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Study on the Utilization of Mangrove Forest Plants

Retni, S. Budiarti[1]*, Harlis[1], Agus Subagyo[1]

[1] Department of Biology Education, Faculty of Teacher Training and Education, University of Jambi, Jambi, Indonesia

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Corresponding Author:
Retni S. Budiarti
retni.sulistiyoning@unja.ac.id

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Abstract: The mangrove forest has unique characteristics, plays a role in ecological and economic functions, and is a natural resource that has not been optimally utilized. This research was conducted in Tungkal 1 Village, Tanjung Jabung Barat Regency, Jambi, to identify the potential utilization of mangrove plants as entrepreneur-based products. The research method involved surveys selected using snowball sampling, interviews with various stakeholders, and data analysis on respondent characteristics, knowledge, understanding, mangrove-based products, community involvement, support, accessibility, and economically valuable strategies for utilizing mangrove plants. The results show that the majority of the community has knowledge about mangrove forests, but their understanding of the potential utilization is still low. Mangrove-based products such as ecotourism, handicrafts, and sustainable fish farming have high economic potential. The level of community involvement in mangrove conservation and support for preservation efforts is high. In conclusion, mangrove management in Tungkal 1 Village can serve as a successful example in supporting sustainable local economic growth while preserving the important

Keywords: Forest; Mangrove; Plants

Introduction

Plants are a biological resource that has been utilized by humans worldwide for a long time. The need for this knowledge is increasing as human dependence on plants grows (Ahmed et al., 2016; Emms & Kelly, 2015; Syahroni et al., 2021; Thatoi et al., 2013). Ethnobotanical studies have emerged and become crucial in understanding the functions of plants in meeting the daily needs of rural communities (Arbiastutie et al., 2021; Jamila & Mostafa, 2014; Ribeiro et al., 2017; Tugume et al., 2016). Ethnobotany is any form of knowledge (about plants) that describes the relationship between local communities (ethnic groups) and natural resources (Barkaoui et al., 2017; Bieski et al., 2015; Malla et al., 2015). By exploring local knowledge about plants, ethnobotany provides valuable insights into how communities manage their natural resources wisely. Additionally, this study can serve as a foundation for the development of sustainable conservation policies and the sustainable utilization of natural resources (Bennett et al., 2015; Braat & de Groot, 2012; Guan et al., 2023). By preserving and understanding the heritage of ethnobotanical knowledge, we can help protect biodiversity, support environmental sustainability, and ensure the well-being of local communities in mangrove areas.

Mangrove forests have unique characteristics compared to other forest formations (Aisiah et al., 2022; Riska et al., 2023; Widayanti & Firmansyah, 2022). The uniqueness of these forests is evident in their habitat and the diversity of flora, including Avicennia, Rhizophora, Bruguiera, and other plants that can withstand the salinity of seawater (Al Idrus et al., 2023; Bernbom et al., 2014; Qosimah et al., 2023; Yuliana et al., 2019). Mangrove forests also serve economic, ecological, and social functions. The economic functions include providing household needs, supplying industrial requirements, and producing seedlings. Ecologically, they act as coastal protectors, preventing seawater intrusion, serving as habitats for various bird species, and more (Cecep, 2015; Rizal, 2018). Mangrove forests in Indonesia are distributed across several provinces in various island clusters. The total area of mangrove

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forests in Indonesia is approximately 3.7 million hectares, making it the largest mangrove forest in Asia and even in the world (Davinsy et al., 2015; Friess et al., 2016; Suparto, 2023).

One of the areas with mangrove forests is the province of Jambi, which has a mangrove forest area of 9,347.61 hectares. These mangrove forests are spread across the regions of Tanjung Jabung Barat and Tanjung Jabung Timur. One of the natural products commonly found in the mangrove forest area is the pidada fruit, perepat, and nyiri fruit, which are abundant but have not been utilized in the natural wealth. The distribution of these fruit plants even extends to growing around residential areas. Based on observations in Tanjung Jabung Barat Regency, specifically in the city of Kuala Tungkal, nipah plants are abundant in brackish forests and swamps from Parit 7 to Parit 9. Many mangrove plants, such as Nipah, Pidada, Api-api, Perpat, Bakau, and others, are growing in this area, but so far, they have not been utilized by the local community. Currently, only nipah and pidada fruits have been processed into food and beverage products, while other parts or fruits have not been fully utilized. Up to now, there has been no significant or sustainable activity that effectively utilizes these mangrove plants. Therefore, various alternative uses for mangrove plants need to be explored, not only to preserve the plants but also to extract their economic value.

