GeoJournal of Tourism and Geosites
ISSN 2065-1198, E-ISSN 2065-0817

Year XVI, vol. 47, no. 2, 2023, p.388-396
DOI 10.30892/gtg.47204-1036

MANGROVE POTENTIAL ASSESSMENT FOR DETERMINING ECOTOURISM ATTRACTION AND STRENGTHENING DESTINATION BRANDING AND MARKETING: "GUNUNG PITHING MANGROVE CONSERVATION", INDONESIA

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Citation: Abidin, Z., Nuryani, F.E., Saputra, D.K., Fattah, M., Harahab, N., & Kusumawati, A. (2023). MANGROVE POTENTIAL ASSESSMENT FOR DETERMINING ECOTOURISM ATTRACTION AND STRENGTHENING DESTINATION BRANDING AND MARKETING: "GUNUNG PITHING MANGROVE CONSERVATION", INDONESIA. *GeoJournal of Tourism and Geosites*, 47(2), 388–396. https://doi.org/10.30892/gtg.47204-1036

Abstract: Explanation of the purpose and objectives of the study (2-3 lines). Mangrove ecosystems perform biological and socioeconomic functions. Mangrove environments can be ecotourism destinations. This study analyzes mangrove potential to determine typical mangrove ecotourism attractions and strengthen the branding and marketing of mangrove ecotourism destination on the Tamban coast of Malang Regency, Indonesia. Explanation of the working methodology and the materials used (2-3 lines). Local management and communities validate mangrove potential field observations. GIS with Sentinel-2 and NDVI approach was used to analyze tides and satellite imaging data on mangrove thickness, density, and area. Analysis of mangrove potential in ArcMap utilizing five parameters: thickness, density, kind, biota, and tides. Four density classes were created using satellite imagery: non-mangroves, rare mangroves, moderate mangroves, and tight mangroves. Presentation and analysis of the obtained results (2-4 lines). The results showed that the Tamban coast mangrove area has a moderate ecotourism potential (potential value = 2.250), so it could be developed into mangrove ecotourism through conservation and limited utilization activities through marine ecotourism to provide economic, ecological, and social incentives. Mangrove ecotourism features that attract tourists and strengthen branding and marketing of this location include mangrove tourism education, canoeing, camping, spot photography, beach attractiveness, bird and violin crab biodiversity. The conclusions obtained following the application of the study (2-3 lines). Mangrove ecosystem on the Tamban coast has a high potential for conservation and marine ecotourism in order to provide economic incentives, also ecological and social benefits. The richness and distinctiveness of Tamban's mangrove ecotourism potential and attractions promotes the GPMC branding as a typical mangrove ecotourism.

Key words: between 5 and 10 keywords, Mangrove potential, GIS, NDVI, ecotourism, ecotourist attraction, destination branding, marketing

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INTRODUCTION

Indonesia has a wide coastline and great economic potential if managed properly (Lukman et al., 2022). The coastal area is a potential area with a variety of resources that can be used in a variety of ways, one of which is tourism, particularly marine ecotourism (Prihadi et al., 2018). When ecological assets are combined with integrated planning that considers all relevant

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factors, benefits can be realized in terms of ecology, aesthetics, and economics (Muflih et al., 2015). One of the potential natural resources in coastal areas are mangrove forests. Mangroves serve a variety of biological, chemical, and socioeconomic functions, including serving as a popular destination for travelers (Andiny and Safuridar, 2019; Prihadi et al., 2018; Fistiningrum and Harini, 2021). Ecotourism could make mangrove ecosystems a place for people to visit. It also gives various business prospects for the community to preserve ecological sustainability if it provides economic benefit (Tjahjono et al., 2022).

