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Ecotourism development as a community-based conservation effort in Ayah Mangrove Forest, Kebumen, Central Java, Indonesia

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Abstract. *Afifah RN, Putri A, Hartanti AN, Negari SIT, Pratama MSR, Zuaini PAK, Al Madani AR, Muryanto BS, Muhammad F, Astikasari L, Indriyani S, Kurniawati I, Sunarto, Kusumaningrum L, Budiharta S, Flores AB, Setyawan AD. 2023. Ecotourism development as a community-based conservation effort in Ayah Mangrove Forest, Kebumen, Central Java, Indonesia. Asian J For 7: 37-44.* The mangrove ecosystem is a transition ecosystem between terrestrial and marine zones affected by tidal waves, water inundation, and high saline water and soil. Mangrove forest plays an important role in physical, ecological and socio-economic aspects. One potential function of mangrove forests from the socio-economic aspect is ecotourism. Ayah Mangrove Forest in Ayah Village, Kebumen District, Central Java Province, Indonesia, has the potential to be developed as a mangrove-based ecotourism area that combines the objective of income generation and mangrove conservation. This research was conducted to examine the conservation and ecotourism efforts by the people of Ayah Village and to assess the local community's perception of the development of mangrove-based ecotourism. The research was conducted in November 2022. Primary data were collected using field observation and interviews with 100 respondents aged 17-60 years using the snowball sampling method, while secondary data were collected using a literature review. The results showed that efforts to protect the Ayah Mangrove Forest area included establishing zones for protection, rehabilitation, and utilization of the mangrove forest. There are also mangrove rehabilitation efforts that involve the community in the form of the establishment of nurseries, mangrove planting, and maintenance of planted seedlings. The local community also carry out garbage cleaning program and public outreach. Besides the conservation aspect, Ayah Mangrove Forest is also utilized for ecotourism objects that generate income for the local community by selling tickets, boats, foods, beverages and souvenirs, tour guides, and parking attendants. Most of the local community has good perceptions and agreed on the development of Ayah Mangrove Forest as an ecotourism area. They are willing to be involved in ecotourism planning and development activities. The community agreed to participate in tour guide activities, selling souvenirs, providing homestays, and participating in ecotourism counseling. Most of the local community has also agreed to form a mangrove conservation community to maintain the sustainability of mangrove forest ecotourism. Nonetheless, support from the government is required, especially in the promotion and rehabilitation programs in the ecotourism development of Ayah Mangrove Forest.

Keywords: Ayah Mangrove, conservation, ecotourism, forest, Kebumen

INTRODUCTION

The mangrove ecosystem is located in the transition zone between terrestrial and marine zones, which is affected by intertidal waves, brackish water, riverine system, and high saline water and soils (Martuti et al. 2018). These unique environmental conditions give the mangrove ecosystem a high level of biodiversity in the form of flora and fauna. Mangrove forest refers to vegetation in the mangrove ecosystem that is tolerant to regular inundation of seawater and sea tides. Plant species that can grow in mangrove forests are generally very limited because the water is brackish, a mixture of seawater and freshwater, making it difficult for other plants to adapt to this area. Mangrove vegetation can be found on estuaries, coral beaches, inland coral reefs with thin sand, or alluvial soil types. Mangrove forest is recognized as the most productive ecosystem and has various functions for the environment and the surrounding community (Sari et al. 2018).

Mangrove forest plays many physical, ecological and socio-economic functions. In the physical aspect, mangrove

forests act as barriers to soil erosion, beach abrasion, strong waves and winds, storms, and even tsunamis (Saenger 2002). Ecologically, mangrove forest is the habitat of various fauna as a place to find food (feeding grounds), breeding and spawning grounds of aquatic biotas, such as fishes, crustaceans, and mollusks (Putriningtias et al. 2019; Irwansyah et al. 2021; Wiraatmaja et al. 2022). Also, it is the important habitat of many species of mammals, birds, amphibians, and reptiles. Meanwhile, mangrove forest delivers numerous socio-economic benefits for the surrounding communities, including the sources of timber for building materials, firewood and charcoal, paper, dyes, and so on. Furthermore, with the increasing issue of climate change, more recent studies have revealed that mangrove forest is among the largest carbon sink in the world compared to other ecosystem types, including tropical lowland forest (Dinilhuda et al. 2018; Ely et al. 2021). Nowadays, mangrove forest is also gaining popularity to be developed as an ecotourism object promoted as a win-win solution of mangrove management that integrates conservation and economic objectives.