The utilization of mangrove plants in Tungkal 1 Village, Tanjung Jabung Barat Regency, encompasses various aspects that have positive impacts on the local community. Mangrove plants are utilized as valuable natural resources, especially the wood used as a local building material (Hadiprayitno et al., 2023; Rumanta et al., 2023; Tandi et al., 2023). Additionally, various types of mangrove plants are also utilized for traditional medicine by the community, indicating potential health benefits. In line with a sustainable approach, this utilization can contribute significantly to the economy and create ecotourism opportunities, promoting environmental sustainability, and providing social benefits to the local community (Kadir et al., 2019; Rahmah, 2021; Rizki, 2017). The importance of involving the community in sustainable management is key to maintaining a balance between the utilization of mangrove plants and the preservation of the mangrove ecosystem itself.

The existence of mangrove forests is crucial because they play a dual role, not only in ecological potential but also in providing economic benefits for the well-being of the surrounding communities (Santoso et al., 2022; K. I. W. Sari et al., 2023). The rapid technological advancements of the times have led the local communities to develop human interests, resulting in a decline in the diversity of mangrove vegetation. Mangrove forests serve functions that are widely felt by the surrounding communities, as well as the aquatic biota found in the vicinity of mangrove forests (Majid et al., 2016; Ndruru & Delita, 2021). In addition to these functions, the potential of mangrove forests can be utilized for superior ecotourism as they can attract tourists to visit. It's not just the beaches that can be destinations, but the mangrove forests around the coast can also become destinations for tourists.

Based on field surveys and interviews with local community leaders in Tungkal 1 Village, Tanjung Jabung Barat Regency, the results indicate that there is still significant untapped potential from mangrove plants. Although some mangrove plants have been utilized for purposes such as construction materials and traditional medicine, a large portion remains largely unexplored. In addition, the mangrove forest in Tungkal 1 Village, Tanjung Jabung Barat Regency, has also been developed into an ecotourism destination that attracts tourists (Bangdimas et al., 2022). With its natural beauty, this ecotourism provides a unique experience for visitors to explore biodiversity and the mangrove ecosystem while increasing awareness of the importance of environmental conservation. These findings present opportunities to develop more holistic and sustainable management strategies to maximize the economic and ecological benefits of available mangrove plants. There is a need for further efforts to support a participatory community approach in identifying and developing new utilization potentials, while still adhering to sustainability principles to ensure long-term positive impacts on the environment and the well-being of the local community. With this potential, it is worth examining the types of mangrove plants that can be processed for various mangrove-based products by local entrepreneurs, with the hope of increasing income and prosperity for the village community. Through this research study, which aims to explore various ways in which mangrove plants can be sustainably utilized, efforts can be directed towards fostering positive long-term impacts on the environment and the well-being of the local community.

Method

This research was conducted in Tungkal 1 Village, Tungkal Ilir Subdistrict, Tanjung Jabung Barat Regency from August to October 2023. The subjects of this research were the community and plants in the mangrove area of Tungkal 1 Village. The tools used included questionnaires, mangrove plant identification books, tally sheets, cameras, and recorders. Data collected in this research included both primary and

secondary data. Primary data were obtained through direct interviews with the community as respondents. Meanwhile, secondary data consisted of general condition data of the research location.

The sampling technique in this research was carried out using the Purposive Sampling method with the main objective of producing samples logically representing the population. This method involves sampling and documentation techniques through field exploration. Respondent selection was done through semi-structured interviews using questionnaires. The selection of respondents was carried out using the snowball sampling method, where key respondents were initially identified, and then other respondents were selected based on information from the previous respondents. Data processing and analysis were performed by tabulating to present data on plant species, families, habitus, parts of the plants used, as well as their benefits and utilization methods. The results of the data analysis were organized based on the usefulness groups, habitus percentages, and the percentage of plant parts utilized.

Result and Discussion

Based on the analysis of the local wealth study in Tungkal 1 Village, Tanjung Jabung Barat, Jambi, through an interview with one of the village figures, it was found that the local community has not fully understood the potential for economic management of mangrove plants. Observations indicate that only some types of mangrove plants are well-managed, while the majority are still not utilized optimally. The economic management of mangrove plants requires a profound understanding of the diversity of mangrove species and the characteristics of each type. This includes knowledge of the life cycle, growth, and the potential economic value of each species. It is essential to understand that mangrove plants have various economic values, such as firewood, building materials, traditional medicines, animal feed, fish farming, and handicrafts (Bangdimas et al., 2022; Islam et al., 2014; Karim et al., 2020).