One of the initiatives to obtain environmental benefits from a sustainable coastal area is the development of mangrove ecotourism (Rijal et al., 2020; Nobi and Majumder, 2019). In the coastal region of Tamban Beach, Tambakrejo Village, Sumbermanjing Wetan District, Malang Regency, the community is establishing GPMC (Gunung Pithing Mangrove Conservation) as a mangrove ecotourism destination based on the potential of the GPMC mangrove ecosystem to become an ecotourism destination. However, the difficulty of coordination in managing mangrove potential in this region persists. As a result, it is feared that the value of resources, such as mangroves, will decrease (Liu et al., 2021). As a reason, it is critical to assess the potential of mangroves, for example, using remote sensing methods. The findings can be used to enhance the development of tourist attractions and strengthen the branding of mangrove ecotourism destinations in the direction of sustainable management. Furthermore, the ecotourism branding can facilitate the green tourism marketing strategy. Green tourism marketing is a type of marketing that emphasizes natural destinations and has indicators of sustainable development based on environmental hospitality and local social, economic, and cultural characteristics (Wurarah et al., 2022).

Mapping with remote sensing and geographic information systems (GIS) have been widely utilized to process spatial data (Ayele et al., 2018; Tran et al., 2022). Remote sensing technology is suitable for mangrove observations (Maurya et al., 2021), because satellite imagery offers spectral information on chlorophyll content, which can also be utilized to assess vegetative stress levels (Razali et al., 2019). GIS can be used to digitize potential resource data and turn it into an important overlay map to promote the growth of ecotourism (Dahuri et al., 1996). GIS (geographic information system) is a type of information system that combines geography and information systems. GIS is also used extensively in planning, research, and decision making. Because it is more effective and efficient, many researchers use GIS technology to identify the potential of natural tourism with existing software (Akbar et al., 2020; Zen et al., 2018).

The Sentinel-2 was employed in this study. It provides global coverage of land and coastal regions as well as high spatial resolution (Bergsma and Almar, 2020), and broad field of view (295 km) for multispectral observation of 13 bands (Gascon et al., 2017). While the index used is the Normalized Difference Vegetation Index (NDVI). NDVI index sensitive to chlorophyll and photosynthesis vegetation (Razali et al., 2019). The image processing classifications include non-mangroves, rare mangroves, moderate mangroves, and tight mangroves (Rudiastuti et al., 2018). NDVI can assess vegetation health, density, and situation (Sukojo and Arindi, 2019). For this reason, the aim of this study is to assess the potential of mangrove ecosystems as a foundation for determining variants and locations of typical mangrove ecotourism attractions, in addition to strengthen the branding and marketing of mangrove ecotourism destinations in order to support the management of sustainable mangrove ecotourism at Gunung Pithing Mangrove Conservation.

MATERIALS AND METHODS

This study was conducted in March-April 2022 at the Tamban Beach area, Tambakrejo Village, Sumbermanjing Wetan District, Malang Regency. Figure 1 depicts the research location, whereas Figure 2 represents the stages of the research method employed. Data on the potential of mangroves were collected through field observation using the stratified random sampling method (Boschetti et al., 2016). The obtained data consists of several aspects of mangrove ecosystems, such as mangrove thickness and density, mangrove type, tides, and biota objects (Yulianda, 2019). The supporting data were collected by conducting interviews with respondents who were selected by purposive sampling (Kim et al., 2017).

