

Analysis of local community ecological knowledge on mangrove ecotourism development in Donggala Regency, Central Sulawesi, Indonesia

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Abstract

The mangrove area in Donggala Regency is a unique and potential area, but the area tends to be threatened by increasing mining activities in the area. Management of the mangrove area in Donggala Regency as an ecotourism area is an alternative form as an innovative effort to maintain environmental functions as a provider of environmental services in order to remain sustainable. This study was aimed at analyzing the Local Community Ecological Knowledge (LCEK) pertaining to mangrove ecosystems and ecotourism development in Donggala Regency. The study used a survey method, utilizing the analysis of the tourism suitability index (IKW) and the carrying capacity of the area (DDK). Community knowledge and perceptions were based on a Likert scale scoring system. The results of the study and the discussion showed that people in Donggala Regency had local ecological knowledge of mangrove forests, especially mangrove habitats, mangrove damage factors and the impact of mangrove damage was better than the function of mangroves. Utilization of mangrove ecosystems in Donggala Regency is very diverse, ranging from the utilization of mangrove stems, fruits, leaves and roots and fishery products such as small fish and shellfish. The community's understanding of ecotourism activities was very good and they agreed with the ecotourism activities that were carried out.

Keywords: carrying capacity, mangrove ecotourism, suitability

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INTRODUCTION

Mangrove areas serve a variety of ecological and socioeconomic functions in addition to being physically functional (Titisari et al., 2022). Mangrove ecosystems play a crucial role in coastal biodiversity and ecosystem services, serving as vital habitats for various flora and fauna while providing essential services to local communities (Maulidah et al., 2024). Moreover, they are also conservation, educational area, and cultural identity (Aipassa et al., 2023). Spalding & Parrett (2019) stated that the importance of mangroves for cultural services, especially their use in recreation and tourism, has received little attention despite frequently being mentioned in reviews. Recognizing the significance of mangrove conservation and sustainable development, this research focuses on the Donggala Regency of Central Sulawesi, Indonesia, where mangrove ecotourism holds promise as a means of both conservation and economic development.

The interaction between local communities and mangrove ecosystems fosters a unique body of knowledge known as Local Ecological Knowledge (LEK) (Susiloningtyas et al., 2017; Longépée et al., 2021). LEK can be an important source of information for conservation and management (Brook & McLachlan, 2008). LEK encompasses traditional practices, beliefs, and understanding accumulated over generations, offering valuable insights into sustainable resource management. In the context of ecotourism development, understanding and integrating LEK can enhance conservation efforts, promote community engagement, and foster ecotourism practices that are both environmentally and socially sustainable (Fabanzo et al., 2024).

This study aimed to analyze the Local Community Ecological Knowledge (LCEK) about mangrove ecosystems and ecotourism development in Donggala Regency. By engaging with local communities, this research seeks to document traditional ecological knowledge, perceptions, practices, and attitudes towards mangrove conservation and ecotourism. Through qualitative and participatory approaches such as interviews, focus group discussions, and participatory mapping, this research endeavors to elucidate the intricate relationships between local communities, mangrove ecosystems, and ecotourism development (Carrasquilla-Henao et al., 2019).

The findings of this research were expected to contribute to the discourse on sustainable mangrove management and ecotourism development, offering practical insights for policymakers, conservationists, and local communities alike. By integrating LCEK into mangrove ecotourism planning and management, this study aspires to foster a synergistic relationship between conservation goals and community livelihoods, thereby promoting the long-term sustainability of mangrove ecosystems in Donggala Regency and beyond.

METHODS

This research was conducted from September to October 2023 in Donggala Regency, Central Sulawesi. Determination of the sample in this study using the purposive sampling method because the respondents who participated were deliberately selected by the researcher according to the criteria of the research respondents (50 respondents). This study used two types of data, namely primary data and secondary data. Rathnayake et al. (2024) stated that primary data is obtained directly in the field by the person conducting the research. Primary data is obtained from informant sources from observations and interviews conducted by researchers. Furthermore, conducting interviews related to the ecological knowledge of local communities related to how people perceive the value of the benefits and functions of mangrove ecosystems and conservation-oriented ecotourism activities. At the same time, secondary data is supporting data from primary data. Secondary data is obtained from various sources such as journals, research reports, and annual reports of related agencies that are considered relevant to the problem under study (Sabai & Sisitka, 2013).

Community knowledge and perceptions were based on a Likert scale scoring system. The data that had been collected through the questionnaire is converted into quantitative form, namely by calculating the answer score of the statement that has been answered by the respondent so that the scoring is based on provisions in Table 1.