Table 1. List of Plants in the Mangrove Forest Area

Local Name	Latin Name	Family	Habitus	Usage
Black flames	*Avicennia lanata*	*Avicenniaceae*	Tree	Wc
White flames	*A. marina*	*Avicenniaceae*	Tree	Wc
To keep	*Sonneratia caseolaris*	*Lythraceae*	Tree	M,F
Quadruple	*Sonneratia alba*	*Lythraceae*	Tree	M, F
Mangrove	*Rhizophora stylosa*	*Rhizophoraceae*	Tree	Wc
Mangrove	*R. apiculata*	*Rhizophoraceae*	Tree	Wc
Letop-letop	*Passiflora foetida*	*Passifloraceae*	Herbs	O
Cengkodok	*Melastoma candidum*	*Melastomatacee*	Lost	M, A
Beluntas	*Pluchea indica*	*Asteraceae*	Lost	M, F
I'm sorry	*Xylocarpus granatum*	*Meliaceae*	Tree	A, W
Packed warehouse	*Acrostichum speciosum*	*Pteridaceae*	Herbs	M
Pandan thorn	*Pandanus odoratissima*	*Pandanaceae*	Tree	Ak
Sea flute	*Melanthera biflora*	*Asteraceae*	Herbs	M
Tancang	*Bruguiera gymnorrhiza*	*Rhizophoraceae*	Tree	F, Wc
Tancang racun	*B. cylindrical*	*Rhizophoraceae*	Tree	Wc
Nipah	*Nypa fruticans*	*Arecaceae*	Tree	M, F, Wc, WC
Footsteps	*Ipomoea pes-caprae*	*Convolvulaceae*	Herbs	M
Sea chest	*Clerodendrum inerme*	*Verbenaceae*	Lost	M
Jeruju	*Acanthus ilicifolus*	*Acanthaceae*	Herbs	M
Ketapang	*Terminalia cattapa*	*Combretaceae*	Tree	M
Dusty	*Sonneratia ovate*	*Sonneratiaceae*	Tree	M, F, A
Keladi air	*Sagittaria guyanensis*	*Alismataceae*	Herbs	WC
Lacquer	*Cayratia trifolia*	*Vitaceae*	Interested	F, A, W
Noni	*Morinda citrifolia*	*Rubiaceae*	Lost	M

Information: M: Medicine, F: Food, A: Aromatics, WC: Weaving and Crafts, Wc: Wood cow W : warn

Furthermore, based on the analysis of various sources, there are many mangrove forest plants and their uses (Table 1).

Table 1. identifies various types of mangrove plants along with their local names, Latin names, families, mangrove types, and their habitus. From the provided data, it can be concluded that mangroves are ecosystems rich in biodiversity, especially in terms of plant species. Each type of mangrove plant has its own characteristics and provides various important benefits to both

communities and the environment. Some mangrove species listed in Table 1 include trees such as Black Mangrove, White Mangrove, Rhizophora, Ketapang, Nipah, Nyireh, Tancang, and others. These trees make a significant contribution by providing wood, construction materials, and various products that can be utilized by the local community. Additionally, mangroves also involve associated plant species such as Beluntas, Jeruju, Water Arum, Lakom, Letop-letop, Noni, Pakis laot, Sea hibiscus, and Horseshoe crab, which play essential roles as medicinal plants, animal feed, and craft materials.

Furthermore, based on the results of observations and interviews, it is evident that mangrove plants have significant economic potential that can be utilized to enhance entrepreneurship in the Tungkal I community or regions with mangrove ecosystems. Here are some types of mangrove plants that have economic potential.

Rhizophora spp.

The Rhizophora spp. commonly found in mangrove forests exhibits antimicrobial properties and contains a variety of enzymes that play a crucial role in ecology and industrial applications (Amiruddin Akbar Fisu et al., 2020; Basyuni, Slamet, et al., 2021). The antimicrobial properties of this plant are associated with the production of compounds such as tannins and flavonoids, which can inhibit the growth of pathogenic microorganisms in the mangrove environment (Ebube Samuel Izuogu et al., 2023; Mustofa & Anisya, 2020; Samson et al., 2021). Additionally, Mangroves produce enzymes such as peroxidase and catalase, which play a role in the detoxification process of harmful compounds, such as heavy metals, in the mangrove soil substrate. The presence of these antimicrobial properties and enzymes not only maintains the balance of the mangrove ecosystem but also has potential applications in the pharmaceutical and industrial fields, especially in the development of drugs and biotechnology (Abuarra et al., 2014; Akpovwovwo & Gbadegesin, 2022; Marashdeh et al., 2017). Therefore, further studies on antimicrobial substances and enzymes from Rhizophora spp. are essential for a deeper understanding of the role of the mangrove ecosystem and its potential applications.