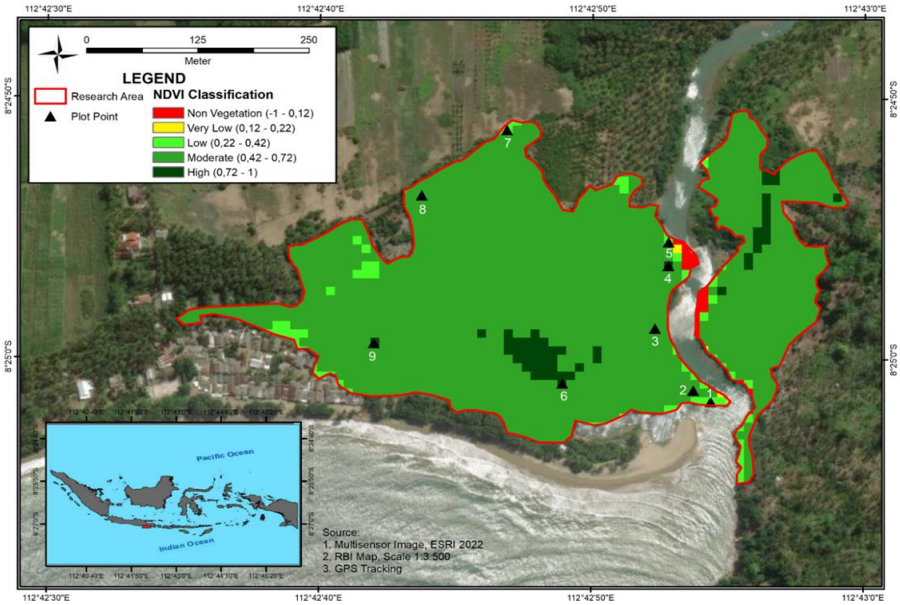

Figure 1. Research Location

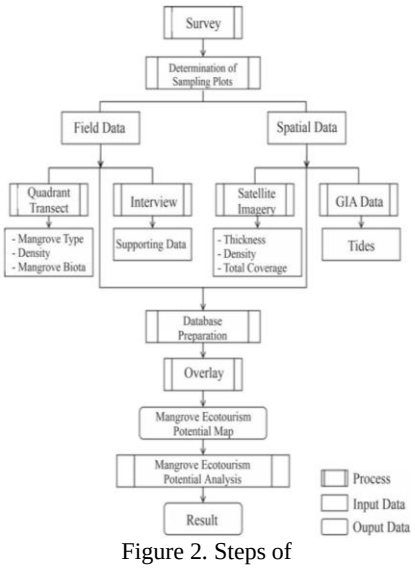

Figure 2. Steps of Research Methodology

* GIA: Geospatial Information Agency

Primary data is collected in the form of mangrove thickness by drawing a straight line from the outer mangrove to the deepest mangrove along the Tamban coast. A quadrant transect that is 10 meters by 10 meters is used to determine the mangrove species as well as the density of the mangroves (Pasaribu et al., 2020). The use of a pocket book was necessary in order to correctly identify the mangroves. By measuring the diameter of the stems in each stand of mangroves, it is possible to get an estimate of the mangrove type density (Xiong et al., 2019). Mangrove rod height was measured with the Monmang 2.0 software. The following equation is used to compute the mangrove density equation:

$$Di = \frac{Ni}{A}$$

Information: Di = Mangrove type density (ind/m^3); Ni = Total mangrove from type I (individual)
A = Area (m^2) (Source: Dharmawan and Pramudji, 2017)

Visual observations of biota in the mangrove environment are conducted in conjunction with mangrove sampling. Interviews with management and local communities are also conducted to validate data truth (Young et al., 2018). The Geospatial Information Agency (GIA) provided the tidal data. The tidal data used is tidal in one month, and the next will be processed with Microsoft Excel using admiralty method.

Furthermore, the NDVI approach is known to be used in the categorization of mangrove vegetation density, which is a density of rare, medium, or dense class density. The following is the NDVI formula. $NDVI = \frac{(NIR-RED)}{(NIR+RED)}$ (Source: Setiawan et al., 2018). NIR is a band 5 or near-infrared band, while red is a band 4 or red band. Based on the results of the band's calculation, this will produce algorithms ranging from -1 to 1 (Chen et al., 2022). The results of the algorithm calculation from the total satellite image processing are required to group NDVI values. Furthermore, the value is separated into three class intervals based on the range of NDVI algorithms. Table 1 shows the NDVI classification. The potential of mangrove ecosystems for development into mangrove ecotourism is assessed using five indicators and four compliance categories derived from the modification of mangrove ecotourism compliance analysis (Yulianda, 2019). Table 2 showed the indicators of potential mangrove ecosystems. After organizing five mangrove ecosystem indicators in Microsoft Excel, ArcMap creates a weighting map and assessment. To create a mangrove ecosystem natural resource potential map, the class range is classified, weighted, and assessed using the overlay method. This study's examination of the mangrove ecosystem's potential was utilized to identify typical mangrove ecotourism attractions and strengthen the branding of GPMC to enable sustainable mangrove ecotourism at Gunung Pithing Mangrove Conservation.