Table 1. Likert Scale Questionnaire Answers

Assessment score	Category
3	Strongly Know/Agree
2	Know/Agree
1	Do not know/Agree

The data obtained from the results of the questionnaire with the Likert scale assessment was then tabulated by calculating the number of scores obtained. Akdan & Ridwan (2013) stated that the Likert Scale assessment is used to measure the knowledge of attitudes and perceptions of a person or group about social events or symptoms. After the number of scores was obtained, then analyzed the data to conclude. The calculation technique used percentage statistics.

$$P = \frac{F}{N} \times 100 \% \quad (1)$$

Description:

P = Percentage (%)

F = Number of Respondent Scores

N = Number of Answer Scores t

Furthermore, it is adjusted to the categorization standard to find out how high a person's understanding is. Arikunto (1993) suggests that a person's level of understanding and attitude can be measured by the criteria in Table 2.

Table 2. Percentage descriptive analysis criteria

Percentage	Category
81.25%–100%	Very Good
62.41%–81.24%	Good
43.75%–62.40%	Less Good
25%–43.74%	Not Good

The variable value is known by using descriptive statistical analysis, namely the percentage dividing the average value of each sub-variable by the ideal score and multiplied by 100% to get a percentage value. Then, the value was interpreted in the form of a flyer diagram. Furthermore, if there is one relatively low value of the variable, it is continued with multiple linear regression analysis and t-test. It is suspected that there is an influence between one or more variables, X and Y. The purpose of using multiple linear regression analysis was to determine how much influence one or more independent variables have on one dependent variable.

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + \dots + b_nX_n + e$$

Description:

Y = Community perception

b₀ = Confounding variable (intercept)

b_i = Regression coefficient

X_i = Coefficient of mangrove function as a protective coastal area

X₂ = Coefficient of local community support willingness

X₃ = Coefficient of local community role

X₄ = Coefficient of regional management form

X₅ = Coefficient of distribution of results

X₆ = Coefficient of village / regional government role

n Number of variables used

e = Error

RESULTS AND DISCUSSION

Community perceptions related to the utilization of mangrove forest ecosystems

Embedded within the fabric of local cultures, mangrove forests often hold profound spiritual, cultural, and historical significance. Indigenous communities and traditional societies may view mangroves as sacred sites or repositories of ancestral wisdom, influencing their perceptions of appropriate utilization practices (Buenavista & Purnobasuki, 2023). Traditional livelihood activities such as fishing, gathering of forest products, and artisanal crafts further reinforce the intricate relationship between culture and mangrove utilization, shaping community attitudes towards conservation and sustainable management (Aulia et al., 2020). For many coastal communities, mangrove ecosystems represent not only a source of cultural identity but also a lifeline for economic sustenance. Fishing, aquaculture, and collection of non-timber forest products provide vital livelihoods, driving perceptions of mangrove utilization through an economic lens. Community attitudes towards conservation and exploitation often pivot on the perceived trade-offs between short-term economic gains and long-term sustainability, reflecting the intricate interplay between livelihood security and environmental stewardship (Moore et al., 2022).

Community perceptions of mangrove utilization were deeply intertwined with ecological understanding and environmental concerns. Local knowledge systems may recognize the ecological functions and services provided by mangroves, shaping attitudes toward conservation practices (Kurnianto et al., 2017). Conversely, firsthand experiences of environmental degradation, including

habitat loss, pollution, and climate change impacts, can foster a sense of urgency and concern among communities, influencing support for sustainable management initiatives. Within the social landscape, power structures, governance systems, and resource access play pivotal roles in shaping community perceptions of mangrove utilization. Differential access to resources and decision-making processes can engender disparities in attitudes toward conservation and development, highlighting the need for inclusive and participatory approaches that empower marginalized voices and promote equitable outcomes (Nijamdeen et al., 2022).

In contexts where mangrove ecotourism is promoted as a means of economic development, community perceptions may vary widely. Some communities may embrace tourism opportunities as avenues for cultural exchange and economic diversification, while others may express concerns about potential negative impacts on traditional livelihoods, cultural heritage, and environmental degradation. Balancing the aspirations of tourism development with the preservation of cultural integrity and environmental sustainability becomes paramount in navigating these divergent perspectives (Satyanarayana et al., 2021).

Utilization of mangrove trunks

The results of interviews of mangrove wood trunks, usually used as firewood, by taking mangrove trees deliberately outside the knowledge of supervisors or taking dry twigs/branches that have fallen. Forms of the utilization of mangrove trunks, in addition to firewood, are also used as building materials and as medicines. Datagraphic one shows that 58% of respondents agreed to utilize mangrove trunks as firewood, building materials (poles), and medicines, while 3% person disagreed about the utilization of mangrove trunks and bark (Figure 1).