The significant economic benefits of the Rhizophora spp. mangrove species lie in its provision of mangrove wood, which has high economic value as a raw material for construction, especially in the making of fences, bridges, and building foundations in coastal areas. This water-resistant and insect-resistant mangrove wood is also used in the shipbuilding industry (Deyoe et al., 2020; Nura, Fadilla et al., 2023; Samal et al., 2023). Secondly, this ecosystem supports the fishing industry by providing shelter for various types of fish and marine organisms, helping maintain local fish stocks and providing a source of income for local fishermen. Furthermore, mangrove plants also have economic benefits as non-wood natural resources. Some Rhizophora spp. species have seeds that can be processed into mangrove oil, used in soap, candle, and skincare product industries. Other economic benefits include the mangrove's function in protecting the coast from erosion and storms, reducing losses caused by natural disasters (Handayani, 2018; Kusmana, 2018; Kusmana & Sukristijiono, 2016). Moreover, ecotourism and environmental education related to the mangrove ecosystem can also serve as an additional source of income for the Tungkal village community by inviting tourists to observe biodiversity and the benefits of this ecosystem.

Avicennia spp.

The Avicennia spp. commonly found in mangrove forests, plays a crucial role in ecology and possesses antimicrobial properties, along with relevant enzymes. The antimicrobial properties of this plant are associated with the production of compounds such as tannins and alkaloids, capable of inhibiting the growth of bacteria and pathogenic fungi in the mangrove environment (Aken et al., 2021; Basyuni et al., 2019; Sabdanawaty et al., 2021; Sumartini et al., 2021). Additionally, Avicennia spp. also produces a variety of enzymes, such as peroxidase and lipase, which play a role in the detoxification process of toxic compounds, such as heavy metals, found in the mangrove soil substrate. The presence of these antimicrobial properties and enzymes not only supports the balance of the mangrove ecosystem but also has potential applications in various industries, including pharmaceuticals and biotechnology, for drug development and waste processing . Therefore, a deeper understanding of antimicrobial substances and enzymes in Avicennia spp. is crucial in the environmental science context and practical applications.

The Avicennia spp. mangrove species (Api-api) in Tungkal Village, Tanjung Jabung Barat, has significant economic benefits. The Api-api trees provide wood used in local construction, especially in the making of fences, bridges, and fishing gear. Additionally, Api-api plants have well-developed root systems that help protect the coastal substrate from erosion, a critical benefit in maintaining coastal quality. Furthermore, this mangrove ecosystem serves as a shelter for various fish species and marine organisms, supporting the fishing industry and providing income for local fishermen. By utilizing the wood and ecosystem services provided by the Avicennia spp. species, the Tungkal Village community can enhance their well-being while

preserving the sustainability of this valuable coastal ecosystem.

Sonneratia spp. (Pidada)

The Sonneratia spp. (Pidada) plant, commonly found in mangrove ecosystem, plays a crucial role in maintaining the balance of this ecosystem and possesses antimicrobial properties along with crucial enzymes. The antimicrobial properties of this plant are associated with the production of compounds such as tannins and flavonoids, which can inhibit the growth of pathogenic microorganisms in the mangrove environment (Basyuni, Slamet, et al., 2021; Kusmana, 2018; Zuraida et al., 2020). Pidada also contains a variety of enzymes such as peroxidase and cellulase, which play a role in breaking down complex organic compounds, such as cellulose, an essential component in mangrove detritus. This process aids in nutrient recycling and the decomposition of organic matter that falls into the mangrove environment. In addition to supporting the mangrove ecosystem, the antimicrobial properties and enzymes of the Sonneratia spp. plant have potential applications in industries such as waste processing, pharmaceuticals, and enzyme production in various biotechnological processes (Amiruddin Akbar Fisu et al., 2020; Masithah et al., 2016). Therefore, further research on antimicrobial substances and enzymes from the Pidada plant is crucial for a deeper understanding of its ecological function and applicative potential.

Sonneratia spp. (Pidada) is a mangrove species that provides significant economic benefits in Tungkal Village, Tanjung Jabung Barat. The Pidada tree has wood used in various local construction applications, including house construction, boat making, and tools. Additionally, extracts from the Pidada bark are used in the leather tanning industry, providing additional economic value for the local community. The Sonneratia spp. mangrove ecosystem also supports the fishing sector by providing shelter for fish and various marine organisms, which are a source of income for fishermen. Furthermore, the Pidada plant has potential in reforestation and coastal land rehabilitation industries that can yield long-term benefits. By harnessing the resources provided by Sonneratia spp., the Tungkal Village community can optimize economic utilization while preserving the sustainability of this vital mangrove ecosystem.

