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Petengoran Mangrove Forest, Pesawaran: Ecological and Ethnocentric Studies

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Abstract

Background: Mangrove environments play an essential function in coastal tidal areas. Petengoran mangrove forest is located in Gebang village, Teluk Pandan district, Pesawaran, Lampung province. Describe the ecological and ethnocentric conditions of the Petengora mangrove forest in Gebang village, linked to mangrove vegetation to facilitate forest maintenance, community empowerment, and community impacts on Petengoran mangroves. **Methods:** This research uses the transect method at three stations with four plots. Each plot had an area of 10 x 10 m2. Ethnocentric data collection was conducted using questionnaires and field observations. **Results:** INP of *Rhizopora mucronata* was the highest (300%). The station's overall diversity level (H') is medium. The specific richness index (R) of all stations is low. All stations' uniformity index (E) is high, as shown by findings from community interviews on ethnocentric elements of Petengoran mangrove ecotourism. The environmental conditions of the mangrove forests are relatively clean and maintained, and the infrastructure and ecotourism infrastructure are pretty adequate. **Conclusions:** Petengora mangroves are managed by farmers who create nurseries and plantations. This area is a mangrove reserve. The mangrove forest is considered a traditional place, but surrounding communities do not have any unique traditions.

Keywords: INP; Mangroves ecosystem; *Rhizopora apiculata*; *Rhizopora mucronata*

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Introduction

Mangrove forests are wooded areas that evolve in tidal regions (particularly sheltered river estuaries and lagoons), which might be flooded at excessive tide and free from puddles at low tide (Kusmana et al., 2003). Coastal areas usually have diverse and abundant natural resource potential to meet the needs of local communities. According to the National Mangrove Map released by the Ministry of Surroundings and Forests, the place of mangroves in Indonesia is 3,364,076 ha in 2021. The mangrove vicinity in Lampung is smaller than on Sumatra Island. Apart from that, the distribution of mangroves in Lampung is 896 kilometers from the 1,105 km duration of the coast as a whole and is outside the forest.

With its biota, wildlife, and surrounding environment, mangrove forests are an ecosystem that has the potential for herbal and environmental beauty. Mangroves ecologically function as habitat, nutrient sources, and spawning grounds, among other things. Mangroves are also used for education and research (Rignolga, 2018). Mangrove forests can prevent abrasion, block wind, reduce carbon dioxide (CO2) gas in the air and water pollutants in swamp waters, and avoid seawater intrusion (seepage). Due to their

ability to absorb pollutants such as Pb, Cd, and Cu, mangrove vegetation also helps maintain water quality. In the Everglades, California, and the United States, mangroves are vital for filtering pollutants before they are released into the open sea (Arisandi, 2010).

Meanwhile, if seen from the social and economic benefits, mangrove forests produce wood for building wood (various wooden crafts), a source of livelihood for people who work as fishermen, and can be used as a natural tourist attraction. Apart from supporting conservation, this ecotourism also teaches the people of Gebang Village District. Teluk Pandan, Kab. Pesawaran states that the lifestyles of mangrove forests are essential to maintaining the balance of the environmental environment. With ecotourism, it is hoped that the Petengoran mangrove can be evolved to assist the neighborhood economy.

Preserving mangrove forests is very important to maintain the balance of species in the food chain because mangrove forests, which are said to produce detritus and other functions, will be disrupted if the mangrove ecosystem is disturbed. Human activities can affect mangrove density (Rakotomavo et al., 2010). Apart from that, competition will also affect individual survival. Competition always exists in the ecosystem. The competition is individual competition for the same limited amount of natural resources (Lang et al., 2013). This will determine its survival, and its density can be measured. Thus, many things influence the density of the mangrove ecosystem.

This research was conducted in the Petengoran mangrove forest in Gebang Village, Teluk Pandan, Pesawaran Regency. This location is also a relatively new ecotourism destination. Consequently, it's miles necessary to carry out this research to describe how the ecological and ethnocentric situations inside the Petengoran mangrove wooded area, Gebang Village, are associated with mangrove plant life to make it less complicated to carry out wooded area protection and network empowerment in addition to the effect felt by using the surrounding network on the mangrove forests in Petengoran, Pesawaran.