Table 1. Classification the value of NDVI (Source: Kawamuna et al., 2017)

value	Classification
0.00 – 0.33	Rare
0.33 – 0.66	Medium
0.66 – 1.00	Dense

Figure 3. GPMC Mangrove Bridges for Tracking (Source: Primary Data, Nuryani, 02.12.2021)

Table 2. Indicators of Mangrove Ecosystems Potential (Source: Yulianda 2019)

No	Indicator	Weight	Category	Score
1	Mangrove thickness (m)	0.380	>500	3
			>200 – 500	2
			50 – 200	1
			<50	0
2	Mangrove density (ind/100 m^2)	0.250	>15 – 20	3
			>10 – 15; >20	2
			5 – 10	1
			<5	0
3	Mangrove type	0.150	>5	3
			3 – 5	2
			2 – 1	1
			0	0
4	Tidal (m)	0.120	0 – 1	3
			>1 – 2	2
			>2 – 5	1
			>5	0
5	Biota Object	0.100	Crabs, birds, mollusks, fish, reptiles, shrimp	3
			Crabs, birds, mollusks, fish, reptiles, shrimp	2
			Crabs, shrimp, fish, mollusks	1
			Only one aquatic biota	0

RESULTS AND DISCUSSION

Profile of Gunung Pithing Mangrove Conservation (GPMC) ecotourism

GPMC is a Tamban coast mangrove ecotourism area pioneered in 2019 by youth organization and the local community. Tamban coastline is 57 kilometers from Malang Regency's center, Kepanjen, and around 70 kilometers from Malang City. The journey from Malang City to GPMC ecotourism takes about 2-3 hours. The GPMC mangrove ecotourism area is equipped with a variety of facilities, such as mangrove bridges for tracking, gazebo, bathrooms, photo shoots, and canoeing, so that visitors can experience the natural splendor of mangrove ecosystems. Figure 3 shows a mangrove bridge that was constructed as a tourist attraction in the form of tracking. This bridge is one of several tourism facilities that have been developed.

Mangrove Thickness

Researchers collected spatial data on the thickness of the mangroves in Tamban's western section of the river, which reaches 382.96 meters (Figure 4). This area has healthy mangrove growth, making it one of the most important operating areas for mangrove ecotourism. The spatial data on the thickness of mangroves along the river's eastern side reached a depth of 140.20 meters. This area is home to a mangrove nursery area, which, in order to improve the overall density of the mangroves, is managed in collaboration with the local people. In this region, mangrove forests are located in close proximity to both residential areas and ports used by small fishing boats.

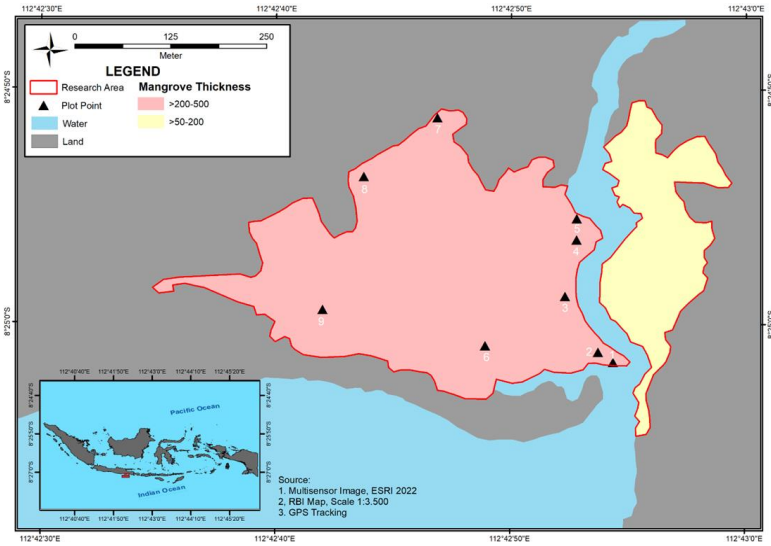

Figure 4. Mangrove Thickness in GPMC Tamban

Mangrove Density and Type

Field observations of the type and density of mangroves lead to values that vary from plot to plot. Based on Table 3, plot 9 has the largest mangroves. It has a total density of 54 individuals/100 m^2 and is dominated by the *Rhizophora mucronata* species, which has a type density of 42 individuals/100 m^2 and a relative density value of 77.78%.