Ayah Mangrove Forest is located in Ayah Village, Kebumen District, Central Java Province, Indonesia. This mangrove forest is close to the popular Logending Beach, giving Ayah Mangrove Forest the potential to be developed as an ecotourism attraction. A previous study documented various species in Ayah Mangrove Forest, including *Rhizophora mucronata*, *Sonneratia caseolaris*, *Avicenna marina*, *Rhizophora apiculata*, *Acanthus ebracteatus*, *Acrostichum aureum*, *Bruguilera gymnorrhiza*, and *Nypa fruticans* (Murniasih et al. 2022). Among such species, *R. mucronata* dominated the vegetation community due to its rapid regeneration, giving the species a large forest cover which is essential in protecting the coastal area in Ayah Beach. Furthermore, the large coverage of mangrove forests in Ayah Beach also creates a natural beauty with stunning views and a pleasant environment which is a good aspect of developing ecotourism.

Currently, Ayah Mangrove Forest is managed as a mangrove conservation area for disaster mitigation and as a tourism object. Nonetheless, the management carried out by the community focuses on mangrove conservation which is overshadowed by the large contribution of the local community group (i.e., KTH Pansela) and financial support through CSR schemes from various companies. The community group created a management body in the form of BumDes (village business unit) to optimize the ecological and economic benefits of Ayah Mangrove Forest. Ecologically, the community gets indirect benefits such as carbon sinks, oxygen suppliers, and disaster mitigation from abrasion to waves and tsunamis. Economically, the community gets a direct impact from ecotourism through the creation of economic opportunities to support tourism activities such as selling food for souvenirs and providing lodging to tour guides. The economic activities generated from the tourism sector in Ayah Mangrove Forest play an important role in driving the economy in Ayah Village. Therefore, this research was conducted to examine the conservation and ecotourism efforts by the people of Ayah Village and to assess the local community's perception of the development of mangrove-based ecotourism.

MATERIALS AND METHODS

Study period and area

The research was conducted in November 2022 in the Ayah Mangrove Forest area, which is located in Ayah Village, Ayah Sub-district, Kebumen District, Central Java, Indonesia (Figure 1). The Ayah Mangrove Forest has an extent of 18.5 hectares. Ayah Mangrove Forest is divided into five zones: protection, utilization, plant collection, rehabilitation, and special use.