Methods

The research was performed from September to November 2023. The study region is inside the Petengoran mangrove woodland region in Gebang Village, Teluk Pandan, Pesawaran Regency, Lampung Province. The vicinity of the Petengoran mangrove wooded area is split into five zones. The locations centered on studies are in Region 2 and Zone three. The gear is plotted to analyze mangrove flowers and interview publications in questionnaires, smartphones, meters, raffia rope, bamboo plot stakes, laptops, and stationery. The object of this study is the mangrove surroundings and agencies inside the Petengoran Mangrove forest vicinity. These studies were done at 3 one of a kind stations as in parent 1. The transect plot was made with sizes 10 m x 10 m or alongside the thickness of the region's mangrove woodland. It was drawn perpendicularly, cutting the contour from the coastline towards the mainland. The transect includes four plots organized in parallel. In each plot measuring 10 x 10 m^2, the information can be taken that the tree stands at the tree growth stage because the study station has uniform mangroves.

Ethnocentric records consist of perceptions of the human beings of Gebang Village who stay close to the Mangrove forest location. Fact collection was achieved through interviews using questionnaires and direct observations inside the area. There are six signs proposed to the community, particularly the environmental circumstances of the mangrove wooded area, the lifestyles of the mangrove wooded area, monetary blessings, ecological benefits, social advantages, and the terrible effects of the mangrove forest felt through the encompassing network (Chantika. et al. 2021). Respondent sampling used random sampling strategies with the age variety of respondents being 17-60 years. Researchers used this method to accumulate facts from communities around the Petengoran mangrove wooded area. In the manner of reading mangrove flora, the condition of the mangrove environment can be analyzed primarily based on the tabulated information, after which the vital fee Index (INP) is looked for.

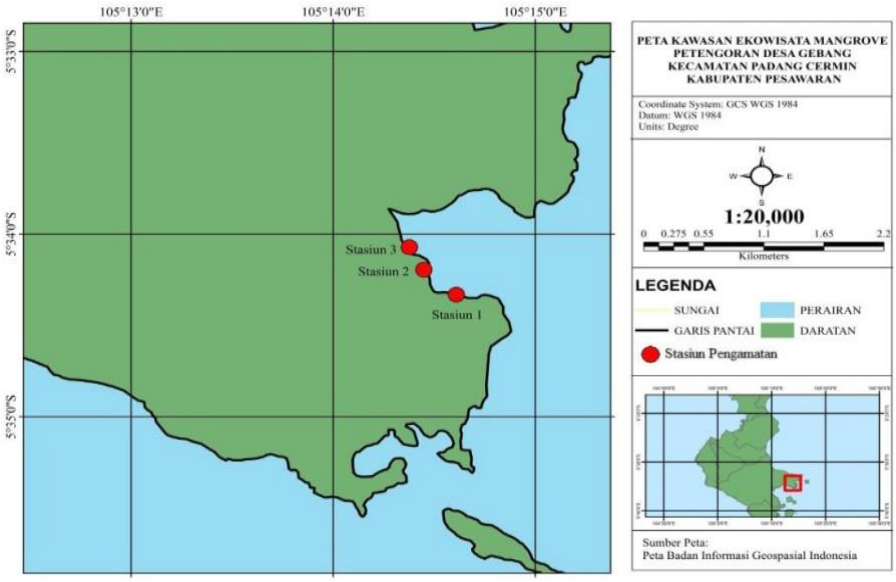

Figure 1. The research location is a red dot, which is the location for sampling mangrove diversity in the Petengoran Mangrove Forest, Teluk Pandan, and Pesawaran.

The importance of the price of a type is from zero to three hundred. The importance of cost provides an overview of the influence or function of a kind of mangrove in society. INP is the Sum of species relative density (KRi), species relative frequency (FRi), and species relative dominance (DRi). Calculation of quantitative values of plant life parameters (Onrizal 2008) is carried out using several indices as follows are used to assess the diversity of vegetation in forest areas:

Wealth index from Margalef

$$R = (S - 1) / \ln (n)$$

Information:
R = Margalef Index
S = Total of types
N = Sum of all individuals
The category range of wealth index (R) values based on this formula is (Wheater et al., 2011):
R < 3.5 = Low wealth
R= 3.5-5.0 = moderate wealth
R > 5.0 = High wealth

Shannon-Wieners diversity index

$$H' = - \sum_{i=1} [(ni/N) \ln (ni/N)]$$

Information:
H' = Shannon-Wiener diversity index
S = Total of types
ni = Number of individuals of the i-th species
N = Number of all individuals
The range of diversity index value categories (H') based on this formula is (Wheater et al., 2011):
H' < 1 = Short diversity
1≤ H'≤ 3 = Moderate diversity
H' > 3 = Great diversity