This fits with the case of how *Rhizophora mucronata* grow, which is usually in groups (Noor et al., 2006). The plot with the lowest density is number 7, which has 10 individuals per 100 m^2 and is mostly made up of *Avicennia marina* and *Sonneratia alba.* Both have 5 individuals per 100 m^2 of mangrove type density and a relative density of 50%. Using identification guidelines by Noor et al., (2006), and the results of field observations in 9 plots, 9 types of mangrove plants have been found, namely *Avicennia alba*, *Avicennia marina*, *Bruguiera gymnorrhiza*, *Ceriops tagal*, *Rhizopora apiculata*, *Sonneratia alba*, *Xylocarpus granatum*, *Heritiera littoralis* dan *Rhizopora mucronata*. Table 4 depicts the mangrove vegetation identified. The pictures in the table 4 were taken by one of authors (Nuryani, 02 December 2021).

Table 3. Mangrove Type Density (Source: Primary Data and Research Data Analysis, 2022)

Plot	Mangrove Species	Mangrove Type Density (Di)	Rdi (%)
1	*Avicennia alba*	0.01	7.69
	Bruguiera gymnorrhiza	0.04	30.77
	Ceriops tagal	0.04	30.77
	Rhizophora apiculata	0.04	30.77
Total		**0.13**	**100.00**
2	*Avicennia alba*	0.03	15.79
	Bruguiera gymnorrhiza	0.03	15.79
	Ceriops tagal	0.11	57.89
	Rhizophora apiculata	0.01	5.26
	Xylocarpus granatum	0.01	5.26
Total		**0.19**	**100.00**
3	*Avicennia alba*	0.06	50.00
	Sonneratia alba	0.04	33.33
	Xylocarpus granatum	0.02	16.67
Total		**0.12**	**100.00**
4	*Avicennia marina*	0.03	15.00
	Heritiera littoralis	0.02	10.00
	Rhizophora mucronata	0.01	5.00
	Sonneratia alba	0.14	70.00
Total		**0.2**	**100.00**
5	*Avicennia alba*	0.05	29.41
	Rhizophora mucronata	0.12	70.59
Total		**0.17**	**100.00**
6	*Avicennia alba*	0.06	12.00
	Ceriops tagal	0.4	80.00
	Xylocarpus granatum	0.04	8.00
Total		**0.5**	**100.00**
7	*Avicennia marina*	0.05	50.00
	Sonneratia alba	0.05	50.00
Total		**0.1**	**100.00**
8	*Avicennia alba*	0.01	3.13
	Rhizophora apiculata	0.07	21.88
	Rhizophora mucronata	0.19	59.38
	Sonneratia alba	0.05	15.63
Total		**0.32**	**100.00**
9	*Avicennia alba*	0.02	3.70
	Rhizophora mucronata	0.42	77.78
	Sonneratia alba	0.1	18.52
Total		**0.54**	**100.00**

Table 4. Mangrove Species in Tamban

Avicennia alba *Rhizopora mucronata*

Avicennia marina *Ceriops tagal*


Bruguiera gymnorrhiza


Rhizopora apiculata


Heritiera Littoralis


Sonneratia alba

(Source: Primary data, by Nuryani, 02 December 2021)


Xylocarpus granatum

Mangroves' diverse qualities will attract ecotourists. Bacmid et al. (2019) and Setyaningrum et al. (2020) argue that the more mangrove species in the ecotourism region, the more visitors will learn about them. This is another unique mangrove in the GPMC Tamban mangrove ecotourism, a typical ecological capital for sustainable mangrove ecotourism management. Mangrove biodiversity, density, and thickness determine the type and quality of mangrove ecotourism attractions marketable in GPMC.

Tides

The data used for tides is from the past 31 days in March 2022 (Figure 5). The data came from the Geospatial Information Agency, and then the admiralty method was used to figure it out (Kisnarti, 2017). Using the admiralty method, the highest tide was on March 22, 2022, at 4 a.m. Western Indonesian Time, when it was 2.75 m. The water level was at its lowest on March 21, 2022, at 10:00 Western Indonesian Time. It was 0.17 m high. When trying to figure out what kind of tides were in Tamban waters, a Formzahl value of 0.512 was found. This meant that the tides were a mix of double daily leaning and single daily leaning (Hendri et al., 2019). Figure 5 shows that at Tamban Beach, there are two pairs and two recedes in one day. The first tide waveform is different from the second tide waveform. Yulianda (2019) said that the height of the sea level and the number of tides also affect how comfortable tourists are.