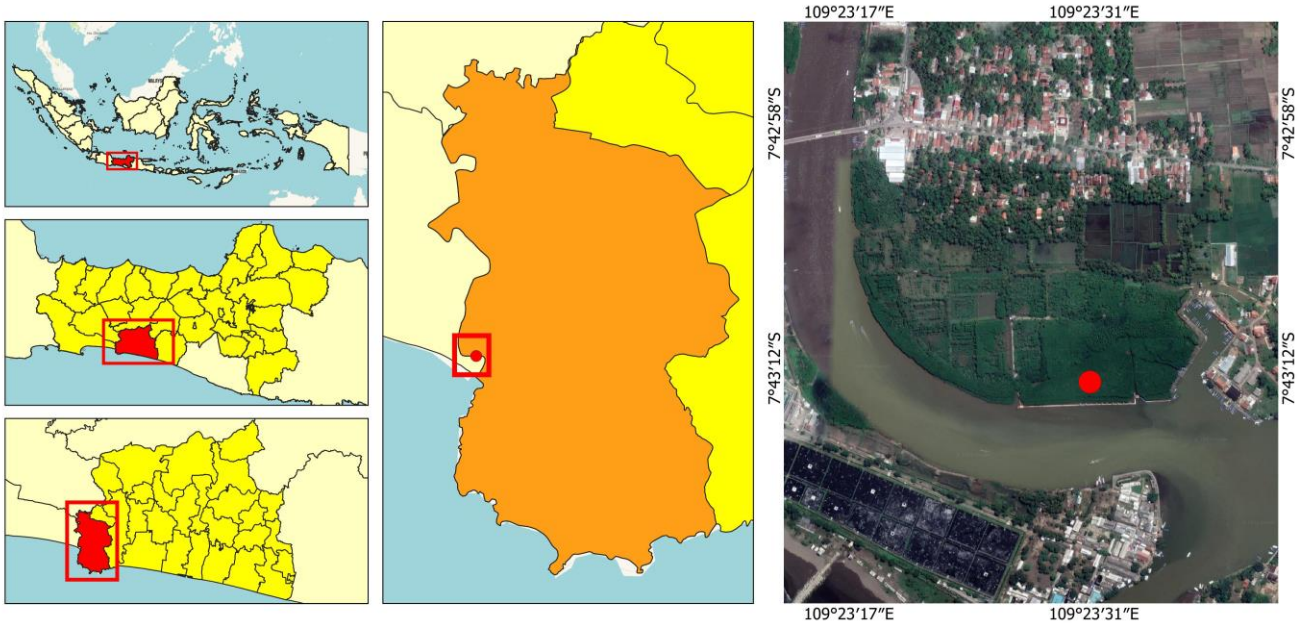

Figure 1. Map of study location in Ayah Mangrove Forest, Ayah Village, Ayah Sub-district, Kebumen District, Central Java, Indonesia

Data collection procedure

This study used primary and secondary data. The primary data were collected using field surveys, interviews, questionnaires, and documentation. Direct observations were carried out during the field survey to determine the actual conditions in the surrounding environment around the Ayah Mangrove Forest area. The interviews aimed at obtaining opinions and perceptions through dialogue and asking questions about the conditions of the research location (Katz-Buonincontro and Anderson 2018). The interviews were conducted using the snowball sampling technique. The target of the interview was the Ayah Mangrove Forest manager as the key informant. The questionnaires were distributed to 100 respondents consisting of residents and tourists who visited Ayah Mangrove Forest aged 17 years and above. Secondary data were collected from literature studies to complement the primary data to be analyzed.

Data analysis

The data were analyzed using an inductive qualitative approach with a descriptive method because it requires an explanation through investigation and direct responses to be able to describe the actual situation and what happened on the ground. The inductive approach was conducted by analyzing the data obtained, then specific relationships were developed to generate hypotheses or theories (Fitrah and Luthfiyah 2018). The community's perceptions included participation, ecotourism community, government intervention, the economic impact of ecotourism, visitors' influence on the environment, and the desire for sustainable ecotourism development. The results of public perceptions were analyzed using the scoring method. The obtained data were analyzed descriptively to relate it with the aspect of conservation, utilization, and community perceptions of the Ayah Mangrove Forest.

RESULTS AND DISCUSSION

Conservation and preservation of Ayah Mangrove Forest

Mangrove conservation includes all efforts to protect various natural resources contained in the mangrove ecosystem, including flora, fauna, water, and soil. The conservation of mangroves would not only benefit the natural resources contained but also could support coastal protection in, which it could prevent 70% risk of beach abrasion (Maulidia et al. 2022). Local-level policies are developed to protect mangrove ecosystems, including Ayah Mangrove Forest. For example, at the district level, the Forestry and Plantation Office of Kebumen District has enacted regulations to prevent disturbances to a mangrove forest and develop a particular zoning system. Some regulations prohibit visitors from bringing flammable items or those that can damage and cause disturbances to the mangrove ecosystem.

In 2008, the district office also legalized the community group, namely *Kelompok Tani Hutan Pantai Selatan* (KTH Pansela; South Coast Forest Farmers Group), as the management body of the mangrove conservation area as the fundamental basis so that conservation would not be interrupted. Further, the district government also provided capacity building through various training and extension programs to improve the management of Ayah Mangrove Forest.

According to Rahmayani (2015), protecting mangrove ecosystems has benefits, including: (i) protecting ecological processes and preserving biodiversity, (ii) supporting research and development activities, (iii) mechanisms for financial and ecotourism management. Some efforts to protect Ayah Mangrove Forest have been implemented by forming zones to facilitate monitoring. For example, based on Table 1, Ayah Mangrove Forest is divided into several zones, one of which is a protection zone that may not be used for any extractive and production activities. Based on interviews with managers and observations at the Ayah Mangrove Forest, the total protection zone is 5.90 Ha or 32%.

Management of mangrove areas is essential to maintain the stability of coastal ecosystems that are useful and sustainable. Community involvement in the development and management of mangrove forest ecosystems could be a strategic and appropriate step by developing community-based management of mangrove ecosystems while at the same time raising public awareness of the importance of protecting natural resources for human lives today and future generations (Amdani 2022). Poor mangrove management will have an impact on the existence of mangroves themselves. For example, untreated garbage in the mangrove area can disturb the pneumatophores of mangrove roots, affecting the breathing process, which can lead to mangrove death (Ruhama et al. 2018).

