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Community perceptions on and participation in mangrove protection efforts for climate change in Pannikiang Island, South Sulawesi

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Abstract. Knowledge, understanding, and participation of the community regarding mangrove protection are important components in supporting climate change mitigation. This study aimed to determine the levels of community perception of and participation in mangrove protection for climate change mitigation in Pannikiang Island, Barru Regency, South Sulawesi, Indonesia. Fourteen of household heads were selected using a saturation sampling method and interviewed based on a questionnaire. A Likert scale and correlation analyses were implemented to determine the level of perception and participation of the community (low, medium, and high) as well as influencing factors. The results showed that the level of all community respondent perceptions (100%) was in the medium category (average score of 16.28), while for a majority (64.29%) their participation rate was in the high category (average score of 21.50). Length of stay was the main factor influencing respondent perception followed by income, while government roles in mangrove protection were the primary factor affecting respondent participation. Improving the knowledge and understanding of the community can be a viable option in mangrove protection efforts related to climate change.

1. Introduction

The climate change issue is one of the biggest environmental issues in the past decades, because it can have negative effects and impacts on various aspects of people's lives, especially in developing countries where they have a high dependence on natural resources [1]. Mangrove forest is one of important ecosystems in the coastal areas [2] and play important roles in climate change mitigation through carbon sequestration services [3]. However, these forests are also a source of greenhouse gases (GHG) emissions, mainly carbon dioxide (CO_2) if disturbed. [4,5,3]. [4] reported that mangrove forests are the largest store of carbon three to five times greater compared to other forest types in the tropics. The upper surface of mangrove trees (mangrove biomass) can store carbon up to 211 Mg C ha^{-1}, while below the surface (soil) it can reach 849 Mg C ha^{-1} [5].

Indonesia with the largest mangrove forest area in the world, namely 3.3 million ha in 2017 [6] has the potential for carbon stock that reaches 3.14 PgC [5]. However, with an annual mangrove deforestation rate of around 6% due to land use activities, these ecosystems can generate 10% -31% of CO_2 emissions from total annual emissions from land use change in Indonesia [5].

The coastal area and small islands in Barru Regency is one of mangrove riches in South Sulawesi. However, due to forest exploitation mainly from conversion into aquaculture ponds, has resulted in the mangrove forests being deforested in recent decades and emitting CO_2 gas into the atmosphere [7].

Given the critical issues, mangrove protection efforts to prevent CO_2 emission rates due to deforestation require high attention from all stakeholders, especially for the coastal communities, who have high dependence on the products and services provided by mangroves [3]. However, mangrove ecosystem services related to carbon sequestration issue are still new and not widely known by the community. Thus, it can further influence the level of community perception and participation in mangrove forest protection programs.

Previous studies related to the level of community perception and participation in mangrove forest protection has been conducted, including [8,9,10,11]. However, specifically for the purpose of measuring the level of community perception and participation in mangrove protection related to carbon sequestration services for climate change mitigation, it is rarely documented. Therefore, this study aims to determine the community perception and participation, and internal and external factors that affect their level of perception and participation in mangrove forest protection efforts for climate change in Pannikiang Island, Barru Regency, South Sulawesi Province.

2. Study Area

The research was conducted in the mangrove area of Pannikiang Island, Barru Regency. This island is situated in Makassar Strait and within the latitude of 4°20'00" - 4°22'00" and longitude of 119°35’20" - 119°36'40" (Figure 1).

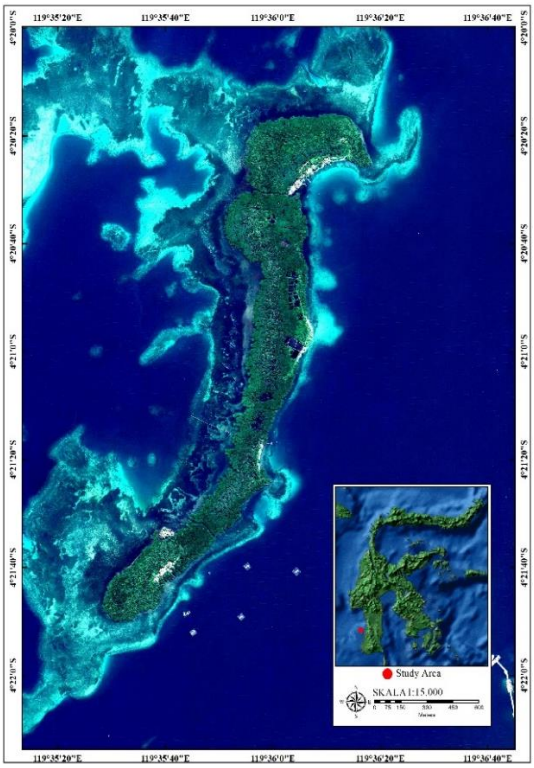

Figure 1. Study area: Pannikiang Island in Barru District, South Sulawesi.

The distance of this island is about 108 km from the capital of South Sulawesi, Makassar City, and 15 km from the center of Barru Regency. Most people are working as fishermen and followed by aquaculture pond farmers in this island [12].