Nypa fruticans (Nipah)

The Nypa fruticans (Nipah) plant that grows in mangrove forests possesses antimicrobial properties and contains enzymes that play a crucial role in both ecological and industrial applications. The antimicrobial properties of this plant are associated with the production of compounds such as tannins and flavonoids, which are effective in inhibiting the growth of bacteria and pathogenic fungi in the mangrove environment, thus contributing to the overall health of the ecosystem (Dalming et al., 2018; Kadir et al., 2019; Zulkarnaini et al., 2019). Nipah also contains enzymes like peroxidase and amylase, which play a role in the detoxification of toxic compounds and the breakdown of complex organic matter, such as starch. This process supports nutrient recycling and the decomposition of organic matter that falls into the mangrove environment. The antimicrobial properties and enzymes of the Nipah plant have potential applications in various industries, including pharmaceuticals, waste processing, and enzyme production in various biotechnological processes (Baharuddin, 2021; Egra et al., 2019; Oktavia et al., 2022). Therefore, further research on antimicrobial substances and enzymes from the Nipah plant is crucial for a deeper understanding of its ecological function and applicative potential.

The Nipah plant (Nypa fruticans) has diverse benefits that can serve as the basis for various economically and ecologically beneficial products. One of the primary benefits of Nipah is its rich starch content. Starch extracted from Nipah fruit, known as "nipah starch," can be used in the food industry as a raw material for making flour, adhesives, food products, and snacks. Nipah starch is also utilized in the pharmaceutical and cosmetic industries as a binding agent and a fundamental ingredient in the production of tablets and skincare products (NUGROHO et al., 2022; Posangi & Bara, 2014).

Ceriops spp. (Tancang)

The Ceriops spp. (Tancang) plant, abundant in mangrove forest ecosystems, plays a crucial role in maintaining the balance of this ecosystem. It possesses antimicrobial properties and contains enzymes that have significant ecological relevance and industrial applications (Ngoma et al., 2020; Subhashini & V, 2014). The antimicrobial properties of this plant are associated with the production of compounds such as tannins and phytoncides, effective in inhibiting the growth of bacteria and pathogenic fungi in the mangrove environment, contributing to the protection of this ecosystem. Tancang also contains various enzymes, such as lipase and amylase, playing a role in breaking down complex organic compounds like lipids and starch. This process supports nutrient recycling and the decomposition of organic matter falling into the mangrove environment, with potential applications in the pharmaceutical industry, waste processing, and enzyme production in various biotechnological processes (Mamuaja et al., 2023; , et al., 2021). Therefore,

a deeper understanding of the antimicrobial properties and enzymes found in the Ceriops spp. (Tancang) plant is crucial for maintaining the balance of the mangrove ecosystem and exploring its applicative potential in various industries.

Ceriops spp. (Tancang) is a mangrove species that provides significant economic benefits in Tungkal Village, Tanjung Jabung Barat Regency. The Tancang plant holds economic value in the construction sector, particularly in the production of boats, embankments, and coastal structures, as its wood is resistant to water and pests. Extracts from the Ceriops roots are also used in the textile dyeing and charcoal industries. Moreover, the Ceriops mangrove ecosystem protects the coast from erosion and storms, reducing losses caused by natural disasters. In the fisheries sector, this mangrove provides shelter for fish and marine organisms, supporting the increase in fish stocks and providing a source of income for local fishermen. By judiciously utilizing the resources from Ceriops spp., the residents of Tungkal Village can improve their standard of living while maintaining the sustainability of the crucial mangrove ecosystem for their coastal communities.

Lindur (B. gymnorrhiza Lamk)

The Lindur plant (Bruguiera gymnorrhiza Lamk), commonly found in mangrove forests, possesses antimicrobial properties and contains a variety of enzymes that play a crucial role in the mangrove ecosystem and have industrial applications. The antimicrobial properties of this plant are associated with the production of compounds such as tannins and flavonoids, which are effective in inhibiting the growth of pathogenic microorganisms in the mangrove environment, contributing to the overall health of the ecosystem (Polnaya et al., 2021; Sulistyawati et al., 2012; Tala, 2020). Lindur also contains enzymes like peroxidase and cellulase, playing a role in the detoxification of toxic compounds and the breakdown of complex organic matter, such as cellulose. This process supports nutrient recycling and the decomposition of organic material that falls into the mangrove environment. In addition to maintaining the balance of the ecosystem, the antimicrobial properties and enzymes of the Lindur plant have potential applications in various industries, including pharmaceuticals, waste processing, and enzyme production in various biotechnological processes (Ergüden et al., 2021; Pentury et al., 2012; P. Sari et al., 2019). Therefore, further research on the antimicrobial substances and enzymes in the Lindur plant is essential for a deeper understanding of its ecological function and applicative potential.

