



Ecological Perspective, Perception, and Attitude of Local Communities Toward Managing and Utilizing the Mangrove Ecosystem in Lampung Province, Indonesia

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Abstract

Mangrove damage is caused by environmental changes in the surrounding area as well as direct and indirect pressures on the existence of mangroves. The preservation of mangrove forests is inseparable from the perceptions and behavior of the community in managing and utilizing mangrove forests. Community decisions to take action in the environment will be rooted in the reciprocal relationship created between humans and their environment. This research investigates the history of mangrove management and the ecological perspectives, attitudes, and perceptions of communities toward managing and utilizing mangroves and compares the management and ecology of two mangrove areas in Lampung Province, Indonesia. This study used structured questionnaires with 97 respondents in Margasari and 48 in Sidodadi who live around mangrove forests. The question related to utilizing mangrove ecology, community perceptions of mangrove forests, and participation in mangrove management. The results showed that the people of Margasari and Sidodadi had positive perceptions of mangrove forests. The number and frequency of people participating in mangrove management in Sidodadi were higher than those in Margasari, but in general, the participation in both villages was low. Neither village utilizes mangrove timber. The utilization of nontimber mangrove products in Margasari is more diverse than in Sidodadi; Margasari has ten types of utilization, while Sidodadi has only four types. The condition of mangrove vegetation cover during the last ten years has the same trend; mangrove cover area has decreased, although there was a slight increase in Sidodadi. Different factors influence the decrease; in Margasari, it is influenced by natural factors, while in Sidodadi, it is influenced by human factors.

Keywords Institutions · Nontimber forest products · Mangrove cover · Participation · Utilization

Introduction

Mangrove is the main life-supporting ecosystem that is important for coastal areas. Mangroves have ecological functions as nutrient providers for aquatic biotas, spawning and breeding places for various biotas, abrasion retention, wind and tsunami barriers, waste absorbers, prevention of intrusion, and preservation/stabilization of shorelines and riverbanks, as well as shielding from wave and current blows (Karlina 2015; Kusmana 2015; Julaikha and Sumiyati 2017). In addition, mangroves also have economic functions, such as providing wood, medicine raw materials (the leaves of mangrove plants), and social functions (as an area of community interaction) (Ariftia et al. 2014; Lugina et al. 2017).

Based on data from the World Mangrove Atlas, in 1999 and 2003, the total area of mangroves worldwide was 152,360 km², and Indonesia has the largest expanse of mangroves in the world: approximately 31,890 km², or 21% of the world's mangrove area (ITTO (International Tropical Timber Organization) 2012). The largest mangrove areas in Indonesia are located on the east coast of Sumatra, the coast of Kalimantan, and Papua (Ghufran and Kordi 2012). Lampung Province is one of the provinces on the East Coast of Sumatra with a total mangrove area of 94,338.94 ha, but 45,136.93 ha or 47% of the area was damaged (Badan Pengelolaan Lingkungan Hidup Daerah Provinsi Lampung 2014).

Mangrove damage is caused by environmental changes in the surrounding area as well as direct and indirect pressures on the existence of mangroves. For example, some studies mention that the conversion of mangroves into shrimp ponds, settlement areas, and tourist attractions and the lack of community awareness about the importance of mangroves have caused mangrove damage in Lampung Province (Mayuftia et al. 2013; Mukhlisi and Purnaweni 2013; Nugraha et al. 2015). Additionally, Gumilar (2018) states that the degradation of mangrove forests is rooted in human behavior.

Human behavior is formed from the perception of how a person sees and assesses their environment (Masria and Ihsan 2015; Irawan et al. 2017; Purnomo et al. 2017). Therefore, the differences in perceptions of environmental conservation will lead to differences in participation (Bustan 2016). However, positive perceptions about forests are not always followed by a high level of participation in forest management activities (Irawan et al. 2017; Purnomo et al. 2017). In addition to perceptions, direct economic benefits from the existence of forests are the factors that determine whether people participate in forest management (Tesyfaye 2017). This means that mangrove forest preservation is inseparable from the perceptions and behavior of the community in managing and utilizing mangrove forests (Zainudin and Susanto 2015; Darmansyah and Erwiantono 2018). Previous research in Margasari and Sidodadi showed that the management and utilization of mangrove forests were limitedly engaged by the community (Ariftia et al. 2014; Setiawan et al. 2017). Community participation, social capital, and collective action of mangrove management in both villages are also low (Ana et al. 2015; Cesario et al. 2015; Qurniati et al. 2017; Alfandi et al. 2019). Community decisions to take action in the environment will be built from the reciprocal

relationship between humans and their environment (Han 2019). Hence, understanding people's perceptions and attitudes is important to determine their perspective on the management and sustainable use of mangrove forest resources.

Studies on perception, attitude, and community participation in the management and utilization of mangrove forests have been conducted, among others, by Darman-syah and Erwianto (2018), Gumilar (2018), Setiyaningrum (2019), and Sulaiman et al. (2019). These studies, however, did not discuss their relation to the ecological conditions that arise from the community's attitude and were conducted only in one location. For this reason, this study compares two cases in different conditions with several research questions: Does the lack of knowledge and ecological skills in environmentally friendly mangrove management techniques affect community actions in managing and utilizing mangroves? Does it have an impact on their ecological conditions? Based on this, this study examines the history of mangrove management, ecological perspectives, attitudes, and public perceptions of the management and utilization of mangroves and compares the management and ecology of two mangrove areas in Lampung Province, Indonesia.

Methodology

The Study Area

The research was carried out from August to November 2019 in two villages with mangrove forests managed by the community. The mangrove forests in the two villages have different geographical characteristics and management types. The mangrove forest in Margasari Village is located on the east coast of East Lampung District, bordering the open Java Sea, so it is quite squashed by sea tides. The Margasari mangrove is managed collaboratively by the University (Lampung University), Margasari Village, and the District Government. Meanwhile, the mangrove forest in Sidodadi Village, Teluk Pandan District Pesawaran Regency, is quite hidden and protected by the small islands surrounding the bay area of the southern part of Lampung, which are relatively safe from high sea tides (Fig. 1).

Data Collection

This study used structured questionnaires with 97 respondents in Margasari and 48 in Sidodadi who live around mangrove forests. The questions are related to the utilization of mangrove ecology, community perceptions of mangrove forests, and participation in mangrove management (see Table 1 for details of data per category). Furthermore, semi-structured interviews were conducted with nine key informants (five from Margasari and four from Sidodadi) selected using the snowball method. The key chosen informants were mangrove managers, village officials, and community leaders who understood the history and dynamics of mangrove management in the two villages. This information was supplemented by spatial data that determined the changes in mangrove forest cover from 2010 to 2019. The map used is thematic