The mangrove extents of this island are 91.64 ha in 2018, decreased 3.19 ha or annual average 0.15 ha since 1997 [7]. Mangrove area was dominated by *Rhizophora* sp. [13] and home for many animals primarily for thousands of bats [14]. The mean of above ground carbon/AGC and below ground carbon/BGC were 5.34 ± 0.17 and 1.68 ± 0.04 Mg C ha^{-1}, respectively, which *Bruguiera gymnorrhiza* stored the greatest carbon stocks. By the total mangrove area in 2018 (91.64 ha), the total carbon stock of AGC and BGC is 489.36 Mg C and 153.95 Mg C. However, mangrove deforestation in this island may generate emissions of 103 Mg CO_2-eq during the period 1997-2018 [7].

3. Methods

A total of 14 head of households, selected using a saturation sampling method, were interviewed by authors and trained enumerators during April 2020 on the basis of a questionnaire to provide data basic household such as age, number of dependents, education, livelihood and income source. Moreover, information was collected on the respondents' understanding of mangrove functions, benefits, and details of their use of mangrove forests, community perceptions regarding mangrove services in carbon sequestration, as well as the willingness and form of community participation in mangrove protection related to climate change mitigation and reducing mangrove deforestation.

A Likert scale and correlation analyses were implemented to determine the level of perception and participation of the community (low, medium, and high) as well as influencing factors [8]. To determine the validity of the questions contained in the questionnaire instrument and the consistency of the instrument in measuring the same symptoms, the validity and reliability of the instrument was carried out. The instrument can be said to be valid if the correlation value (Spearman Correlation) is positive and the correlation probability value [sig. (2-tailed) <significant level 0.05. The construct validity was calculated by looking for the correlation of each question with the total score. Furthermore, the measurement is said to be reliable if the Cronbach Alpha coefficient is if ri is positive and the value is close to 1 (Cronbach's Alpha> 0.6) [8].

4. Results and Discussion

4.1. Community perceptions on mangrove forest protection effort for climate change

The level of community perception on mangrove protection derived from the Likert scale from a total score of 8 validated questions. The sum of the question scores shows that the community perception level is in the medium category, with an average value of 16.26 (Table 1).

Table 1. Perception level of community on mangrove protection in Pannikiang Island .

Category	Score	Number of Respondents	Percentage (%)
High	20 – 24	0	0
Medium	15 – 19	14	100
Low	8 – 14	0	0
Total		14	100

Source: Primary data processing, 2020.

This result on Table 1 indicated that the community knowledge about the role of mangrove forests related to carbon sequestration services for mitigating climate change was still lacking due to limited information gained regarding this mangrove service. All of respondents more familiar with mangrove services as an

abrasion preventive and provider of fishery products, such as fish, shrimp, and crab, and forestry products, such as firewood and building materials. Although the community knowledge is very limited related to carbon sequestration service of mangrove, their participation to protect of mangrove is high (Table 2). Thus, it gives a worth contribution to protect carbon stored in mangrove area of this island and help to mitigate climate change.

4.2. Community participation in mangrove forest protection effort for climate change

In community participation on mangrove protection, based on the Likert scale from a total score of 9 validated questions. The sum of the question scores shows that the community perception level is in the high category, with an average value of 21.5 (Table 2).

Table 2. Participation level of community in mangrove protection in Pannikiang Island.

Category	Score	Number of Respondents	Percentage (%)
High	21 - 27	9	64,29
Medium	15 – 20	5	35,71
Low	9 - 14	0	0
Total		44	100

Source: Primary data processing, 2020.

The result on Table 2 demonstrated the high level of community participation in the protection of mangrove forests on this island. It is due to the good awareness of the community about the benefits of mangrove forests in supporting their livelihoods, which are generally fishermen. They always protect and preserve mangrove forests, by not logging and converting mangroves into aquaculture ponds. In addition, the role of the local government is in providing understanding regarding the protection and preservation of mangrove forests and the application of prohibitions on exploiting mangroves on this island gives a worth contribution to their high participation.

4.3. The Influence factors of community perception on and participation in mangrove protection

The Influence factors of community perception on and participation in mangrove protection in Pannikiang Island provides in Table 3.

Table 3. The influence Factors of community perception and participation.

Factor		Correlation coefficient	
Internal	External	Perception	Participation
Age	-	0,000	0,277
Level of education	-	-0,316	0,258
Occupation	-	0,050	0,185
Income	-	0,825	0,149
Length of stay	-	0,830	0,394
	Role of government	0,183	0,556

Source: Primary data processing, 2020.

This result showed that external factor (role of government) was the main influences factor of community perception on and participation in mangrove protection effort to mitigate climate change than internal

factors. In the meanwhile, the length of stay was the main internal factor influencing community perception and participation on this island (Table 3).

The role of the Government of Barru Regency through socialization and counseling programs concerning the function and benefit of mangrove for environmental and community livelihoods, and establish community social institutions for monitoring and protecting of mangrove in this island have influenced to the perception on and participation of community in mangrove protection in this island. Besides, the declaration of this island as a conservation area at the same time as an ecotourism and educational areas based on Barru Regent Decree year 2014 [14] have contributed to preserve and conserve of mangroves on this island, and community perception and participation.

5. Conclusions

The present study has demonstrated the community perception on and participation in mangrove protection effort for climate change in Pannikiang Island. Even though, the community knowledge is very limited related to carbon sequestration service of mangrove, their high participation in mangrove protection have given a worth contribution to mitigate climate change. The factor of government role in mangrove conservation and preservation have play important role to influence the community perception and participation on this island. Therefore, more attention to improve knowledge and understanding of community related to carbon sequestration service of mangrove such as through counseling programs by government or the other stakeholder become a viable option in mangrove protection effort for climate change.

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