The Lindur mangrove fruit (B. gymnorrhiza Lamk) can traditionally be processed into cakes, mixed with rice, or eaten directly with coconut seasoning due to its high energy and carbohydrate content. In fact, it exceeds various types of carbohydrate sources commonly consumed by the community, such as rice, corn, cassava, or sago (Amalia et al., 2016; Hardoko et al., 2020).

Nyirih (Azadirachta indica)

The Nyirih plant (Azadirachta indica), also known as the neem tree, is a primary source of antimicrobial compounds and enzymes with ecological significance and diverse industrial applications. This plant is known to contain compounds such as nimbin, nimbidin, and azadirachtin, which exhibit strong antimicrobial and antifungal properties (Dewi et al., 2020; Hernowo, 2017). These compounds are used in pest and plant disease control, as well as in skincare products and pharmaceuticals. Additionally, Nyirih contains various enzymes, such as lipase and amylase, which can be utilized in industrial processes, including biodiesel production and the food industry. The presence of antimicrobial properties and enzymes in the Nyirih plant creates a broad range of potential applications in plant protection, waste processing, and the development of pharmaceutical and industrial products, making it a valuable resource in both ecological and human benefits (Asimuddin et al., 2020; Braga et al., 2021; Dutt et al., 2023). Therefore, further research on antimicrobial compounds and enzymes from the Nyirih plant remains relevant and important in the context of science and industry.

The Nyirih plant (Azadirachta indica), also known as neem, is a plant with diverse benefits identified in various scientific studies. One of its main benefits is as a source of active ingredients with high pharmacological potential. The main components found in the Nyirih plant are neem oil and azadirachtin, which possess strong antioxidant, anti-inflammatory, and antimicrobial properties. Therefore, the Nyirih plant has been used in traditional medicine to treat various diseases, such as skin infections, digestive disorders, and cardiovascular diseases (Asghar et al., 2023; Dwivedi et al., 2021; Pandey et al., 2020).

Jeruju (Acanthus ilicifolius)

The jeruju plant (Acanthus ilicifolius), which grows in mangrove forest areas, possesses antimicrobial properties and contains a variety of enzymes that hold ecological significance and crucial industrial applications. The antimicrobial properties of this plant are associated with the production of phytoncide and tannins, which effectively inhibit the growth of pathogenic microorganisms in the mangrove environment, playing a role in maintaining ecosystem

health. Additionally, jeruju also produces enzymes, such as peroxidase and amylase, involved in the detoxification of toxic compounds and the breakdown of complex organic matter, such as starch (Aisiah et al., 2022; Firdaus et al., 2013; Naher et al., 2022; Xu et al., 2021). This process supports the recycling of nutrients and the decomposition of organic matter that falls into the mangrove ecosystem. The antimicrobial properties and enzymes possessed by jeruju have potential applications in various industries, including pharmaceuticals, waste processing, and enzyme production in various biotechnological processes. Therefore, further research on antimicrobial compounds and enzymes from the jeruju plant is crucial for a deeper understanding of its ecological functions and potential applications.

The primary benefit of jeruju lies in its role as a source of bioactive compounds with anti-inflammatory, antioxidant, and antimicrobial properties. The alkaloid content in this plant can have anti-inflammatory effects useful in the treatment of various inflammatory conditions. Additionally, the flavonoids present in jeruju act as antioxidants that can help combat oxidative stress in the human body (Basyuni, Situmeang, et al., 2021; Purwoko et al., 2023).

Perepat (Sonneratia alba)

The perepat plant (Sonneratia alba), commonly found in mangrove forests, possesses antimicrobial properties and contains various enzymes that play a crucial role in the mangrove ecosystem and have the potential for applications in various industries. The antimicrobial properties of this plant are related to the production of compounds such as tannins and flavonoids, which are effective in inhibiting the growth of pathogenic microorganisms in the mangrove environment, thus contributing to maintaining ecosystem balance (Latief et al., 2019; Mairing & Ariantari, 2022; Latief, et al., 2021). Additionally, perepat also contains enzymes like peroxidase and cellulase, which play a role in the detoxification of toxic compounds and the breakdown of complex organic matter, such as cellulose. This process supports the recycling of nutrients and the decomposition of organic matter that falls into the mangrove environment. The antimicrobial properties and enzymes of the perepat plant have potential applications in various industries, including pharmaceuticals, waste processing, and enzyme production in various biotechnological processes. Therefore, further research on antimicrobial compounds and enzymes from the perepat plant remains essential for a deeper understanding of its ecological functions and potential applications (Bakshi et al., 2015; et al., 2017; Wijaya & Indraningrat, 2021).