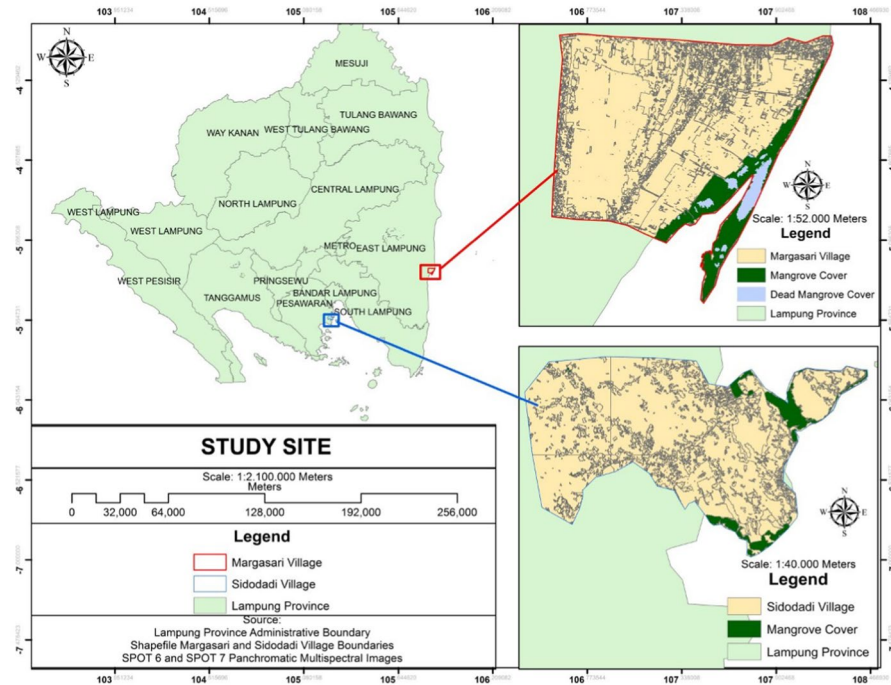


Fig. 1 Map of mangrove area in Margasari and Sidodadi Villages in Lampung Province, Indonesia

because it presents the land cover of the study area. Time-series and satellite image data were used to derive the land cover data, namely, Satellites Pour l'Observation de la Terre (SPOT) 6 and SPOT 7 images with an image resolution of 1.5 meters from the Indonesian Institute of Aeronautics and Space (Lapan). A visual interpretation was carried out at a scale of 1:25,000 to produce a land cover map from the satellite images. The map scale refers to Lapan's website catalog information.lapan.go.id.

Data Analysis

The local community's ecological perspective toward mangrove forest management and utilization in Margasari and Sidodadi was analyzed descriptively. First, the history and dynamics of mangrove forest management that the community had carried out and the utilization of mangrove forests in both villages were analyzed. Then, descriptive tables were used to compare the current condition of the local community in terms of perception and participation. Subsequently, the land cover maps of 2010–2019 were produced from landsat satellite image by conducting an object-based image analysis using eCognition Developer software. eCognition is a leading object-based image analysis platform for multi-dimensional image analysis. Furthermore, the changes in forest cover compared to mangrove forest management

Table 1 Data categories and survey items

Category	Items
Mangrove management	History of mangrove management Dynamism of mangrove management
The utilization of the mangrove ecosystem	Potential used Utilization Revenue from mangrove products The production cost of mangrove products The economic value of mangrove products
Perceptions of mangrove forest	Knowledge of mangrove forest Mangrove utility The current condition of the mangrove forest The willingness to participate in mangrove management The suitability of current management with community expectations Knowledge of mangrove management rules
Participation in mangrove management	Planning Cultivation Protection Utilization Monitoring Seedling Planting Extension program
Mangrove ecology	Land cover of mangrove vegetation The change of mangrove vegetation cover in 2010–2019

implemented by communities in both villages. Based on this, in the final section, recommendations to make mangrove management sustainable were prepared.

Results and Discussion

Management and Utilization of Mangrove Forest in Lampung Province

Mangrove Management in Margasari Village

The mangrove forest in Margasari Village is a protected area with common pool resources (Kustanti et al. 2014) that grows along the coastline on the East Coast of Sumatra Island. The characteristics of mangrove forests, the open access, and the increase in shrimp prices in the 1980s led to the conversion of mangrove forests into shrimp ponds. Shrimp ponds were managed intensively, producing waste (pollutants) that had damaged the mangrove ecosystem. The ever-increasing conversion of

mangroves caused massive beach abrasion, which in turn damaged houses and submerged land, including shrimp ponds. This incident began to make people aware of the importance of the mangrove ecosystem.

An integrated community with local governments, universities, and nongovernment organizations (NGOs) has been undertaking the rehabilitation and management of mangrove forests since 1992. Community groups that actively participate include shrimp processing groups, fish processing groups, fishing groups, farmer group associations, and mangrove groups. Rehabilitation began with planting mangrove vegetation such as *Sonneratia caseolaris*, *Rhizophora* sp, and *Nypa fruticans*. Furthermore, other species also grow there naturally and due to planting, and the dominant mangrove species that developed later was *Avicennia marina*.

In 2005, the head of Margasari Village submitted a request to hand over mangrove forest management to the University of Lampung, a state university in the province, hoping that mangrove management could be better. The local government and the Department of Forestry and Agriculture later approved the application in location determination for managing mangrove forests in education, environmental conservation, and community development in Margasari. As a result, the rehabilitation and conservation of mangrove forests have shown good results. For example, in 2014, the mangrove forest area reached 700 ha (Kustanti et al. 2014), and the mangrove forest area in 2015 increased to 817.59 ha (Cesario et al. 2015). This area consists of mangrove vegetation cover and “*tanah timbul*”, land that appears above the water surface due to the accumulation of soil material (sedimentation), naturally occurring as the mangrove ecosystem improves.

Mangrove Management in Sidodadi Village

The history of mangrove management in Sidodadi was motivated by the extensive utilization of mangrove forests in the 1980s. Nevertheless, since the 1990s, most of the forest has been damaged due to its conversion to shrimp ponds and residential areas. Moreover, during the economic crisis in 1997–1998, the intensity of mangrove deforestation increased and threatened its existence. This led to the initiative of a community leader to form a mangrove group named the Papeling Group on March 16, 2000.

The Papeling group started its activities in 2004 by carrying out routine planting and nurseries for mangrove rehabilitation. This activity resulted in an increase in the area of mangrove forests, which, based on Cindoswari (2008) research, reached 60 ha in 2006. This achievement led the Papeling group to receive the Kalpataru Award for its contribution in preserving the environment in 2006. However, since 2012, the Papeling group has not been active in mangrove management and has rarely held group meetings. Currently, mangrove nursery businesses continue to be run not by the group but personally by the new head of the Papeling group.

The pressure on the mangrove forest ecosystem in Sidodadi Village is increasing. Mangrove forest damage was caused not only by its conversion into shrimp ponds and settlements but also by tourism activities that did not consider environmental aspects. According to Rahmayanti (2009), in 2009, the mangrove forest covered an area of only 27.28 ha, consisting of 3.69 ha in good condition, 21.48 ha facing

the threat of damage, and 2.21 ha already in damaged condition. The community felt threatened by this condition and continued to carry out mangrove rehabilitation with various parties until the mangrove forest area increased by 42.17 ha in 2014 (Nugraha et al. 2015).

Mangrove forest management by the community in both villages was motivated by a decrease in the mangrove forest areas. This decrease was caused by the conversion of mangrove land to shrimp ponds, settlements, and tourist attractions, which caused sea abrasion, especially in Margasari Village, Labuhan Maringgai District. The area of mangrove forest in Labuhan Maringgai Regency decreased in 1973–1983 by 546.81 ha (23.04%), and in 1983–1994, it was 1199.81 ha (65.69%) (Yuliasamaya and Hilmanto 2014). Community concerns about widespread abrasion and tsunami disasters encouraged people to plant mangroves. Planting was carried out by the mangrove forest management group established in the two villages.