Index of evenness

$$E = H' / \ln (s)$$

Information:

E = Evenness index

H' = Shannon – Wiener diversity index

S = number of types

The category range of evenness index (E) values based on this formula is (Wheater et al., 2011):

0 < E ≤ = Little equity, depressed communities

0,4 < E ≤ 0,6 = Medium evenness, unstable community

0,6 < E ≤ 1,0 = High equity, stable community

Likert scale analysis measures ethnocentrism regarding mangrove forests—four alternative answers on a Likert scale. The answers obtained will be searched for the average of the respondents' answers. Determine the average value using class intervals. The formula for determining the length of the class interval:

$$= \frac{Highest\ Score - Lowest\ Score}{Number\ of\ Class\ intervals}$$

The data that has been obtained is then analyzed descriptively quantitatively, namely using a formula and indicated based on specific categories (Table 1) as follows:

$$Percentage = \frac{f}{N} \times 100\ \%$$

Information:

f = category variable

N = Number of frequencies

100 = constant.

Table 1. Category Questionnaire Score

Interval Persen	Category
81% < Skor ≤ 100%	Totally agree
63% < Skor ≤ 81%	Agree
44% < Skor ≤ 63%	Disagree
19% < Skor ≤ 44%	Totally Disagree

Result

There are four types of mangroves found in the Petengoran Mangrove Forest. Based on the results of vegetation research, the most common types of mangroves found are the *Rhizopora apiculata* species, while the least abundant species is the *Ceriops tagal*. The highest INP is the *Rhizopora mucronata* species at station 1 (300%). Table 2. shows that mangrove ringworm *R. mucronata* has the highest total INP from the accumulation of all research stations. Indriyanto (2006) states that the dominant species in a plant community could have a high significance index, so the maximum dominant species could have the most significant index. This is the same opinion as Raymond et al. (2010). Species that get a high INP suggest they have an extra cumulative mastery cost and more control over their habitat.

Table 2. shows the importance of mangroves for observation station 1, which has *R. mucronata* vegetation with the highest INP of 300%. *R. mucronata* has the highest INP. These results indicate that the mangrove forest in the study site is in good condition. The *R. mucronata* type has a vital role at the research location because this type of mangrove has characteristics and morphology that enable it to compete with other types. It can be said that the water conditions at the research location are reasonable compared to mangrove growth—a study by Eggy et al. (2016). *R. apiculata* vegetation received the

highest INP, namely 300%, because apart from the type of substrate in the Kuala Idi area, another supporting factor that can support the high importance index of *R. apiculata* at each station is temperature, where the average temperature in the Kuala Idi area is 23^0C. The high INP of *R. mucronata* mangrove vegetation in this panel cannot be separated from the environmental carrying capacity of the research location. The characteristic *R. mucronata* mangrove existed in the area even before mangrove restoration. Rhizophora's genus can develop well on muddy, sandy substrates (Anwar et al. 2017). Observations made by Oktaviani et al. (2022) in the Petengoran mangrove forest ecotourism resulted in temperatures of 25^0-32^0 C, Ph 6.8-7.8, RH 64.7%- 95%, and a silky clay loam texture. Looking at the factors obtained from research by Oktaviani et al. (2022), the Petengoran mangrove forest ecotourism area is suitable for mangrove growth.

Table 2. Importance Value Index of Petengoran Mangrove Ecosystem

Local Name	Species Name	INP (%)		
		Station I	Station II	Station III
Bakau Kurap	*Rhizophora mucronata*	300	79,6	29,9
Bakau Minyak	*Rhizophora apiculata*	0	95,15	270,1
Bakau Kecil	*Rhizophora stylosa*	0	66,02	0
Tengar Putih	*Ceriops tagal*	0	59,22	0

Table 3. Diversity Index (H'), Species Richness Index (R), and Evenness Index (E) of the Petengoran Mangrove Ecosystem.