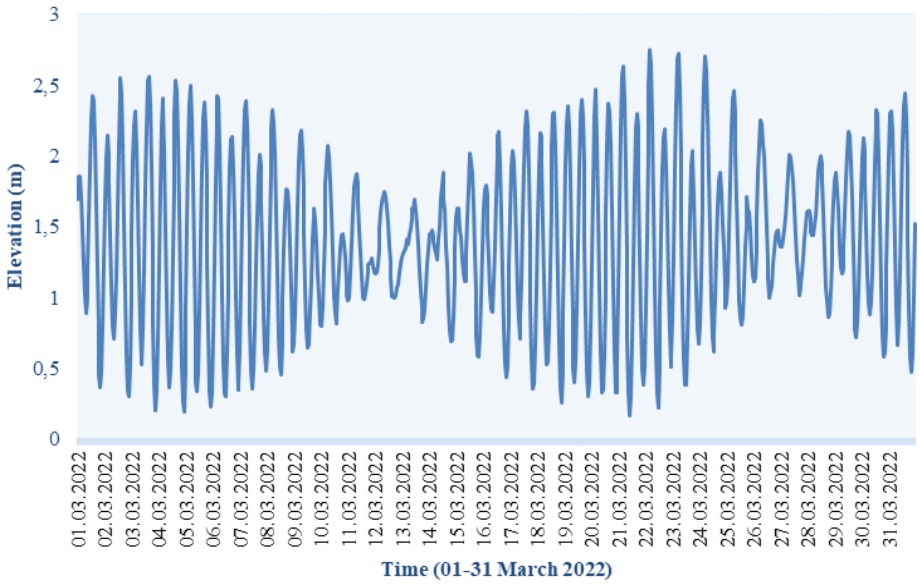

Figure 5. Coastal Area of Tamban Beach Tidal Graph
(Source: Geospatial Information Agency, 2022)

Mangrove Biota

The GPMC mangrove tourist area has terrestrial and aquatic biota (Nelly et al., 2020). According to Yulianda (2019), tourists are interested in biota variety, making the GPMC mangrove ecotourism simpler to promote. Mangrove crab (*Scylla serrata*) and crab violin (*Uca spp.*) are two crustaceans found in the GPMC area. Mollusk habitat and crustaceans are typically found attached to the roots and mangrove rods or the substrate (Irwanto, 2006; Imakulata and Tokan, 2018). In this investigation, two types of birds were discovered: "Sirtu" Birds (*Aegithina tiphia*) and "Cekakak Biru" Birds (*Alcedo coerulescens*), as well as Gelodok Fish (*Periophthalmus sp.*).

Table 5. Mangrove Biota in GPMC, Tamban

Terrestrial Biota

Alcedo coerulescens (Woodal, 2020)

Aquatic Biota

Nerita fulgurans (WoRMS, 2022b)

Aquatic Biota

Scylla serrata (Pratiwi, 2011)

Aegithina tiphia (Lepage, 2022)

Littoraria sp. (WoRMS, 2022a)

Uca spp. (Wulandari et al., 2013)

Table 6. Potential Value of Mangrove Ecotourism on the Coast of Tamban (Source: Primary Data and Research Data Analysis, 2022)

No	Parameter	Weight	Score	Value
1	Mangrove thickness (m)	0.380	2	0.760
2	Mangrove type density (100 m^2)	0.250	3	0.750
3	Mangrove type	0.150	2	0.300
4	Tides	0.120	2	0.240
5	Mangrove biota	0.100	2	0.200
Total				2.250

Balanus sp. (Tapilatu and Pelasula, 2012)

Periophthalmus sp. (Capuli, 2022)

Potential Mangrove Ecotourism Areas

Categories of potential mangrove ecotourism area in Tamban may be examined using data processing that includes tides, mangrove biota, mangrove type density, and mangrove thickness (Table 6).