The primary benefit of perepat lies in the weaving industry. The flexible and sturdy leaves of perepat are used as materials for crafting various woven products, such as mats, bags, hats, and other handicrafts. Additionally, perepat has benefits as a fuel source. The wood and plant fibers are utilized in fish smoking processes, charcoal production, and as fuel for cooking . Besides its economic benefits, the use of perepat in fish smoking also imparts a distinctive aroma valued in traditional culinary practices. Perepat can also serve as a raw material in the pharmaceutical and cosmetic industries. Compounds found in perepat, such as tannins and flavonoids, have pharmacological potential and can be used in the development of natural health products or skincare items (Bakshi et al., 2015; Puasa et al., 2018; Rakotomavo et al., 2018).

Buta-buta (Excoecaria agallocha)

The Buta-buta plant (Excoecaria agallocha), commonly found in mangrove forests, possesses antimicrobial properties and contains enzymes that play a crucial ecological role. The antimicrobial properties of this plant are associated with the production of compounds such as tannins and phytoncides, which are effective in inhibiting the growth of bacteria and pathogenic fungi in the mangrove environment (Liu et al., 2022; Mondal et al., 2016; Prihanto et al., 2019). Additionally, Buta-buta contains enzymes like lipase and amylase, involved in breaking down complex organic compounds, such as fats and starch. This process supports the decomposition of organic matter that falls into the mangrove environment, aiding in nutrient recycling and maintaining ecosystem balance. The antimicrobial properties and enzymes of the Buta-buta plant have potential applications in the pharmaceutical industry, waste processing, and various biotechnological processes (Abdul Razak et al., 2019; Bhuvaneswari et al., 2017; Laith, & Najiah, 2014; Sabu et al., 2022; Shelar et al., 2019). Therefore, a deeper understanding of the antimicrobial compounds and enzymes from this plant is crucial for sustaining the mangrove ecosystem and exploring its potential applications in various industrial sectors.

Buta-buta (Excoecaria agallocha) is one of the mangrove species with significant economic benefits in the Tungkal Village, Tanjung Jabung Barat Regency. Although this plant is generally avoided due to the toxicity of its latex, some local communities have found ways to utilize this resource. The latex of Buta-buta has been used in traditional medicine and as a natural insecticide. Furthermore, some small-scale industries in the area have utilized Buta-buta wood to craft various items, including handicrafts. However, it is important to note that the use of this plant should be done with

caution due to its potential toxicity. With a good understanding of the potential benefits and risks, the Tungkal Village community can harness Buta-buta as an additional economic resource in their efforts to maintain the sustainability of the crucial mangrove ecosystem in the region.

Furthermore, the results of interviews with community figures state that only a few types of mangrove plants in Tungkal Village 1, West Tanjung Jabung Regency, have been utilized (Table 2).

Table 2. Mangrove plants that have been made into products

Local Name	Latin Name	Product
Pidada	*Sonneratia caseolaris*	
Nipah	*Nypa fruticans*	

Based on Table 2, many mangrove plants have not been utilized, mainly due to a lack of knowledge and education provided to the community. Although mangrove ecosystems provide a variety of plant species with significant potential benefits, some people do not fully understand the economic, ecological, and well-being values that can be derived from each species. Careful education and awareness campaigns regarding the biodiversity of mangroves, the benefits of their ecosystems, and sustainable ways to utilize them could be key to increasing community awareness and involvement. By enhancing local knowledge, it is hoped that the community can maximize the sustainable use of mangrove plants, creating a balanced relationship between humans and the mangrove environment that supports long-term sustainability.

Meanwhile, some research results on the utilization of mangrove plants have already been applied. In a previous study in the Nipah Village mangrove forest in the Serdang Bedagai Regency, North Sumatra, 8 mangrove plant species were utilized, consisting of 5 true mangrove species and 3 associated mangrove species from 8 families, with the majority having a tree habit (Alfa Rosyada, M. Sofwan Anwari, 2018). The tree habit was the most utilized due to almost all parts being usable for daily life. Another study conducted in the Teluk Buo mangrove forest in the Bungus Teluk Kabung Subdistrict of Padang City found that 17 mangrove species were utilized by the community. Of these, 11 species were used for medicinal purposes and 15 species for other purposes (Muhtadi et al., 2020)

Furthermore, (Muhtadi et al., 2020) mentioned in the same research that the most utilized part of the plant by the community in the Teluk Buo mangrove forest was the leaves, with a total of 12 species. The high frequency of using leaves as medicinal ingredients is related to their advantages, such as a higher quantity or productivity of leaves, easier accessibility compared to other parts, and their relatively easier use due to the direct applicability.

