinal studies to assess temporal dynamics in ecosystem services under changing environmental conditions.

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