The active group institution was shown in the early history of its formation. It has continuously increased the mangrove forest area through large-scale planting by many communities in both villages. This planting collaborates with the government, universities, the private sector, and NGOs. As a result, various conservation efforts carried out by the group and the community improved the condition of mangrove cover in both villages. In Labuhan Maringgai (especially in Margasari and Pasir Sakti Village), there was an increase in the mangrove forest area in 2004–2013, covering an area of 446.86 ha or 62.12% (Yuliasamaya and Hilmanto 2014). However, the mangrove group institutions in both villages are inactive, and group activities are almost nonexistent. The mangrove nursery, a group initially managed in Sidodadi, is presently privately managed. Parties have initiated mangrove planting in the two villages outside the group in the last few years. However, the village community is involved only as planting workers and in small numbers.

The Utilization of the Mangrove Ecosystem

Both villages have high economic potential from mangrove forests, but their utilization is low. The community does not utilize wood from mangrove forests but only nontimber forest products. The utilization in Margasari is more diverse than that in Sidodadi; Margasari has ten types of utilization, while Sidodadi has four types (Table 2). The use of nontimber forest products from mangrove forests in Margasari was initially carried out in groups but later individually for a private business. Limited marketing within the village causes stagnant production, and the number of people participating in this business declines. In Sidodadi, the use of nontimber forest products does not exist because the community does not know how to manage them.

Several mangrove species, such as *Acanthus ilicifolius*, *Sonneratia caseolaris*, and *Avicennia marina*, are used by the mangrove forest community in Margasari to process into food products. Food products are not produced in groups but by private businesses on a small scale. As in Margasari, various regions in Indonesia have also used mangroves, such as processing tea and crackers from *Acanthus ilicifolius* in Sei Nagalawan Village, Lubuk Kertang Village, Sembilan Island, Kampai Island, and other coastal areas (Silalahi et al. 2016 and Prayogo et al.

Table 2 Types of direct use of mangrove forest ecosystems in the two research locations

No	Potential used	Products being marketed	
		Margasari Village	Sidodadi Village
1	<i>Acanthus ilicifolius</i>	Tea, crisps/ <i>peyek</i> (thin chip made of flour and shrimp or small fish), crackers, and fish cake (<i>pempek</i>)	–
2	<i>Sonneratia caseolaris</i>	Syrup and toffee (<i>dodol</i>)	–
3	<i>Avicennia marina</i>	Vegetable salad (<i>urap</i>), fresh vegetables, and cake	–
4	Fish	Fresh fish, salted fish, and pempek	Fresh fish
5	Small Shrimp	Fresh small shrimp (<i>rebon basah</i>), dried small shrimp (<i>rebon kering</i>), and shrimp paste (<i>terasi</i>)	Fresh small shrimp (<i>rebon basah</i>)
6	Shrimp	Fresh shrimp	–
7	Small crab	Fresh small crab	–
8	Squid	Fresh squid	Fresh squid
9	Golden snail	Crackers	–
10	Ecotourism	Ecotourism	–
11	Nursery	–	Propagule of <i>Rhizophora stylosa</i> , <i>Rhizophora mucronata</i> , and <i>Rhizophora apiculata</i>

2016), processing *syrup* and *dodol* from *Sonneratia caseolaris* in Juntikebon, Sidoarjo and Muara Gembong Villages (Handayani 2018; Prasasty et al. 2018; Sugianto 2019), and *urap* (type of salad) from *Avicennia marina* leaves on the Coast of Java Island (Mulyatun 2018).

Many potential uses in the mangrove forests in the two villages have not been utilized, even though they are available in sufficient quantities. For example, *Acanthus ilicifolius* leaves can be processed into beverage products (Najar and Asyik 2018), flour as a natural preservative for chicken meatballs (Jayadi et al. 2018), and chips (Firdaus et al. 2019). *Sonneratia caseolaris* can be processed into candy (Bidayani et al. 2016), jam (Harnadi et al. 2018), and *rujak*/salad (Ananda et al. 2019). *Avicennia marina* can also be processed into flour (Rosyada et al. 2018), syrup, sweets (Riwayatı 2014), and chips (Mulyatun 2018). *Bruguiera gymnorrhiza* fruit can be processed into flour and rice, which have carbohydrates, as do potatoes (Ananda et al. 2019). *Nypa fruticans* can be processed into syrup and sugar, resulting in better results than sugarcane (Handayani 2018).

Food products developed in coastal areas not only utilize mangrove plants but also utilize various marine organisms, such as fish, dried shrimp, and golden snails. The abundant catch of fish in Margasari has led to fishers' initiative to process them into salted fish, *pempek* (a sort of fish cake), and shrimp paste. Marketing of *pempek* is carried out by opening small stalls in the neighborhood where people live, while shrimp paste and salted fish are marketed outside the region. Other processed seafood products are *rebon* and golden snails. These products are processed into shrimp paste, dried shrimp, and chips. Mardiyati and Amruddin (2016) explained that dried shrimp can also be processed into crackers, nuggets, meatballs, and other food products, but these have not been developed in Margasari and Sidodadi.

Comparing costs and revenues for each product produced from mangrove forests shows that all direct use by the community is very profitable (Table 3). However, the income from the utilization of mangrove forests cannot be used to fulfil their monthly expenses because the production of mangroves and marine products is on a small scale and not regular. Hence, it is just a secondary income for communities. The utilization that provides the highest profit in Margasari is the products produced on a small scale and with limited marketing within the village, such as fresh vegetables, crackers, and *pempek*. Increasing market share outside the village has not been carried out because market information and marketing networks are still limited within the village. Therefore, the community needs training to increase their marketing knowledge and to improve the quality of their products so that profits can be increased. In contrast to Sidodadi, the utilization limited to marine products does not provide added value for the utilization of mangrove forest products, so the ratio of revenue and cost of marine products is the highest, while the nurseries that have been implemented have not provided high profits.

One of the potential uses of mangroves that has not been utilized optimally in both villages is ecology-based tourism or ecotourism. Ecotourism is the possible utilization of mangrove forests without damaging the ecosystem (Harahab and Setiawan 2017). In addition, mangrove ecotourism development is necessary to increase community income and provide education about the importance of mangrove forest conservation (Fahrian et al. 2015; Affandy et al. 2016).

Table 3 Comparison of revenue and cost for each utilization

No	Utilization	Revenue (Rp/year)	Cost (Rp/year)	R/C
<i>A. Margasari village</i>				
1	Dumplings made with <i>Acanthus ilicifolius</i>	22,500,000	9,000,000	2.5
2	Crackers made with <i>Acanthus ilicifolius</i>	65,040,000	16,200,000	4.0
3	Crips (<i>Peyek</i>) made with <i>Acanthus ilicifolius</i>	127,500,000	22,500,000	5.7
4	Tea made with <i>Acanthus ilicifolius</i>	112,500,000	19,500,000	5.8
5	Cake made with <i>Avicennia marina</i>	24,000,000	3,000,000	8.0
6	Vegetable salad (<i>urap</i>) made with <i>Avicennia marina</i>	6,000,000	240,000	25.0
7	Syrup made with <i>Sonneratia caseolaris</i>	37,500,000	16,000,000	2.3
8	Toffee (<i>dodol</i>) made with <i>Sonneratia caseolaris</i>	34,000,000	20,000,000	1.7
9	Shrimp paste (<i>terasi</i>)	1,881,600,000	376,320,000	5.0
10	Golden snail chip	76,800,000	3,360,000	22.9
11	Fresh fish	146,162,856,000	74,985,600,000	1.9
12	Salted fish	4,138,446,000	1,098,720,000	3.8
13	Fish cake (<i>empek</i>)	115,200,000	76,80,000	15.0
14	Shrimp	7,350,000,000	3,397,500,000	2.2
15	Small shrimp	6,750,000,000	3,600,000,000	1.9
16	Squid	5,400,000,000	2,400,000,000	2.3
<i>B. Sidodadi village</i>				
1	Fish	768,600,000	7,32,00,000	10.5
2	Squid	9,60,00,000	32,00,000	30.0
3	Dried small shrimp (<i>rebon kering</i>)	4,32,00,000	28,80,000	15.0
4	Nursery	450,000,000	315,000,000	1.4

The community in Margasari has developed mangrove ecotourism, which was inaugurated in early 2019, while in Sidodadi, it is only a plan. Sidodadi faces constraints on the unclear status of its mangrove forestland. The legality of the mangrove forest area in Sidodadi is an obstacle to ecotourism development. The location of Sidodadi, which is close to the center of the provincial capital, has market potential that supports this utilization. Some parts of the mangrove forest are claimed as private property, especially in the part of the forest bordering the certified land.