The preservation of mangrove forest resources is critical for the long-term viability of coastal and marine ecosystems. The existence of mangrove forests also plays an important role in preventing disasters from tidal waves. Unfortunately, as time goes by, more and more people are irresponsible and deliberately damage the existence of mangrove forests, affecting the existence of mangrove forests.

Table 1. Zonation in Ayah Mangrove Forest, Kebumen, Central Java, Indonesia

Zone	Extent (Ha)	Percentage
Protection	5.90	32%
Utilization	6.40	35%
Plant collection	4.40	24%
Rehabilitation	1.30	7%
Special use	0.50	3%
Total	18.50	100%

Therefore, preserving the resources in the mangrove forest is necessary to avoid a much bigger impact. There are several efforts to preserve mangrove forests that can be carried out, including: (i) establishing a nursery to produce mangrove seedlings; (ii) planting mature seedlings in degraded areas; (iii) maintaining the planted seedling to grow and increase the forest cover; (iv) carrying out environmental improvements around the mangrove forest; (v) carrying out spatial management by segmenting the protection area (including rehabilitation zone) and utilization area (including ecotourism); (vi) providing public awareness and education about the importance of mangrove forests for human life and how to preserve them.

Mangrove forest conservation implemented in the Ayah Mangrove Forest area is carried out through reforestation, enrichment planting, and environmental rehabilitation around the coast, which KTH Pansela mainly conducts. In addition, this organization encourages the community's participation in mangrove conservation through public outreach and involvement. Several programs developed by this organization in mangrove conservation include conducting seedlings production, planting mangroves, maintaining mangroves vegetation, tourism, outreach, and outdoor studies. Some of the mangrove seedlings planted by the KTH Pansela were obtained from their nurseries, and some were bought from outside. Mangrove seedlings are also obtained from the Forestry Service of Central Java Province. The mangrove planting is divided into two stages, the intensive stage is carried out in the first six months after planting, followed by routine maintenance for two years, and regular maintenance and monitoring after two years.

According to research by Yuliani et al. (2018), besides the mangrove reforestation, the KTH Pansela has also made several efforts related to mangrove conservation, including: (i) Protection of life support systems. This effort is based on the regulations enacted by the Kebumen District Forest Management Office in the mangrove ecosystem area of Ayah Village. (ii) Conservation of flora and fauna. This effort is carried out by facilitating the mangrove area with trash cans so visitors do not litter in the mangrove area and imposing a ban on the construction of permanent buildings in the mangrove forest area. (iii) Sustainable utilization of the mangrove ecosystem. This is done by establishing fishing businesses such as shell crabs and shrimp in mangrove habitats and developing mangrove areas as educational tourism destinations.

Utilization of Ayah Mangrove Forest

Mangrove forest provides various ecosystem goods and services. Mangrove plants have strong roots, so they can act as a barrier from waves, winds, abrasion and tsunamis, retain mud and trap sediment transported by water, and neutralize water pollution from heavy metals to certain limits (Zakiyah et al. 2020). Mangrove forests also maintain the balance of ecosystems and biodiversity in coastal areas. Mangrove ecosystems serve as spawning and nursery ground, feeding grounds for marine organisms, such as fish, shrimp, crabs, clams, snails, and other animals (Rahmila and Halim 2018). In addition, mangrove forests are habitats for several wild animals, such as monkeys, snakes, otters, monitor lizards, and birds (Ali et al. 2020). Economically, the goods generated from mangrove forests can be used by the community as food ingredients and fuel wood to improve the surrounding community's economic conditions (Afonso et al. 2022). In addition, fishermen and farmers on the coast depend on natural resources from mangrove forests as a source of livelihood and sustenance for the community. Communities obtain marine products such as fish, shrimp, crabs, clams, snails, and other types of animals (Ismail et al. 2018). Mangrove forests can also be developed as an ecotourism attraction. Tourism activities in mangrove forest areas could impact the surrounding community's economy by providing jobs and business opportunities (Razak et al. 2018).