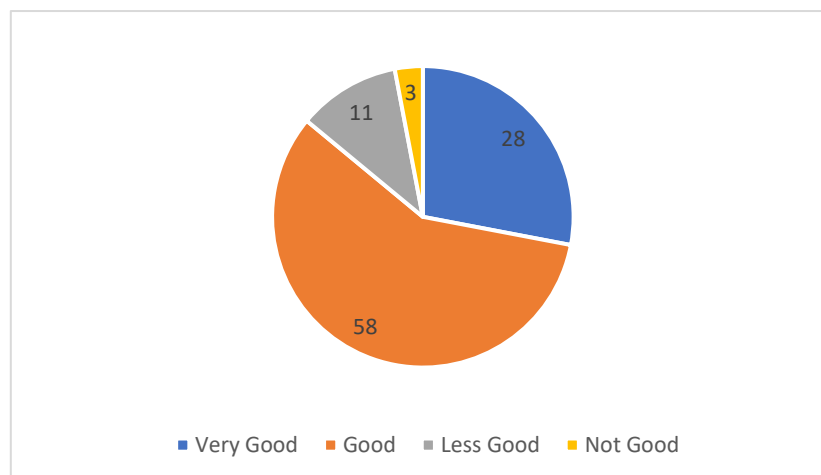


Figure 1. Utilization of mangrove stems as firewood, building materials, and medicine

These results showed that people in Donggala Regency believe that mangrove bark could be used as a natural (traditional) medicine, especially for women after childbirth, muscle pain, back pain, and itching. The type of mangrove used is *Sonneratia albadan* *Rhizophora stylosa* mangrove. Based on the results of research from Brown et al. (2018) it shows that the utilization of mangrove wood can be used as fuel and house building poles. While Ravaoarinorotsihoarana et al. (2023) added that *Rhizophora apiculata* stems bark extract contains bioactive compounds such as tannins, flavonoids, terpenoids, saponins, and steroids, which can provide various potential effects for health, such as antioxidants, anti-inflammatory, antimicrobial, antiseptic and accelerate wound healing.

The traditional medicines of mangrove ecosystems unveil a realm of healing steeped in nature's wisdom and cultural heritage (Az-Zahra et al., 2021). As custodians of this botanical legacy, coastal communities bear witness to the enduring symbiosis between humanity and mangroves, where each leaf, bark, and root harbors a story of resilience, adaptation, and healing. Yet, as we navigate the currents of modernity, let us not forget the importance of preserving these sanctuaries of traditional

medicine, safeguarding not only biodiversity but also the intangible heritage of healing that binds us to the coastal realms. In the embrace of mangrove forests lies a timeless reminder of nature's benevolence and the enduring power of traditional wisdom to heal both body and soul (Salampessy et al., 2021).

These various potential effects still require further research to make the materials used beneficial to health. The results of research by Kadaverugu et al. (2021) also show that mangrove bark can be used as a medicine for itching, restoring the stamina of mothers giving birth, muscle pain, lumbago, bone pain, and rheumatism. Furthermore, Salampessy et al. (2021) stated that mangroves used as medicinal materials for all regions are almost the same, coming from the fruit, leaves, bark, and roots of mangroves.

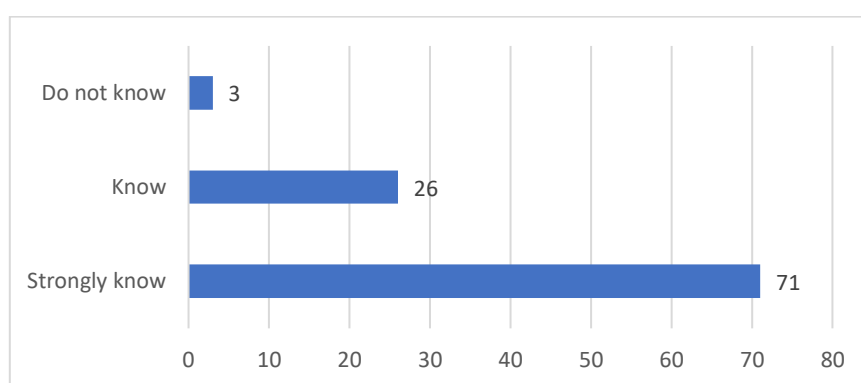


Figure 2. Distribution of mangrove stem utilization for daily needs

Data from Figure 2 shows that 71 of the respondents agreed to use mangroves as firewood, building poles, and medicines in their daily lives. While three disagree if mangrove stems and bark continue to be utilized in the daily lives of the people of Donggala Regency. The high value of utilization of mangrove stems, and skins creates a high chance of mangrove damage due to the utilization of mangrove stems and skins. This is in line with Ravaoarinorotsihoarana et al. (2023), one of the causes of mangrove damage is logging for wood utilization, development of aquaculture areas, reclamation, and housing.