In 2000, the development of mangrove ecotourism in Margasari was carried out, but until 2017, the number of tourists visiting was only 5–10 people/month, unlike the current number of 100 people/month. This difference is due to the development of tourist objects such as bridges, photo spots, seats, huts, and boats to go around the mangrove forest. Previously, the tourist objects were bird-watching towers, track trails, and floating piers (Ariftia et al. 2014). However, these facilities are no longer functioning because access to these locations has been closed by expanding community-owned shrimp ponds (Prasetyo et al. 2019). Therefore, mangrove ecotourism facilities in Margasari need to be improved to increase the number of visitors. In line with the results of visitors' assessments of

mangrove ecotourism in Klong Kone, Thailand, the adequacy of public facilities obtains the highest score, and it has become a top priority for tourists and locals who visit (Swangjang and Kornpiphat 2021). In addition, research on facilities in the Pantai Indah Kapuk Mangrove Forest also shows a significant influence on visitor satisfaction (Sulistio and Septiani 2018). Therefore, the existing facilities in some mangrove ecotourism can be a reference. For example, mangroves in Muara Angke (Jakarta) has attractive amenities for ecotourism such as lodging, boats to go around mangrove forests, children's playgrounds, and mangrove conservation packages for planting mangrove seeds by visitors (Mahardhika et al. 2018). However, Lee (2021) emphasized that ecotourism facilities should focus more on providing educational support services rather than promoting private business interests.

Community Perception

Community perception of mangrove forests in Margasari and Sidodadi is dominant at the same level (Table 4). The people in Sidodadi and Margasari are not familiar with the term mangrove. In general, they call mangroves by the local term "bakau"

Table 4 Community perception of mangrove forests

No	Perception	Category	Percentage (%)	
			Sidodadi	Margasari
1	Knowledge of mangrove forests	Know	90	71
		Do not know	10	29
2	Benefits of mangroves	Useless	6	12
		Beneficial	94	88
3	Mangrove condition	Mangroves were in better condition in the past	38	25
		Mangroves are in better condition today	56	57
		The same	2	7
		Do not know	4	11
4	Willingness to participate in mangrove management	Not willing	10	11
		Willing	90	89
5	The appropriate of current management is as expected	Not appropriate	42	26
		Appropriate	38	23
		Do not answer	21	52
6	Knowledge of mangrove regulations	Do not know	56	71
		Known	44	29
7	Approval of the rules of mangrove	Disagree	65	57
		Agree	35	43

or “hutan bakau”, where “bakau” is the local name for mangrove plants. However, community knowledge about mangrove forests is higher in Sidodadi (90%) than in Margasari (71%). According to the community, mangrove forests are (1) forests that can be protective of abrasion and breakwaters and tourist attractions, (2) mangrove trees and other trees on the beach, (3) forests that are places for nature conservation and for crab and shellfish ecosystems, (4) forests that are used by the community, and (5) trees that provide flood protection.

Many people in the two villages think the mangrove forests in their village are currently in better condition than in previous years, but some say it is actually worse. However, the residents who have lived in the two villages for a long time stated that the mangrove forest condition was better and wider than it is now. For example, the Margasari community pointed out several locations that were previously covered by mangroves. However, the vegetation was lost due to abrasion or death because an artificial barrier on the beach now covers the area, so the area is not inundated by seawater. Meanwhile, in Sidodadi, the decline in mangrove forest areas was caused by the logging of mangrove forests for beach tourism.

The dominant theme of the respondents' answers was that preserving mangrove forests is the entire community's responsibility. However, a few respondents think that only certain parties, such as group managers, are responsible for preserving mangrove forests. Therefore, a lack of community interest in mangrove management, both individually and in groups with other community members, can hinder the sustainability of mangroves (Qurniati et al. 2017). Nevertheless, all respondents stated their willingness to participate in mangrove forest management. However, the community does not know how mangrove management should be carried out, so when asked about the suitability of current management with expectations, they cannot answer. In line with the opinion of Lio and Stanis (2017), the community realizes that they depend on existing mangrove forest resources. Nevertheless, they do not understand that mangrove forests need to be managed to obtain sustainable benefits. For this reason, Wahyurini (2017) stated that the government's role is to provide much-needed counseling to foster community understanding about how to manage and preserve mangrove forests sustainably.

As the two villages have been studied, most Indonesian villages have unwritten regulations/local wisdom to protect their environment. The communities do not have written rules for mangrove forest management. However, they have unwritten rules regarding mangrove management that have been implemented by the community and agreed upon by mangrove groups, village officials, government agencies, universities, and NGOs. These rules pertain to actions that the community can and cannot take regarding managing and utilizing mangrove forests and sanctions in case of these rules are violated. Previously, in Margasari Village, there was a written rule in the form of a Village Regulation (“Peraturan Desa/Perdes”) on mangrove forest management. Nevertheless, a few years ago, this document was lost.

On the other hand, Sidodadi Village has never had written rules. The absence of written rules as a formal regulation in the two villages has resulted in many people who do not know the contents of these rules and disagree with the rules that prohibit people from entering and utilizing mangrove forests. However, Presidential Regulation number 73 of 2012 concerning the National Strategy of Mangrove Ecosystem

Management and Regulation of the Minister of Marine and Fisheries of the Republic of Indonesia Number 24/Permen-KP/2016, concerning the Rehabilitation of Coastal Areas and Small Islands Procedures, stated that there is no prohibition for people to enter mangrove forests. Mangrove ecosystem management, which includes all efforts to protect, preserve, and utilize mangroves, is carried out to ensure the functions and benefits of the mangrove ecosystem in a sustainable way for the community's welfare.

Community Participation

The number and frequency of people participating in mangrove management in Sidodadi were higher than those in Margasari, but the participation in both villages was generally low (Table 5). The level of participation can indicate awareness that there is no coercion from any party and that there is support for existing activities (Rizal and Rahayu 2015). In addition, the low participation is also due to the high perceptions of the community in the two villages that mangroves cannot encourage participation. The low economic benefits received by the community from the presence of mangrove forests are one of the factors that weaken community participation. Mangrove management is not a group activity but an activity from outside the group carried out in the mangrove forests in the two villages. This is due to the group institutions in the two villages that are not active, which results in low levels of community participation in mangrove forest management in Margasari and Sidodadi. Low participation is also found in several previous studies conducted in Margasari (Qurniati et al. 2017; Setiawan et al. 2017) and Sidodadi (Ana et al. 2015; Alfandi et al. 2019). Before that time, in 2014, the participation of the Margasari community in mangrove management was high (Cesario et al. 2015), and in Sidodadi Village, the participation of the Sidodadi community in mangrove planting and nursery activities was high (Harja 2001; Rahmayanti 2009).