The fact that many mangrove plants in Tungkal Village 1, West Tanjung Jabung Regency, have not been economically utilized provides a significant opportunity for local potential development. Mangrove plants not only have ecological value in maintaining coastal ecosystems but also store significant economic potential. With a deeper understanding of their properties and benefits, the local community can begin to explore the potential of medicines, foods, and other products from mangrove plants. Initiatives for local economic development through sustainable utilization of mangrove plants can provide dual benefits: improving the livelihoods of the local community while maintaining the sustainability and balance of the essential mangrove ecosystem for the surrounding environment. Therefore, further introduction regarding the economic benefits of mangrove plants can be a positive step in strengthening community involvement and preserving the sustainability of coastal ecosystems.

According to Muhtadi et al., (2020) , the entire mangrove ecosystem has other economic potentials such as:

Fisheries

Mangrove ecosystems provide a crucial environment for fish, shrimp, and various other marine fauna. This creates opportunities for sustainable fisheries, offering livelihoods for local fishing communities and supporting the fishing industry.

Tourism

Mangroves and their natural beauty can be developed as attractive ecotourism destinations. Ecotourism activities such as boat tours, bird watching, and walking along wooden bridges through the mangrove forest can attract tourists, providing additional income for local communities and the local tourism industry.

Carbon Sequestration

Mangrove ecosystems play a vital role in absorbing carbon dioxide (CO2) from the atmosphere. This can

present economic opportunities in the form of carbon credits or within the framework of international carbon emission trading programs. With increased attention to climate change mitigation, sustainable mangrove management can offer economic benefits through protection and reforestation efforts.

The community of Tungkal I can develop various mangrove-based economic activities by harnessing the diverse potential of these mangrove plants. It is important to consider sustainability principles and mangrove ecosystem preservation when developing these economic ventures to ensure long-term benefits without harming the environment. Scientific testing based on existing literature can be conducted on several types of mangroves found in Tungkal I that have both utilitarian and economic value, including Rhizophora spp. (Bakau), Avicennia spp. (Api-api), Sonneratia spp. (Pidada), Nypa fruticans (Nipah), Bruguiera spp. (Berus), Ceriops spp. (Tancang), Lindur (B. gymnorrhiza Lamk), Nyirih, Jeruju (Acanthus ilicifolius), Perepat (Sonneratia alba), and Buta-buta (Excoecaria agallocha).

The mangrove ecosystem holds vast economic potential, particularly in fisheries. Mangroves provide a crucial habitat for various types of fish and shrimp. The mangrove forest serves as an ideal shelter for juvenile fish and shrimp, fostering populations that can be harvested by local fishermen. This ecosystem also offers a secure haven for adult fish and shrimp, helping maintain abundant fish stocks. Consequently, local fishermen can rely on mangrove fisheries for their livelihoods. Additionally, the mangrove ecosystem plays a vital role in maintaining the balance of marine ecosystems and coastal economies, contributing to long-term benefits in sustainable fishing. By preserving the mangrove ecosystem, coastal communities can optimize the economic potential of their fishing sector while protecting this beneficial environment.

Apart from the economic benefits in the fisheries sector, the mangrove ecosystem also has significant potential in the tourism industry. Mangrove areas can be developed as attractive educational and ecotourism destinations. Tourists can visit the mangrove ecosystem to learn more about the importance of environmental conservation and coastal ecosystems. Beyond education, mangrove tourism can include activities such as boat trips through dense mangrove tunnels, bird watching, fishing, and various recreational activities that can attract tourists. This creates employment opportunities for local communities in the tourism sector, including tour guides, fishermen, and small business owners selling local products. Mangrove tourism can also provide an additional source of income for coastal communities, promote awareness of nature conservation, and provide incentives to preserve the sustainability of the mangrove ecosystem. However, the development of mangrove tourism should be managed sustainably, considering its impact on the ecosystem and local culture, to provide long-term benefits for all parties involved.

Conclusion

Conclusion from the analysis of local wealth in Tungkal Village 1, West Tanjung Jabung Regency, Jambi, shows that the local community has not fully understood the potential for economically managing mangrove plant resources. Observations indicate that only a few types of mangrove plants are well-managed, while the majority are still not optimally utilized. The economic management of mangrove plants requires a deep understanding of the diversity of mangrove species and the characteristics of each type, including knowledge of their life cycle, growth, and the potential economic value of each species. This limited understanding may hinder significant economic and environmental potential that mangrove forests can provide. Therefore, educational efforts and training for the local community are crucial to enhance their understanding of sustainable and effective mangrove plant management. Education programs are needed that cover species identification, cultivation techniques, and sustainability principles to support more effective mangrove plant management. This will help the village community maximize the economic potential of mangrove resources while maintaining the crucial sustainability of this ecosystem.

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Author Contributions

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper

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