Utilization of mangrove fruit, leaves, and roots

The fruits of mangrove trees, though often overlooked, are culinary delights rich in flavor and nutrition. From the succulent berries of *Avicennia marina* to the tart pods of *Rhizophora* spp., mangrove fruits offer a tantalizing array of tastes and textures. Historically, coastal communities have harvested mangrove fruits for consumption, either fresh or processed into jams, pickles, and sauces. Beyond their culinary appeal, mangrove fruits are nutritional powerhouses packed with vitamins, antioxidants, and essential minerals. As global interest in exotic fruits and functional foods grows, there is increasing recognition of the potential of mangrove fruits as novel ingredients in the culinary and health food industries (Kadaverugu et al., 2021).

Another form of utilization of mangrove trees was used as food and medicine from the fruit, leaves, and roots of mangrove trees. However, the results of the analysis of respondents stated that mangrove fruit cannot be eaten or processed into food. The questionnaire results showed the highest value was in the disagree option at 69 people (Figure 3). These results showed that most people have not utilized mangrove fruit, and some do not know the benefits of fruit from several types of mangroves that can be eaten or processed into food/food ingredients. These results were much different from the research of Salampessy et al. (2021), showing the fruit of *Avicennia alba*, *Avicennia lanata*, *Nypa fruticans*, and *Sonneratia caseolaris* can be consumed directly or boiled/burned with coconut consumed by the Inanwatan tribe in Sorong.

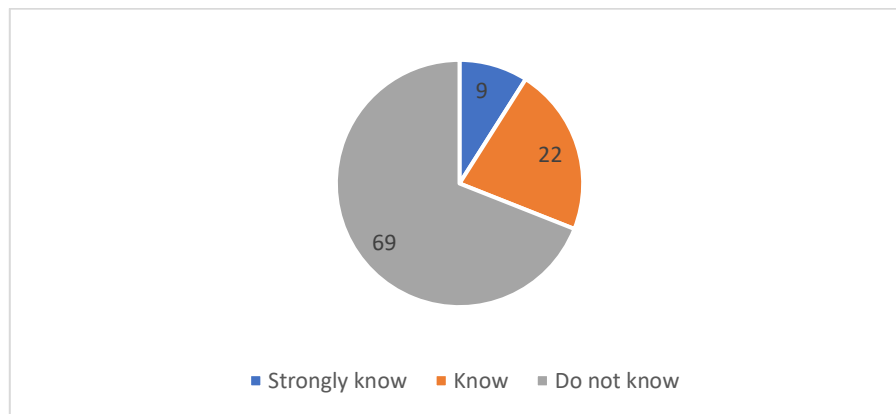


Figure 3. Utilization of mangrove fruits as food and medicine

Donggala Regency people believed that the leaves, fruit/propagules, and roots of mangrove species *Rhizophora stylosa*, *Rhizophora apiculata*, and *Bruguiera gymnorhiza* could be used as a reliever of itchy skin and fungal diseases in children's tongues. These results are in line with Syakirin et al. (2023) that the addition of mangrove leaf extract to the feed has a real influence on the growth of milkfish. Abubakar et al. (2019) also added that the use of mangrove types and parts for treatment varies depending on the disease suffered. Mangir disease (fungus on the tongue) in children under five used *B. gymnorhiza* (fruit/propagules), *R. apiculata*, *R. stylosa* (young roots), and *S. alba* (young fruit). Itching disease uses the leaves of *B. gymnorhiza*, *R. apiculata*, and *R. stylosa*. The data in Figure 4 shows that the average respondent who gave the highest statement was in the agree option, which was 58%. From these results, it is known that the largest number of respondents are people who participate in utilizing mangrove leaves, fruits/propagules, and roots. The utilization is only used for medicine.