Based on the calculation of the potential value of the Tamban coastal mangrove ecotourism (Table 6), a value of 2.250 was obtained. This means carrying a mangrove ecosystem in the GPMC Tamban ecotourism has the potential of mangroves with a medium category, so that the mangrove ecosystem is very potential to be developed or managed in a sustainable manner from the ecological, economic, and social dimensions. The research results of the potential mangrove ecotourism in the GPMC Tamban are outlined in the map of the potential mangrove ecotourism area (Figure 6). GPMC has the potential of ecotourism and utilization that can meet the needs of the surrounding community. Meanwhile, there are only a few ecotourism activities in the GPMC Tamban mangrove ecotourism because the community as the manager of GPMC is continuing to improve the development of this mangrove area as a mangrove-based marine ecotourism area.

Determination of Mangrove Ecotourism Attractions in GPMC Tamban

In the GPMC Tamban mangrove ecotourism area, mangrove ecosystems have a moderate potential. There is mangrove biodiversity and both terrestrial-based and aquatic-based biota in the area. As shown on the potential map, the results of this study can be used to figure out the types and locations of typical ecotourism attractions in the GPMC Tamban (Figure 4).

According to the study findings, mangrove education is one of the prospective tourist attractions for the GPMC Tamban ecotourism region. The next potential ecotourism activity is canoeing in the Mangrove Ecotourism region of the estuary to

appreciate the natural beauty and discover the mangrove environment from the boat. In addition, tourists have the option of camping in a parking lot near the mangrove ecology. Some potential ecotourism attractions can be employed to prevent tourists' activities from becoming repetitive. At addition, there are other ecotourism activities that tourists may enjoy in the GPMC Tamban, such as taking photographs of the mangrove and beach scenery, as well as seeing birds and violin crabs. The view of the green is mangrove forest and birds that adorn the mangroves can be enjoyed by tourists when making mangroves by foot or using a boat. In addition, in the mangrove area also seen diversity of violin crab biota which is one of the uniqueness of GPMC Tamban. For lovers of natural beauty, of course this is interesting to see or photographed.