In Ayah Mangrove Forest, communities obtain economic benefits from fishing and farming activities conducted around the mangrove area. The local people create ponds for fish farming around the mangrove forest since it can maintain water salinity and regulate tides (Ahmed et al. 2017). From fishing activities, the community obtains various marine products such as mullet, tilapia, milkfish, white snapper, clam shells, full-blooded clams, crabs, and snails that they get in the Ayah Mangrove Forest area and are sold to fish auctions located not far from this area (Figure 2).

Figure 2. Fishermen collecting marine products around the Ayah Mangrove Forest area, Kebumen, Central Java, Indonesia

Besides the marine products, the economic benefits are also derived from wood products of mangroves forest, such as firewood for self-use or sale. Some residents take sap from the nipa plant (*Nypa fruticans*), a raw material for brown sugar, alcohol, vinegar, sweets, and syrup (Figure 3). To collect the sap in the nipa plant, the community traditionally uses a container made of bamboo or a plastic bottle placed under the nipa bunch. The community sells nipa sugar for IDR 16,000 per kilogram. Some people use mangrove leaves and stem as natural dyes for fabrics. Mangrove plants contain many tannins and natural brown dyes (Pringgenies et al. 2018). The local community has also utilized mangrove plants for traditional medicinal purposes, but it is only used by the community and is not produced commercially. For example, the local community has widely used extracts and raw materials from mangroves to cure ulcers and smallpox.

Ayah Mangrove Forest is also developed as an ecotourism area since it has the advantage of being close distance to the popular Logending Beach. The utilization of mangrove forests as ecotourism is in line with the shifting in the tourist industry from old tourism to new tourism, which emphasizes natural ecotourism destinations with elements of education and conservation (Murtini et al. 2018). Many facilities and utilities are provided in Ayah Mangrove Forest, such as boats that can be rented to explore the area (Figure 4). Also, there are bamboo bridge facilities to facilitate tourists' mobility in enjoying the mangrove forest. The ecotourism development in Ayah Mangrove Forest aims to improve the local people's economy by creating jobs and business opportunities around the area. They can set up shops, stalls, restaurants, transportation, and other activities around the Ayah Mangrove Forest ecotourism area.

Community perceptions of ecotourism development

Developing an area for ecotourism can be conducted through many strategies, such as involving the surrounding community in tourism activities (Hidayat 2016). The community perceptions of ecotourism development in this study were obtained from interviews with 100 respondents, with the results are presented in Table 2. The interviews consisted of several aspects, including participation in ecotourism development, responses to ecotourism groups, government intervention, the economic impacts of ecotourism, the impact of visitors on the environment, and the desire to develop ecotourism sustainably. The respondents had age of more than 16 years old, with the majority being over 35 years old or in the adult category, suggesting that the decision-making is more mature (Putra et al. 2018). The majority of the respondents were sellers, fishermen, and homemakers. Other jobs included pond labor, parking staff, self-employed, private employees, etc.

Figure 3. Utilization of nipa plant (*Nypa fruticans*) for its sap to be processed for various food products in the Ayah Mangrove Forest, Kebumen, Central Java, Indonesia

Figure 4. Utilities and facilities in Ayah Mangrove Forest in the form of boats and bridges

When developing an ecotourism area, it is important to provide opportunities for the local community to participate in all aspects, including planning, development, and management (Tiga et al. 2019). Community perceptions can indicate community participation in developing ecotourism. There were five questions to represent community participation in the development of ecotourism, namely planning activities, tour guide activities, selling souvenirs, providing homestays, and counseling about ecotourism. The interview result showed that the community's perception of participating in developing ecotourism in Ayah Mangrove Forest was very high, with around 97% of the respondents agreeing to participate. The community hoped there would be education and coaching activities to drive the community's economic activities. These include training and involvement in ecotourism concepts, creating small businesses, tour guides, and accommodation management. Community empowerment can also be conducted by providing credit so they can start businesses such as souvenir shops, food stalls, boat rentals, etc. However, several respondents did not agree to provide homestays around the mangrove forest because there is no proper infrastructure. Moreover, according to them, the ecotourism in Ayah Mangrove Forest does not need homestays because visitors rarely spend a long time there.

The local community manages Ayah Mangrove Forest ecotourism under the group of KTH Pansela. The management of Ayah Mangrove Forest is considered well-organized. Some efforts made by the management body to protect the mangrove ecosystem include monitoring activities, planting mangroves, installing signage boards, and establishing protection zone. The Ayah Mangrove Forest is divided into a zoning system to maintain the mangrove forest area. The community is very supportive of those activities carried out by the manager, however only about 57% of the respondents were willing to participate in ecotourism management because they are already tied up with daily work.