The low intensity of community interaction in the mangrove forest indicates low utilization. The group rule in Margasari, which prohibits people from entering mangrove forests, limits their use to mangrove plants located adjacent to community lands. Low

Table 5 Level of community participation and frequency in mangrove management

No	Activity	Participation (%)		Frequency	
		Margasari	Sidodadi	Margasari	Sidodadi
1	Planning	7	13	3	1
2	Nursing	4	13	1	2
3	Protection	1	13	1	1
4	Utilization	7	9	3	2
5	Monitoring	2	13	1	2
6	Nursery	5	65	2	3
7	Planting	16	69	6	2
8	Extension program	13	39	2	3

utilization, especially related to economic activities, has reduced community participation. This is in line with the study by Lio and Stanis (2017) stating that the level of community participation in the utilization of mangrove forests is influenced by local government regulations regarding the use of existing resources.

Nursery and planting have a high level of participation in Sidodadi but a low level in Margasari. The nursery in Margasari is operated privately by one person, and it contains only a few plant communities; thus, only small quantities of seed are produced. The seeds are purchased from other areas when there are many planting activities. Unlike in Sidodadi, although the nursery business belongs to the group leader and does not belong to the Papeling Group, its implementation involves many Papeling Group members. This activity is carried out by small teams of several households adjacent to the mangrove forest. A household becomes a small team that works by optimizing the workforce in the family consisting of parents and children. Men, including fathers and sons, look for propagules (mangrove fruit that has undergone germination) in the mangrove forest. Women, including mothers and adult daughters, plant the propagules in polybags (plastic bags for nurseries). In this way, the community is involved and can produce large quantities of seeds. However, the number of people participating is lower than in the past because the demand for seeds has decreased.

In 2002, the people of Sidodadi had a tradition of “selapanan”, a tradition of managing mangrove forests, especially planting and seeding activities carried out by the Sidodadi community every 35 days. In addition, the members of the Papeling Group routinely held meetings in conjunction with religious activities; this meeting was “yasinan”, and it was held once a month. At the “yasinan” event, the Papeling leader, who was the village head, always gave the community an understanding of the importance of the mangroves. “Selapan” and “yasinan” were local wisdom and unwritten regulations for conserving mangrove forests. In Indonesia, the communities in almost all mangrove areas had unwritten regulations related to mangrove utilization and conservation. The tsunami tragedy in Aceh Province and several other areas in 2004 made people aware of the importance of mangroves. It encouraged them to participate, but unfortunately, this tradition is no longer running.

The decrease in the participation level can be seen in the change in the number of people involved, both group administrators and members. Qurniati et al. 2017 explained that mangrove planting activities in Sidodadi and Margasari were mostly carried out by outside the group, such as universities, the government, the private sector, students, and NGOs, with little involvement from the community. There was also low involvement in extension programs, which were influenced by various factors, including limitations of parties that could be involved (Lio and Stanis 2017), frequency of activities (Amal 2016), and irregular activities (Tanjung et al. 2021). These factors also contributed to the low participation of the community in the extension programs in the two villages.

Mangrove Ecology

The ecological condition of mangrove forests is described by their forest cover. The area of mangrove forest cover in 2010–2019 in Margasari Village decreased (Figure 2 and Table 6). In contrast, several studies stated that the area of mangrove

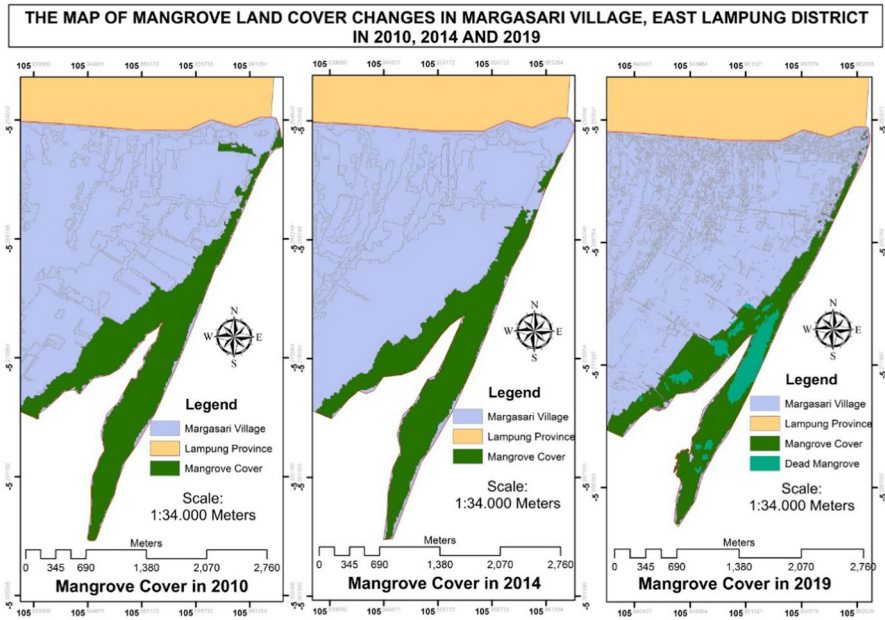


Fig. 2 Land cover of mangrove vegetation in Margasari Village, 2010–2019

Table 6 The changes in mangrove vegetation cover in Margasari Village, 2010–2019

Year	Area (ha)	Changes (ha)	Annotation
2010	176.5	–	–
2014	163.2	13.3	–
2019	124.2	39	25 ha (Critical mangroves)

forests in Margasari was 700 ha in 2009 (Kustanti et al. 2014), 700 ha in 2013 (Yuliasamaya and Hilmanto 2014), and 817.59 ha in 2014 (Putra et al. 2015). The difference was caused by the fact that these studies calculated the area of mangrove vegetation cover and “*tanah timbul*” around it. *Tanah timbul* is rising ground (exposed land) because of soil accumulation from erosion in the river delta. Therefore, the “*tanah timbul*” area is larger than the vegetation cover.

The map of mangrove vegetation cover shows the decrease in mangrove vegetation area on the outside bordering the sea/coast. The decrease in mangrove vegetation cover occurred due to abrasion and the presence of critical mangrove vegetation due to disease attacks and dried mud (Fig. 3). The abrasion is caused by strong ocean currents and high tidal waves. The mangrove vegetation in Margasari, which was dominated by *Avicennia marina*, could not withstand high ocean currents and tidal waves. *Avicennia marina* has a root system to adapt to harmful tidal waves and hypoxia in muddy soils, with anchor roots that grow



Fig. 3 Critical mangrove stands (a) and mangrove stands that collapsed due to abrasion (b)

below and air roots growing up (Hao et al. 2021). Air roots can precipitate thick mud substrates and form land so that tides no longer inundate the area and can cause *Avicennia* to die. At this time, *Avicennia* must be replaced with other species, such as *Rhizophora*, because, as Herison et al. (2014) stated, changes in mangrove function will always occur if there is no change in the procedures for the planting and maintenance of mangroves.

The mangrove cover area in Sidodadi was smaller than that in Margasari. Sidodadi had no “*tanah timbul*” that appears around mangrove forests such as Margasari. However, the species diversity in Sidodadi mangroves was much higher than that in Margasari mangroves. Mukhlisi et al. (2013) reported that the Sidodadi mangrove consists of 22 major mangrove species dominated by *Rhizophora apiculata* Blume and *Rhizophora stylosa* Griff. In comparison, Margasari comprises nine species dominated by *Avicennia marina* (Widiastuti et al. 2019). The location of mangrove forests in Sidodadi, which faced small islands, made the ocean currents and wind speed not as strong as those in Margasari.