Station	H'	R	E
I	1,37	0,72	0,99
II	2,90	3,28	1,02
III	1,39	0,88	0,87
Total	5,66	4,88	2,88

Table 4. Average Ethnocentric Questionnaire Results

No	Ethnocentric Aspect	Results		Average
		Score	Category	
1	Environmental conditions of mangrove forests	77,50%	Agree	74,51%
2	The existence of mangrove forests	82,50%	Totally agree	
3	Ecological benefits of mangrove forests	88,33%	Totally agree	
4	Economic benefits of mangrove forests	79,58%	Agree	
5	Social benefits of mangrove forests	75,83%	Agree	
6	Negative impacts felt by society	43,33%	Disagree	

According to the data in Table 3. the diversity (H') level of mangrove ecosystems in Petengoran Mangrove Forest at Stations I, II, and III is included within the medium category. Moderate range indicates that the level of species variety is enough to maintain its sustainability and has a reasonably solid resilience (Kusmana et al., 2021). Compared to the research of Ningtias et al. (2022), the diversity index value (H') ranged from 0.18 - 2.38 at each research station. The diversity index value generated (H') is classified as low to medium. This indicates that the community is quite complex because the interaction between species within the community is quite good. The greater the species diversity in an ecosystem, the more stable the ecosystem. This is because the ecosystem has many

species that interact with each other, thus positively impacting the stability of nutrient cycles, water cycles, and community dynamics. Different species can form different ecosystem structures that produce decomposition with different wastes to create ideal nutrients for the species' growth (Sari, 2023).

Table 5. Ethnocentric Aspects of the Community Around Petengoran Mangrove Forest Ecotourism

No	Ethnocentric Aspect	Information	Percentage (%)	Category
1	Environmental conditions of mangrove forests	The mangrove forest environment is clean and well-maintained.	84,16	Totally agree
		Visitors do not leave much rubbish.	81,67	Totally agree
		There are many water sources found for visitor facilities.	76,67	Agree
		The road to the mangrove forest is available and easy to take.	67,5	Agree
2	The existence of mangrove forests	Preservation of mangrove forests with nurseries.	83,33	Totally agree
		Preservation of mangrove forest resources by planting.	89,16	Totally agree
		Mangrove forests are protected areas.	85	Totally agree
		The existence of mangrove forests has increased in the area.	72,5	Agree
3	Ecological benefits of mangrove forests	Mangrove forests are where marine life lives.	86,67	Totally agree
		Mangrove forests protect from natural disasters.	88,33	Totally agree
		Mangrove forests act as flood control and resist abrasion and seawater intrusion.	90	Totally agree
4	Economic benefits of mangrove forests	Utilization of mangrove forest resources as ecotourism.	87,5	Totally agree
		Mangrove forests can be harvested for crabs, shellfish, etc.	76,67	Agree
		Mangrove forests as a source of medicine.	78,33	Agree
5	Social benefits of mangrove forests	Mangrove forests as ecotourism objects.	75,83	Agree
		Mangrove forests are a place of community belief/tradition.	66,67	Agree
		Mangrove forests are educational objects/places for scientific development.	85	Totally agree
6	Negative impacts felt by society	Mangrove forest ecotourism creates a lot of waste.	42,5	Disagree
		Illegal logging activities are occurring in mangrove forests.	46,67	Less agree
		Mangrove forests disrupt community activities.	40,83	Disagree

Based on the species richness index (R) results, all stations are classified within the low category. Still, Station II, which has an index value of 3.28%, is close to the medium category. The things that affect the consequences of the species richness index are plot size and variety stage. The broader the plot length and the higher the extent of variety, the better the species richness index price (Sari, 2023). Various factors influence mangrove forest species richness. Coastal development, climate change, and pollutants are significant threats to mangrove ecosystems that can affect the variety and abundance of bacterial groups in mangrove soils (Quintero, 2022). Sea rise, sediment supply, and anthropogenic constraints can affect mangrove extent and species loss. Air temperature and precipitation are essential in mangrove distribution, abundance, and species richness, with thresholds varying between regional boundaries (Osland 2017). Hydrological restoration can increase niche availability for different groups of birds, resulting in better bird species richness and relative abundance at disturbed and restored websites in comparison to undisturbed sites (Delgadillo 2019). Additionally, anthropogenic pressures such as deforestation, pollution, and high levels of heavy metals in water can impact mangrove forests and the trees within them, potentially causing internal imbalances and disease (Reyes 2018).

The results of the evenness index (E) at all Petengoran mangrove forest stations are included in the high evenness level. It suggests that the evenness of mangrove species is appropriately distributed and that the community is solid. The evenness index represents the diploma of people inside their respective species. The evenness index is also associated with the variety index; the better the evenness index, the stronger the species variety (Kusmana, 2021).

Based on the research results, there are six (6) indicators, namely environmental conditions, the existence of mangrove forests, ecological benefits, economic benefits, social benefits, and perceived negative impacts, and an average score of 74,51% is acquired that is covered in the "agree" class which is proven in Table 4.