The respondents perceived that Ayah mangrove ecotourism needs intervention from the government to support the development of the area, for example, by promoting Ayah Mangrove Forest so that many visitors come to enjoy the beauty of the ecotourism area. In addition, government intervention is required in the form of the provision of mangrove seedlings and conducting socialization.

However, most respondents agreed that the government's involvement is only partial since they perceived the main actor of ecotourism in Ayah Mangrove Forest as the local community. The government, along with the private sector, NGOs, and the community, have an important role in developing ecotourism, including mangrove-based ecotourism in Ayah Village. Mangrove ecosystems will be well-maintained if all stakeholders are involved (Handayani and Suruwaky 2020).

Ecotourism can support the local community's economy so they can live prosperously. Ecotourism is hoped to generate economic benefits for the surrounding community in the form of a source of income from ecotourism activities, such as selling food and drinks, being a parking attendant, and renting boats. About 56% of the respondents agreed that Ayah mangrove ecotourism could improve the economy in the area. However, about 71% of the respondents agreed that the economic benefits are only for some people.

Table 2. The community's perception on ecotourism development in the Ayah Mangrove Forest, Kebumen, Central Java, Indonesia

Aspect	Agree	Less agree	Not agree
Participation in ecotourism development			
Planning activities	97	3	0
Tour guide activities	92	3	5
Selling souvenirs	91	3	6
Providing homestays	84	10	6
Counseling about ecotourism	96	3	1
Community response to ecotourism groups			
Group formation	97	3	0
Willingness to join the group	57	18	25
Government intervention in Ayah mangrove ecotourism			
Partial intervention	77	19	4
Full intervention	20	32	48
Economic benefits of ecotourism			
Economic benefits for the whole community in Ayah Village	56	37	7
Economic benefits only for some participants	71	17	12
Environmental impacts of ecotourism			
Garbage in the mangrove forest area	38	5	57
Garbage in the village	35	5	60
Destruction of mangrove trees	2	6	92
Destruction of ecotourism facilities	1	6	93
The desire to develop sustainable mangrove ecotourism	96	2	2

The development of Ayah Mangrove Forest as an ecotourism object will likely impact the environment. In particular, the behavior of visitors who litter and destroy trees and existing facilities can endanger the sustainability of ecotourism. Indiscriminate waste disposal will cause water and soil pollution and cause plants to be unable to live properly. The most common waste in mangrove ecotourism is all kinds of plastic. The same condition was also reported in research in the Mangrove ecosystem area of Lesah Village (Loliwu et al. 2021). The types of marine debris found at the study site were plastic, rubber, metal, and glass waste, with plastic being the most dominant type of waste. The solutions that can be taken to reduce this impact include limiting the number of visitors, monitoring, encouraging visitors not to litter, and installing signage boards.

Most respondents agreed on the sustainability of ecotourism development in Ayah Mangrove Forest. They attributed this as an opportunity to improve the economy of the Ayah Village. In addition, managing the mangrove forest as an ecotourism object can also maintain, protect and rehabilitate the function of mangroves. Ayah Village has KTH Pansela, which promotes mangrove forest conservation and encourages community participation in protecting and conserving mangrove forests. This organization has several mangrove conservation programs, including seedlings provision, mangrove planting and maintenance, ecotourism management, public outreach, and field studies.

In conclusion, Ayah Mangrove Forest has the potential to be developed as one of the ecotourism objects in the Kebumen District, Central Java, Indonesia. There have been several conservation, protection, and utilization efforts in Ayah Mangrove Forest, and mangrove-based ecotourism can be aligned with conservation programs. Most of the local community has good perceptions and agreed on the development of Ayah Mangrove Forest as an ecotourism area. They are willing to be involved in ecotourism planning and development activities. The community agreed to participate in tour guide activities, selling souvenirs, providing homestays, and participating in ecotourism counseling. Most of the local community has also agreed to form a mangrove conservation community to maintain the sustainability of mangrove forest ecotourism. Nonetheless, support from the government is required, especially in the promotion and rehabilitation programs in the ecotourism development of Ayah Mangrove Forest.

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REFERENCES

Afonso F, Felix PM, Chainho P, Heumuller JA, de Lima RF, Ribeiro F, Brito AC. 2022. Community perception about mangrove ecosystem services and threats. Reg Stud Mar Sci 49: 1-14. DOI: 10.1016/j.rsma.2021.102114.