From 2010 to 2019, the data showed increased mangrove vegetation cover in Sidodadi (Figure 4 and Table 7). The increase in mangrove cover in Sidodadi occurred in line with several factors in the location. These factors include the planting activities undertaken by the community in collaboration with several agencies in mangrove conservation efforts that are still being carried out today. In addition, planting using seeds from the mangrove nursery was carried out by the Sidodadi community members of the Papeling Group. Apart from planting, the increase in the area also occurs naturally due to the presence of mangrove fruit carried by the waves and grows in new locations, increasing the area of mangrove vegetation.

The mangrove forest area in Sidodadi has increased slightly over the past ten years (Table 7). This occurred because during the period 2014–2019, the planted mangrove seedlings died or failed. In addition, in 2014–2015, approximately 2 ha of mangrove stands were felled to be used as tourist attractions. The increase in the area of mangrove vegetation was not very significant compared to the increase in 2010–2014. The unclear status of mangrove forestland in Sidodadi is an obstacle to maintaining the existence of mangrove forests. The community cannot do anything when the mangroves are cut down and converted into a tourist attraction by a party who claims to have a certificate for the land.

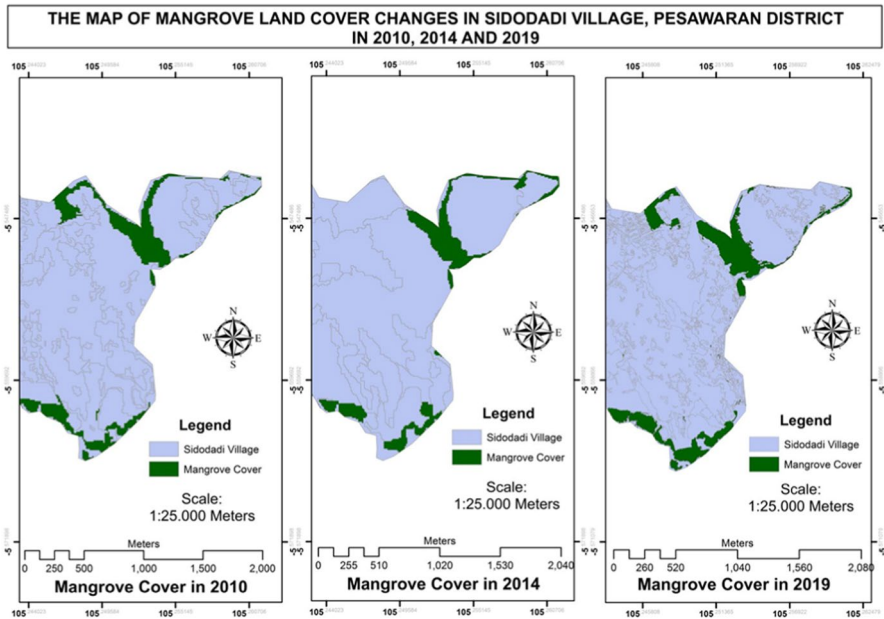


Fig. 4 Mangrove vegetation cover in Sidodadi Village, 2010–2019

Table 7 Changes in mangrove cover in Sidodadi Village, 2010–2019

Year	Area (ha)	The Changes (ha)
2010	38.1	–
2014	41.9	3.8
2019	42.2	0.3

Conclusion

Regarding the condition of mangrove vegetation cover over the last ten years, there was a decrease in the area of mangrove forest cover in Margasari. However, there was a slight increase in Sidodadi. The cases in the two villages indicate that mangrove forest degradation originating from human attitudes is in line with what happened in Sidodadi but different from that in Margasari. In the process of reciprocity with the environment, community actions can change over time, such as changes in group and community participation in the case of both villages. However, the high level of community perception and understanding of the importance of mangroves is not enough for the community to take participatory action. The economic benefits following this perception must be felt directly by the wider community so that people are willing to be involved in maintaining the existence and preservation of mangrove forests.

Planting mangrove species suitable for coastal physical conditions is needed in Margasari for the village to become a functional natural fortress for coastal protection and for marine life development and where fisheries are the biggest economic source for the Margasari community. In contrast to Margasari, to maintain and preserve the mangrove forests in Sidodadi, the mangrove area's legality and management are needed to limit mangrove conversion. Furthermore, collaboration and support involving all stakeholders, including the government, private sector, NGOs, and universities, are required to strengthen group institutions in both villages. Thus, the community can become a driving force in mangrove forest management so that the area of mangrove vegetation increases and sustainable utilization can be optimized.

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References

- Affandy B, Setiawan Duryat A (2016) Potensi wisata alam di pematang tanggang desa negeri Kecamatan Kelumbayan Kabupaten Tanggamus. *J Sylva Lestari* 4(1):41–50. <https://doi.org/10.23960/jsl1441-50>
- Alfandi D, Qurniati R, Febryano IG (2019) Partisipasi masyarakat dalam pengelolaan mangrove. *J Sylva Lestari* 7(1):30–41. <https://doi.org/10.23960/jsl1730-41>
- Amal BII (2016) Persepsi dan partisipasi masyarakat dalam pengelolaan hutan mangrove berbasis masyarakat di kecamatan suppa Kabupaten Pinrang. *J Sci Pinisi* 2(1):1–7
- Ana AF, Qurniati R, Wulandari C (2015) Pengaruh karakteristik individu terhadap aksi kolektif kelompok peduli mangrove di Desa Sidodadi Kecamatan Padang Cermin Kabupaten Pesawaran. *J Hutan Tropis* 3(1):8–17
- Ananda KD, Suparyana PK, Nada FMH (2019) Peran Balai Pengelolaan Hutan Mangrove Wilayah I Bali dalam pengelolaan hasil hutan mangrove berbasis pemberdayaan masyarakat lokal. *J Sos Ekonomi Pertanian* 13(3):331–339. <https://doi.org/10.24843/SOCA.2019.v13.i03.p04>
- Ariftia RI, Qurniati R, Herwanti S (2014) Nilai ekonomi total hutan mangrove Desa Margasari Kecamatan Labuhan Meringgai Kabupaten Lampung Timur. *J Sylva Lestari* 2(3):19–28. <https://doi.org/10.23960/jsl3219-28>
- Badan Pengelolaan Lingkungan Hidup Daerah Provinsi Lampung (2014) Laporan status lingkungan hidup Daerah provinsi Lampung. Pemerintah Provinsi Lampung.
- Bidayani E, Soemarno S, Harahab N, Rudianto R (2016) Model components of mangrove resources management based on blue economy concept. *Econ Soc Fish Marine J* 4(1):1–15. <https://doi.org/10.21776/ub.ecsofim.2016.004.01.01>
- Bustan A (2016) Public perception and participation in environmental preservation of watershed. *Int J Agric Syst (IJAS)* 4(2):147–160. <https://doi.org/10.20956/ijas.v4i2.688>