The following are the results of interviews with local communities regarding ethnocentrism, which refers to six aspects, namely the condition of mangrove forests (77.50%), the existence of mangrove forests (82.50%), ecological benefits (88.33%), economic benefits (79.58%), social benefits (75.83%), and negative impacts felt by society (43.33%).

Discussion

The ethnocentrism of the people of Gebang Village, Teluk Pandan, Pesawaran Regency to mangrove ethnocentrism shows that the scores for each perception indicator obtained are classified as Totally agree, agree, disagree, and disagree (Table 4). Positive public perception determines how the sustainability of the mangrove ecosystem is maintained. The public awareness and attitudes towards mangrove ecosystems greatly determine mangrove restoration (Setiawan, 2017). Analysis of community perceptions of ecosystems can also be used as a benchmark in ecosystem management and development (Denada et al., 2020; Nurbaiti et al., 2020).

The condition of the Petengoran mangrove forest can be seen from the fact that the forest environment is clean and well maintained due to the public's awareness and visitors not leaving rubbish carelessly. The mangrove forest management provides many water source facilities, and the road to the mangrove forest is easy to reach. This is proven by the public's response, which stated that 77.50% agreed. Respondents with a high response were people with broad insight and could receive information from outside, specifically regarding mangrove forests.

Gebang Village, Teluk Pandan, Pesawaran Regency, there are mixed opinions regarding the ethnocentrism of mangrove existence (82.50%). The percentage of ecological benefits (88.33%) is high and is in the category of Totally agree. This is due to several factors, one of which is the community's perception that mangroves have ecological functions, namely protecting potential biodiversity, maintaining balance, preventing erosion, and controlling oxygen and the level of carbon dioxide in the atmosphere. Compared to the research of Ramadhan et al. (2022), Mangrove Forest ecotourism in Langsa City can protect the existing mangrove forest ecosystem. Mangrove forests can maintain aquatic ecosystems between sea, beach, and land. This ecotourism can be controlled if there is damage to mangrove plant nurseries, replanting mangrove forests, and restoring mangrove forests, which are ways to protect the mangrove forest ecosystem in Langsa. This is in line with community mediation, as shown by the existence of forest ecosystems. Mangroves can act as breakwaters and protect the coast by preventing erosion, maintaining coastal stability, and blocking or dampening strong sea winds.

Mangrove forests are typical forest ecosystems in coastal areas. The results showed that mangrove forests provide economic (79.58%) and social (75.83%) benefits. Mangrove forests can be used as tourist destinations for food sources such as fish, crabs, shellfish, and medicines. Mangrove forests offer a different view from other tourist points of interest. The characteristics of the wooded area at the transition factor between land and sea are particular. Tourists can also learn about the environment directly from nature. In addition to direct income through front tickets and parking, this tourism interest is likewise capable of developing the encircling network's economy by offering employment and business

opportunities, which include starting meal stalls, renting boats, and turning into publications. Mangrove forests are utilized to develop technological know-how and generation, thus requiring an excellent area laboratory for studies and getting-to-know activities. Compared to Mayangsari's research (2017), mangrove ecotourism has not increased community income. There has been no change in the level of community income, especially the community around the mangrove ecotourism area as an influence mangrove ecotourism in Pasir Village, Mempawah Hilir Sub-district, Mempawah Regency because mangrove ecotourism object is a new ecotourism area, so people outside the city of Mempawah have not widely recognized it.

Mangrove forests include protected areas, so illegal logging activities are prohibited to preserve mangrove forests. Judging from the community's disapproval response to the statement that mangrove forests have a negative impact (43.33%), this proves that the community cares about mangrove forest conservation. Petengoran mangroves do not interfere with the activities of the surrounding community because they are not directly adjacent to residents' homes and have canals for fishing boats. According to research by Permata et al. (2021), in communities around mangrove forests in Kota Karang Village, Bandar Lampung City, the community tends to doubt that there are illegal logging activities because now logging is only done when mangroves block the road. However, the community admits that logging was indeed carried out to build settlements on mangrove habitat land in the past.

Conclusions

This study can be concluded the highest INP result is *Rhizopora mucronata* (300%). All stations' diversity (H') is in the medium category. All stations' species wealth index (R) is in the low category. All stations' evenness index (E) is in the high category. The condition of the mangrove forest is relatively clean and well-maintained, and access to ecotourism is adequate. Petengoran mangrove forest is managed by cultivators who carry out nurseries and planting. This area is a protected forest area for mangroves. The mangrove forest is considered a place of tradition, but the local community has no unique traditions.

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Declaration statement

The authors reported no potential conflict of interest.

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