Ahmed N, Cheung WWL, Thompson S, Glaser M. 2017. Solutions to blue carbon emissions shrimp cultivation mangrove deforestation and climate change in coastal Bangladesh. Mar Policy 82: 68-75. DOI: 10.1016/j.marpol.2017.05.007.

Ali M, Sulistiono, Imran Z, Simanjuntak CPH. 2020. The potential development of ecotourism base on mangrove ecosystem in Ujung Pangkah of Gresik District East Java Province Indonesia. IOP Conf Ser Earth Environ Sci 800: 1-15. DOI: 10.1088/1755-1315/800/1/012054.

Amdani A. 2022. Sistem pengelolaan Mangrove Information Center (MIC) di Desa Wonorejo Surabaya. Jurnal Riset Perikanan dan Kelautan 4 (1): 435-445. DOI: 10.15578/jbf.v1i2.15. [Indonesian]

Dinilhuda A, Akbar AA, Jumiati. 2018. Peran ekosistem mangrove bagi mitigasi pemanasan global. Jurnal Teknik Sipil 18 (2): 1-8. DOI: 10.26418/jtsft.v18i2.31233. [Indonesian]

Ely AJ, Tuhumena L, Sopaheluwakan J, Pattinaja Y. 2021. Strategi pengelolaan ekosistem hutan mangrove di Negeri Amahai. Jurnal Triton 17 (1): 57-67. DOI: 10.30598/TRITONvol17issue1page57-67. [Indonesian]

Fitrah M, Luthfiyah. 2018. Metodologi Penelitian: Penelitian Kualitatif, Tindakan Kelas & Studi Kasus. CV Jejak, Malang. [Indonesian]

Handayani M, Suruwaky AM. 2020. Persepsi dan partisipasi masyarakat terhadap ekosistem mangrove di Distrik Sorong Timur, Kota Sorong Provinsi Papua Barat. Jurnal Airaha 9 (1): 58-62. DOI: 10.15578/ja.v9i01.162. [Indonesian]

Hidayat S. 2016. Strategi pengembangan ekowisata di Desa Kinarum Kabupaten Tabalong. Jurnal Hutan Tropis 4 (3): 282-292. [Indonesian]

Irwansyah RM, Azzahra SIN, Darmastuti SA, Ramadhandi AR, Firdaus O, Daeni F, Safitri N, Fajri OPA, Nugroho GN, Naim DM, Setyawan AD. 2021. Crab diversity and crab potential as support ecotourism in Teleng Ria, Grindulu and Siwil Beach, Pacitan, East Java, Indonesia. Intl J Bonorowo Wetlands 11: 75-83. DOI: 10.13057/bonorowo/w110204.

Ismail, Sulistiono, Hariyadi S, Madduppa H. 2018. Condition and mangrove density in Segara Anakan Cilacap District Central Java Province Indonesia. Jurnal Akademik. 11 (4): 1055-1068. [Indonesian]

Katz-Buonincontro J, Anderson RC. 2018. A review of articles using observation methods to study creativity in education. J Creat Behav 54: 1-17. DOI: 10.1002/jocb.385.

Loliwu SJ, Rumampuk NDC, Schaduw JNW, Tilaar SO, Lumoindong F, Wagey BT, Rondonuwu AB. 2021. Identifikasi sampah anorganik pada ekosistem mangrove di Desa Lesah Kecamatan Tagulandang Kabupaten Sitaro. Jurnal Pesisir dan Laut Tropis 9 (2): 44-52. DOI: 10.35800/jplt.9.2.2021.34852. [Indonesian]

Martuti NKT, Susilowati SME, Sidiq WABN, Mutiatari DP. 2018. Peran kelompok masyarakat dalam rehabilitasi ekosistem mangrove di Pesisir Kota Semarang. Jurnal Wilayah dan Lingkungan 6 (2): 100-114. DOI: 10.14710/jwl.6.2.100-114. [Indonesian]

Maulidia V, Akbar AA, Jumiati, Arifin, Sulastri A. 2022. The value of mangrove ecosystems based on mangrove carbon sequestration in West Kalimantan. J Wetlands Environ Manag 10 (1): 12-26. DOI: 10.20527/jwem.v10i1.279.