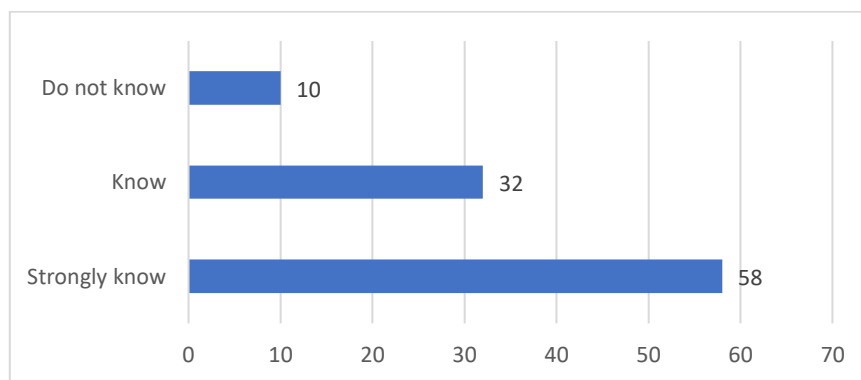


Figure 4. Distribution Utilization of leaves, fruits, and roots for daily needs

Community perceptions related to the establishment of ecotourism areas

The mangrove ecosystem area in Donggala Regency is very suitable if it is developed as a mangrove ecotourism area, but this will be in vain if the people around the area do not have good insight into mangrove management (Nijbroek, 2014). Assessment of community perceptions of the establishment of ecotourism areas is influenced by the level of education, knowledge, experience, and attitudes and behavior of the community (Setiawan et al., 2017). The results of the analysis show that the most emerging values are in the very good category, so it is known that the perceptions of the people of Donggala Regency related to Ecotourism areas are in the good category (Figure 5).

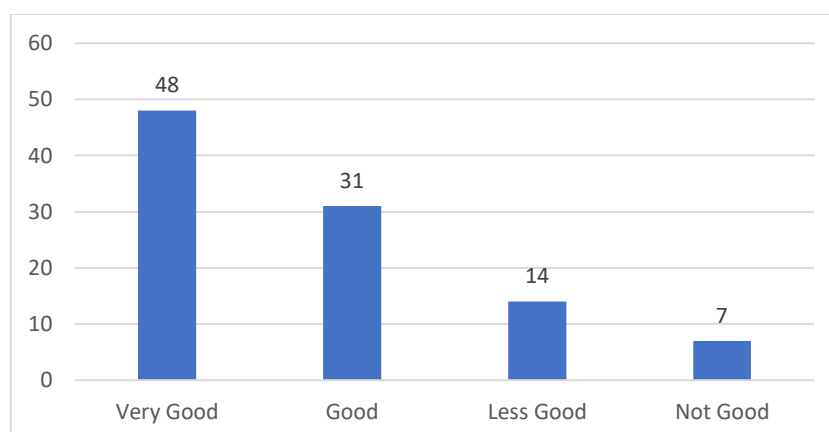


Figure 5. Distribution of community perception levels related to ecotourism areas

One of the reasons for the good perception was due to the level of education of the community, which is mostly high school graduates. On the other hand, because the area is in the mining area management area, the environmental education process is often delivered by several related agencies. This result was corroborated by research by Utami et al. (2018), which stated that the level of education can affect the form of community perception. The occurrence of this is also because the community has realized that they depend on mangrove forest biological resources but do not understand that these resources need to be managed sustainably so that the benefits can be obtained sustainably.

This high and low understanding greatly affects the level of community participation in the sustainability of ecotourism activities that will be carried out. Research conducted by Dharmawan al. (2012) stated that the level of knowledge has a positive effect on the level of community participation in a particular environment. Meanwhile, unfavorable perceptions must be addressed by conducting socialization from the government or related institutions about the importance of protecting or sustaining an aquatic resource to the community in Donggala Regency to increase public understanding of the importance of establishing conservation-based eco-tourism areas.

CONCLUSION

Based on the results and discussion above, it can be concluded that people in Donggala Regency have local ecological knowledge of mangrove forests, especially mangrove habitats, mangrove damage factors, and the impact of mangrove damage is better than the function of mangroves. The utilization of mangrove ecosystems in Donggala Regency is very diverse, ranging from the utilization of mangrove stems, fruits, leaves, and roots to fishery products such as small fish and shellfish. The community's understanding of ecotourism activities is very good, and they agree with the ecotourism activities that will be carried out.

Limitations and Future Direction

To obtain optimal benefit value while maintaining mangrove sustainability, mangrove management in Donggala Regency is directed towards developing ecotourism and silvofishery systems. Both activities involved local communities and were produced for environmental education. Apart from that, ecotourism development, which is currently being carried out by local communities, must also be embraced by the regional government as the area manager to ensure that what local communities are doing is by applicable laws and regulations.

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Declarations

The authors declare there is no conflict of interest in any part of this research.

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