- Cesario AE, Yuwono SB, Qurniati R (2015) Partisipasi kelompok masyarakat dalam pelestarian hutan mangrove di desa margasari kecamatan labuhan maringgai Kabupaten Lampung Timur. *J Sylva Lestari* 3(2):21–30. <https://doi.org/10.23960/jsl2321-30>
- Cindoswari AR (2008) Analisis gender dalam gerakan rehabilitasi local hutan mangrove (bakau) pada kelompok masyarakat peduli lingkungan (Papeling) di Desa Sidodadi, Kecamatan Padang Cermin, Kabupaten Lampung Selatan, Propinsi Lampung. Program Studi Komunikasi dan Pengembangan Masyarakat Fakultas Pertanian Institut Pertanian Bogor
- Darmansyah O, Erwiantono, (2018) Persepsi dan partisipasi masyarakat dalam pelestarian hutan mangrove di Desa muara pantuan Kecamatan Anggana Kabupaten Kutai Kartanegara. *J Hutan Trop* 6(2):137–144. <https://doi.org/10.20527/jht.v6i2.5401>
- Fahrian HH, Putro SP, Muhammad F (2015) Potensi ekowisata di kawasan mangrove Desa Mororejo. Kabupaten Kendal *J Biosaintifika* 7(2):104–111
- Firdaus RM, Kusufa RAB, Dwanoko YS (2019) PKM Pemberdayaan kelompok usaha keripik mangrove Desa Tambakrejo, Sumbermanjing Wetan. Kabupaten Malang *J Serv Learn* 5(2):38–42. <https://doi.org/10.9744/share.5.2.38-42>
- Ghufnan H, Kordi K (2012) Ekosistem mangrove: potensi, fungsi, dan Pengelolaan. Rineka Cipta. Jakarta
- Gumilar I (2018) Partisipasi masyarakat pesisir dalam pelestarian ekosistem hutan mangrove (Studi kasus di Kabupaten Indramayu Jawa Barat). *Sosiohumaniora J Ilmu ilmu Sos dan Hum* 20(2):145–153
- Han Y (2019) Written corrective feedback from an ecological perspective: the interaction between the context and individual learners. *System* 80(2019):288–303. <https://doi.org/10.1016/j.system.2018.12.009>
- Handayani S (2018) Identifikasi jenis tanaman mangrove sebagai bahan pangan alternatif di Kabupaten Sidoarjo Jawa Timur. *J Teknol Pangan* 12(2):33–46. <https://doi.org/10.33005/jtp.v12i2.1287>
- Hao S, Su W, Li QQ (2021) Adaptive roots of mangrove *Avicennia marina*: structure and gene expressions analyses of pneumatophores. *Sci Total Environ*. <https://doi.org/10.1016/J.SCIOTOTENV.2020.143994>
- Harahab N, Setiawan S (2017) Indeks kesesuaian ekowisata mangrove di Kabupaten Malang. *ECSOFIM J Econ Soc Fish Mar* 04(02):153–165
- Harja HM (2001) Partisipasi masyarakat dalam pelestarian hutan mangrove (Studi kasus di desa durian dan desa sidodadi kecamatan padang cermin kabupaten lampung selatan. Tesis. Program Pasca Sarjana Intitut Pertanian Bogor
- Harnadi A, Wijayanti SH, Hardianto AW (2018) Pelatihan pencatatan keuangan dan pemasaran bagi Kelompok Mangrove Indah di Bekasi. *J Bakti Masy Indones* 1(2):200–210. <https://doi.org/10.24912/jbmi.v1i2.2904>
- Harrison A, Yulianda F, Kusmana C et al (2014) The existing condition of mangrove region of *avicennia marina*: its distribution and functional transformation. *J Manaj Hutan Trop* 20:26–34. <https://doi.org/10.7226/jtfm.20.1.26>
- Irawan A, Iwanuddin I, Halawane JE, Ekawati S (2017) Analisis persepsi dan perilaku masyarakat terhadap keberadaan kawasan KPHP Model Poigar. *J Penelit Sos dan Ekon Kehutan* 14(1):71–82. <https://doi.org/10.20886/jsek.2017.14.1.71-82>
- ITTO (International Tropical Timber Organization) (2012) Tropical Forest Update: pemetaan mangrove, ITTO. Yokohama Jepang, 21(2)
- Jayadi F, Sukainah A, Rais M (2018) Pemanfaatan tepung daun mangrove jeruju (*Acanthus ilicifolius*) sebagai pengawet alami bakso ayam. *J Pendidik Teknol Perta* 4(1):1–13. <https://doi.org/10.26858/jptp.v4i0.6906>
- Julaikha S, Sumiyati L (2017) Nilai ekologis ekosistem hutan mangrove. *J Biol Trop* 17(1):23–31. <https://doi.org/10.29303/jbt.v17i1.389>
- Karlina E (2015) Strategi pengembangan ekowisata mangrove di Kawasan Pantai Tanjung Bara, Kutai Timur, Kalimantan Timur. *J Penelit Hutan dan Konserv Alam* 12(2):191–208. <https://doi.org/10.20886/jphka.2015.12.2.191-208>
- Kusmana C (2015) Integrated sustainable mangrove forest management. *J Pengelolaan Sumberd Alam Dan Lingkung* 5:1–6
- Kustanti A, Nugroho BM, Nurrochmat DR, Okimoto Y (2014) Evolusi hak kepemilikan dalam pengelolaan ekosistem hutan mangrove di Lampung Mangrove Center. *J Risal Kebijak Pertan Dan Lingkung* 1(3):143–158
- Lee J, hyuck, (2021) Using Q methodology to analyze stakeholders' interests in the establishment of ecotourism facilities: the case of Seocheon, Korea. *J Ecotour* 20:282–300. <https://doi.org/10.1080/14724049.2021.1883626>