Murniasih S, Hendarto E, Hilmi E. 2022. The mangrove density, diversity, and environmental factors as important variables to support the conservation program of essential ecosystem area in Muara Kali Ijo, Pantai Ayah, Kebumen. Jurnal Sylva Lestari 10 (3): 400-416, DOI: 10.23960/jsl.v10i3.596.

Murtini S, Kuspriyanto, Kurniawati A. 2018. Mangrove area development strategy Wonorejo as ecotourism in Surabaya. 2018. J Physis Conf Ser 953: 1-5. DOI: 10.1088/1742-6596/953/1/012174.

Pringgenies D, Widiyadmi R, Ariyanto D, Idris R, Djunaedi A. 2018. Bakteri konsorsium dari serasah mangrove untuk produksi kompos. Jurnal Pengelolaan Perairan 1 (2): 19-26. DOI: 10.33019/jour.trop.mar.sci.v1i1.657. [Indonesian]

Putra P, Rosalinda E, Latifah S. 2018. Persepsi masyarakat terhadap Air Terjun Rombo Panga'a di Desa Antan Raya Dusun Sungai Durian Kabupaten Landak sebagai destinasi wisata. Jurnal Hutan Lestari 6 (4): 875-882. [Indonesian]

Putriningtias A, Faisal TM, Komariyah S, Bahri S, Akbar H. 2019. Keanekaragaman jenis kepiting di Ekosistem Hutan Mangrove Kuala Langsa, Kota Langsa, Aceh. Jurnal Biologi Tropis 19 (1): 101-107. DOI: 10.29303/jbt.v19i1.1074. [Indonesian]

Rahmayani H. 2015. Ekowisata mangrove sebagai kawasan perlindungan sumberdaya alam dan nilai budaya di Bandar Bakau Kota Dumai. Jom FISIP 2 (1): 1-11. [Indonesian]

Rahmila YI, Halim MAR. 2018. Mangrove forest development determined for ecotourism in Mangunharjo Village Semarang. Icenis J 73 (5): 1-5. DOI: 10.1051/e3sconf/20187304010.

Razak NA, Afandi SHM, Shuib A, Ghani ANA. 2018. Visitors travelling time cost for ecotourism at Matang Mangrove Forest Reserve. Intl J Bus Soc 19: 117-127.

Ruhama D, Sugito R, Atmaja THW. 2018. Sampah anorganik sebagai ancaman di Kawasan Ekosisistem Hutan Manggrove Kuala Langsa. Jurnal Jeumpa 5 (2): 84-90. [Indonesian]

Saenger P. 2002. Mangrove Ecology, Silviculture and Conservation. Kluwer Academic Publishers, London. DOI: 10.1007/978-94-015-9962-7.

Sari YP, Salampessy ML, Lidiawati I. 2018. Persepsi masyarakat pesisir dalam pengelolaan ekosistem hutan mangrove di Muara Gembong Bekasi Jawa Barat. Jurnal Perennial 14 (2): 78-85. ICENIS 5 (73): 1-5. DOI: 10.24259/perennial.v14i2.5303. [Indonesian]

Tiga MRM, Putri EIK, Ekayani M. 2019. Persepsi masyarakat Desa Katikuwai dan Desa Praing Kareha terhadap pengembangan ekowisata di Taman Nasional Matawala, NTT. Sodality: Jurnal Sosiologi Pedesaan 7 (1): 34-40. DOI: 10.22500/sodality.v7i1.22866. [Indonesian]

Wiraatmaja MF, Hasanah R, Dwirani NM, Pratiwi AS, Riani FE, Hasnaningtyas S, Nugroho GD, Setyawan AD. 2022. Structure and composition molluscs (bivalves and gastropods) in mangrove ecosystem of Pacitan District, East Java, Indonesia. Intl J Bonorowo Wetlands 12: 1-11. DOI: 10.13057/bonorowo/w120101.

Yuliani E, Liesnoor D, Aji A. 2018. Pelaksanaan pendidikan konservasi untuk pelestarian hutam mangrove pada Kelompok Peduli Lingkungan Pantai Selatan (KPL PANSELA) Desa Ayah Tahun 2016. Educ Geogr 6 (1): 8-15. [Indonesian]

Zakiyah U, Ramadhanti M, Parwati E. 2020. Analisys of changes in mangrove area and sedimentation on the Indah Kapuk Beach using remote sensing data. J Environ Eng Sustain Tech 7 (2): 1-17.