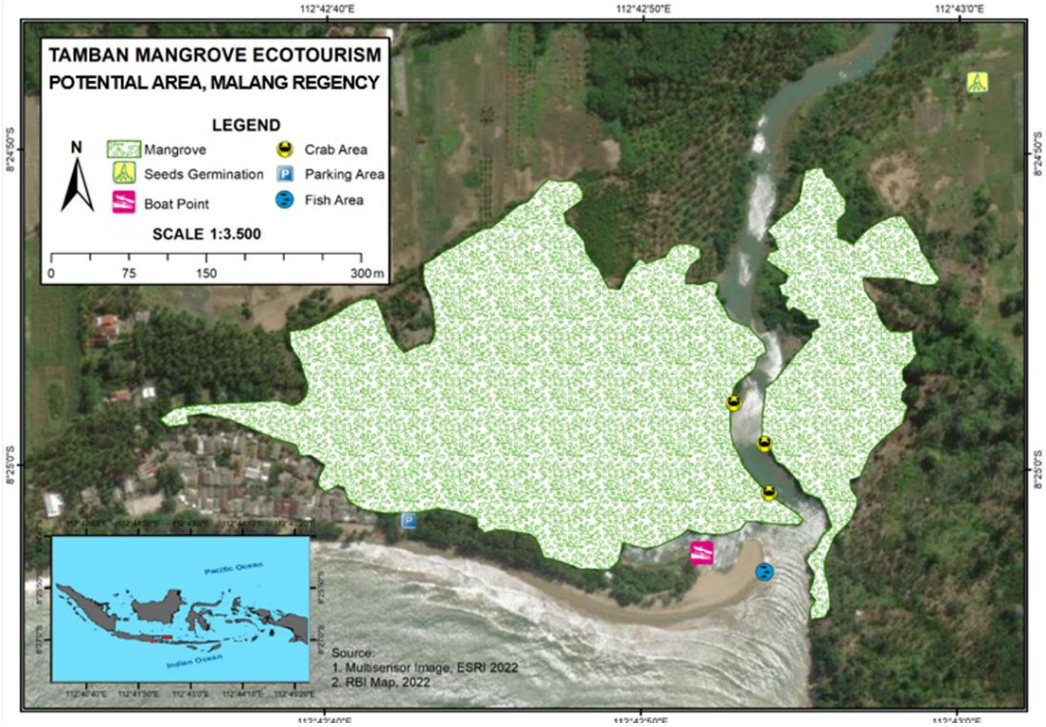

Figure 6. Map of Tamban Mangrove Ecotourism Potential Areas

Strengthening Mangrove Ecotourism Branding and Marketing Based on the Mangrove Potential in GPMC, Tamban

Initially, GPMC was the name of the mangrove conservation movement led by youth organization and the Tamban community, which was worried about the state of mangroves. This movement began four years ago (in 2019). Along with the mangrove conservation movement, they continue to prepare for the launch of mangrove ecotourism with GPMC branding, as it has been recognized through Instagram, Google searches, and direct visits from various agencies, community members, colleges, and visitors. This endeavor is anticipated to assist the economic and social sustainability of mangrove ecosystem management, in addition to its ecological sustainability, such as happened in CMC Tiga Warna that is highly sustainable (Harahab et al., 2021). This sentence reaffirms that the potential of mangrove ecosystems in GPMC Tamban is categorized as moderate, and that mangroves and terrestrial and aquatic biota are diverse.

This study not only serves as the foundation for identifying the typical mangrove ecotourism attraction in the GPMC Tamban region, but it also strengthens the GPMC's branding and marketing as a mangrove ecotourism destination. GPMC branding is part of the economic, ecological, and social capital management of mangrove ecotourism in the GPMC Tamban mangrove ecotourism. Uniqueness and diversity of mangroves and biota in the GPMC mangrove ecotourism have the potential to attract ecotourists and help the marketing of mangrove ecotourism.

Determination of the types and quality of diverse mangrove ecotourism attractions in the GPMC also begins with the potential biodiversity and density of mangroves. In terms of marketing management of tourism services based on the statement by Madiistriyatno (2013) and Lina (2018), that the product quality of ecotourism destinations, including the diversity and uniqueness of mangrove ecotourism attractions in Tamban, is the best guarantee of loyalty to ecotourism visitors, the strongest defense in dealing with ecotourism competition, and the way to maintain the marketing growth and income of the mangrove ecotourism business.

CONCLUSION

Ecotourism has a moderate potential for development in mangrove forests along the Tamban coast, indicating that this region has a high potential to be developed through conservation and limited utilization activities in the form of marine ecotourism to provide economic benefits in addition to sustainable ecological and social benefits. The wealth and uniqueness of Mangrove Tamban ecotourism's potential and attractions helps promote GPMC branding as typical mangrove ecotourism, as well as being the main input in ecotourism marketing and the most effective defense strategy in ecotourism competition. This raises the likelihood that GPMC will continue to be the best in this sector.

Author Contributions: Conceptualization, Z.A. and F.E.N.; methodology, Z.A. and F.E.N.; software, M.F. and F.E.N.; validation, F.E.N. and M.F.; formal analysis, Z.A. and F.E.N.; investigation, D.K.S. and M.F.; data curation, D.K.S.and M.F.; writing - original draft preparation, Z.A. and F.E.N.; writing—review and editing, Z.A., N.H., and A.K.; visualization, F.E.N. and D.K.S.; supervision, A.K. and N.H.; project administration, F.E.N. All authors have read and agreed to the published version of the manuscript.

Funding: the Education Fund Management Institute (LPDP).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study may be obtained on request from the corresponding author.

Acknowledgments: Thank you for the confidence and faith placed in us by the Ministry of Education, Culture, Research, and Technology, as well as the Education Fund Management Institute (LPDP), which has funded the Scientific Research Program in 2021/2022. For the cooperation of research partners, specifically mangrove ecotourism managers at GPMC, and relevant stakeholders, in order for this research to be carried out as intended.

Conflicts of Interest: The authors declare no conflict of interest.

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Article history: Received: 28.11.2022 Revised: 25.02.2023 Accepted: 29.03.2023 Available online: 11.04.2023