- Lio FXS, Stanis S (2017) Partisipasi masyarakat dalam pelestarian hutan mangrove di Kelurahan Oesapa barat Kota Kupang. *J Kawistara* 7(3):207–314. <https://doi.org/10.22146/kawistara.17150>
- Lugina M, Alviya I, Pribadi MA (2017) Strategi keberlanjutan pengelolaan hutan mangrove di Tahura Ngurah Rai Bali. *J Anal Kebijakan Kehutan* 14(1):61–77. <https://doi.org/10.20886/jakk.2017.14.1.61-77>
- Mahardhika SM, Saputra SW, Ain C (2018) Valuasi ekonomi sumberdaya ikan dan ekowisata mangrove di Muara Angke Jakarta. *J Maquares* 7(4):458–464. <https://doi.org/10.14710/marj.v7i4.22670>
- Mardiyati S, Amruddin A (2016) Diversifikasi produk olahan udang rebon pada kelompok wanita nelayan. *J Al-Ikhlâs* 2(1):1–10
- Masria G, Ihsan M (2015) Persepsi dan sikap masyarakat lokal terhadap hutan di desa Labuan Toposo Kecamatan Labuan Kabupaten Donggala. *War Rimba* 3(2):57–64
- Mayuflia R, Hartoko A, Hendart B (2013) Tingkat kerusakan dan karbon mangrove dengan pendekatan data satelit NDVI (Normalized Difference Vegetation Index) di Desa Sidodadi Kabupaten Pesawaran Provinsi Lampung. *Manag Aquat Resour J* 2(4):146–154. <https://doi.org/10.14710/marj.v2i4.4278>
- Mukhlisi, Hendarto IGNB, Purnaweni H (2013) Keanekaragaman jenis dan struktur vegetasi mangrove di Desa Sidodadi Kecamatan Padang Cermin Kabupaten Pesawaran, Provinsi Lampung. *Prosiding Seminar Nasional Pengelolaan Sumberdaya Alam dan Lingkungan* 218–225
- Mulyatun M (2018) Pemberdayaan masyarakat pesisir berbasis potensi lokal; alternatif ketahanan pangan berupa tepung mangrove. *J Pemikir Agama untuk Pemberdaya* 18(2):211–238. <https://doi.org/10.21580/dms.2018.182.3260>
- Najar T, Asyik N (2018) Kajian pengembangan pangan fungsional minuman daun jeruju (*Acanthus ilicifolius*) dengan penambahan daun pandan (*Pandanus amaryllifolius* Roxb) terhadap karakteristik organoleptik dan aktivitas antioksidan. *J Sains Dan Teknolo Pangan* 3(2):1237–1246
- Nugraha B, Banuwa IS, Widagdo S (2015) Perencanaan lanskap ekowisata hutan mangrove di pantai sari ringgung desa Sidodadi Kecamatan Padang Cermin Kabupaten Pesawaran. *J Sylva Lestari* 2(3):53–66. <https://doi.org/10.23960/jsl2353-66>
- Prasasty VD, Gunadi M, Vinvin V (2018) Identifikasi pengetahuan higienitas dan sanitasi masyarakat pengolah dodol pidana di wilayah Muara Gembong Kabupaten Bekasi. *J Mitra* 2(2):137–146. <https://doi.org/10.25170/mitra.v2i2.107>
- Prasetyo D, Darmawan A, Dewi BS (2019) Persepsi wisatawan dan individu kunci tentang pengelolaan ekowisata di Lampung Mangrove Center. *J Sylva Lestari* 7(1):22–29. <https://doi.org/10.23960/jsl1722-29>
- Prayogo E, Purwoko A, Hartini KS (2016) Analisis finansial pemanfaatan dan pengolahan daun jeruju (*Acanthus ilicifolius*) menjadi berbagai produk olahan. *Peronema For Sci J* 5(1):82–93
- Purnomo B, Anggoro S, Izzati M (2017) Analysis of perception and community participation in forest management at KPHP model unit VII-Hulu Sarolangun, Jambi Province. 3rd International Conference of Planning in the Era of Uncertainty. IOP Publishing. <https://doi.org/10.1088/1755-1315/70/1/012034>
- Putra AK, Bakri S, Kurniawan B (2015) Peranan ekosistem Hutan Mangrove pada imunitas terhadap Malaria: studi di Kecamatan Labuhan Maringgai Kabupaten Lampung Timur. *J Sylva Lestari* 3(2):67–78. <https://doi.org/10.23960/jsl2367-78>
- Qurniati R, Hidayat W, Kaskoyo H, Inoue M (2017) Social capital in mangrove management: a case study in Lampung Province. *Indones J For Environ Sci* 33(1):8–21. <https://doi.org/10.7747/JFES.2017.33.1.8>
- Rahmayanti RA (2009) Partisipasi masyarakat dalam pengelolaan ekosistem mangrove di Desa Sidodadi Kecamatan Padang Cermin Kabupaten Pesawaran Propinsi Lampung. Tesis. S2 Magister Pengelolaan Lingkungan Universitas Gajah Mada
- Riwayati R (2014) Manfaat dan fungsi hutan mangrove bagi kehidupan. *J Kel Sehat Sejaht* 12(24):17–23
- Rizal M, Rahayu SP (2015) Tingkat partisipasi petani dalam kelompok tani padi sawah untuk mendukung program M-P3MI di Kabupaten Paser, Kalimantan Timur. *Pros Sem Nas Masy Biodiv Indon* 1(2):352–357. <https://doi.org/10.13057/PSNMBI/M010231>
- Rosyada A, Anwari MS (2018) Pemanfaatan tumbuhan mangrove oleh masyarakat desa bakau besar laut Kecamatan Sungai Pinyuh Kabupaten Mempawah. *J Hutan Lestari* 6(1):62–70
- Setiawan W, Harianto SP, Qurniati R (2017) Ecotourism development to preserve mangrove conservation effort: case study in Margasari Village, District of East Lampung Indonesia. *Ocean Life* 1(1):14–19. <https://doi.org/10.13057/oceanlife/o010103>

- Setiyaningrum IF (2019) Community perceptions on Mangrove Forest sustainability in Dukuh Bendo, Jatikontal Village, Purwodadi District, Purworejo Regency Central Java. *IOP Conf Ser Earth Environ Sci* 271(1):012017. <https://doi.org/10.1088/1755-1315/271/1/012017>
- Silalahi ESP, Utomo B, Yunafsi Y (2016) Identifikasi jenis-jenis mangrove yang bermanfaat secara ekonomi bagi masyarakat di Pulau Sembilan dan Pulau Kampai Kabupaten Langkat. *Peronema For Sci J* 5(1):52–63
- Sugianto, (2019) Diversifikasi produk olahan mangrove bisa meningkatkan kesejahteraan masyarakat Pesisir Indramayu. *J Mangifera Edu* 3(2):133–139. <https://doi.org/10.31943/mangiferaedu.v3i2.27>
- Sulaiman B, Bambang AN, Purnaweni H, Lutfi M, Mohammed EMA (2019) Coastal community perception of mangroves in Suli Subdistrict Luwu. *J Pendidik IPA Indones* 8(4):561–569. <https://doi.org/10.15294/jpii.v8i4.21396>
- Sulistio TD, Septiani T (2018) The influence of accessibility and facilities on visitor satisfaction in Mangrove Forests Pantai Indah Kapuk. *TRJ Tour Res J*. <https://doi.org/10.30647/trj.v2i1.28>
- Swangjang K, Kornpiphat P (2021) Does ecotourism in a Mangrove area at Klong Kone, Thailand, conform to sustainable tourism? A case study using SWOT and DPSIR. *Environ Dev Sustain* 23:15960–15985
- Tanjung NS, Sadono D, Wibowo CT (2017) Tingkat partisipasi masyarakat dalam pengelolaan hutan nagari di Sumatera Barat. *J Penyul* 13(1):14–30. <https://doi.org/10.25015/penyuluhan.v13i1.12990>
- Tesfaye SS (2017) Assessment of local community perception of and attitude towards Participatory Forest Management (PFM) system and its implications for sustainability of forest condition and livelihoods: The case of ChilimoGaji Forest in Dendi District, West Shewa Zone, Oromia, Ethiopia. *J Earth Sci Clim Chang* 8(1):1–10. <https://doi.org/10.4172/2157-7617.1000382>
- Wahyurini ET (2017) Pemberdayaan dan peran masyarakat pesisir pada pengembangan mangrove menuju ekowisata di Kabupaten Pamekasan. *J Pengabd kpd Masy* 1(1):49–64. <https://doi.org/10.29062/engagement.v1i1.7>
- Widiastuti EL, Maharani WH, Abrini H (2021) Biodiversity support and ecotourism for local economic development of Margasari village-east Lampung District-Indonesia. *Proc Int Conf Sustain Biomass (ICSB 2019)*. <https://doi.org/10.2991/aer.k.210603.001>
- Yuliasamaya, Darmawan A, Hilmanto R (2014) Perubahan tutupan hutan Mangrove di pesisir Kabupaten Lampung Timur. *J Sylva Lestari* 2(3):111–124. <https://doi.org/10.23960/jsl32111-124>
- Zainudin S, Susanto D (2015) Perilaku Masyarakat dalam Pelestarian Hutan Mangrove di Kabupaten Pangkep Provinsi Sulawesi Selatan. *J Penyul* 1(1):91–100. <https://doi.org/10.25015/penyuluhan.v1i1.9936>

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