

The impacts of coastal community activities on the existence of the Waranggui mangrove forest in South Manokwari, West Papua, Indonesia

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Manuscript received: 6 September 2019. Revision accepted: 19 November 2019.

Abstract. Amir A, Maturbongs RA, Tapilatu RF. 2019. *The impacts of coastal community activities on the existence of the Waranggui mangrove forest in South Manokwari, West Papua, Indonesia. Ocean Life 3: 54-64.* Coastal areas are generally complex, both economically and ecologically. Various types of community activities involving the use of natural resources in coastal areas have impacts on the ecological sustainability of coastal areas, particularly mangrove ecosystems. Mangrove forests serve as coastal protectors against tsunamis, buffer erosion and sediment traps, recycle nutrients, ensure fishery productivity, reduce the rate of seawater intrusion, support health, maintain biodiversity, and provide habitat for other aquatic ecosystems. The Waranggui area, Oransbari Sub-district, South Manokwari District, West Papua Province, Indonesia, is one of the coastal areas with a mangrove ecosystem, known by the community as a mangrove forest or mangle mangle. It is rich in natural resources and widely used by people who live around it. The objectives of this study are (i) Determining the current area of the Waranggui mangrove forest cover in the Oransbari Sub-district and analyzing its changes related to community activities. (ii) Determining and analyzing the socio-economic dimensions and the diversity of local wisdom of the Waranggui Village community in utilizing the mangrove forest. This study was descriptive qualitative-quantitative and focused on a case found in the field. Researchers described the object under study based on the data and facts obtained at the time of observation and interviews. The data obtained were further tested by using non-parametric statistics. The type of data used in this study was both primary data and secondary data. The following conclusions can be drawn from research on the effect of coastal community activities on the Waranggui mangrove forest in Oransbari Sub-district, South Manokwari District: (i) The Data from the DJI Phantom 4 Professional Drone at a flying height of 200 meters and a resolution of 5.1 cm/pixel, yielded data on the Waranggui mangrove forest covering 384.76 ha. After subtracting the measurement of the open land area of 7.91 ha, the actual area is 376.86 ha. The difference in area between the maps is thought to be due to the interpretation of the coastline and the identification of mangrove forest coverage, as well as the map's resolution. (ii) The variable factor's total scoring value is 270. This demonstrates that socioeconomic factors have a significant impact on the destruction of the Waranggui Oransbari mangrove forest in the South Manokwari District. As many as 100 percent of the community said they knew about mangroves and that their condition had begun to deteriorate and that they needed to be treated.

Keywords: Coastal community, socio-economic, Waranggui mangrove forest

INTRODUCTION

Coastal areas are generally complex, both economically and ecologically (Bengen 2004). Various types of community activities involving the use of natural resources in coastal areas have impacts on the ecological sustainability of coastal areas, particularly mangrove ecosystems. The existence of mangrove forests is critical because they have the potential to support life in economic, social, and environmental aspects. Mangrove forests in most parts of Indonesia are currently under threat due to deforestation that frequently exceeds the limits of sustainability and carrying capacity. As a result, it is time for many parties to pay attention to coastal management. Development in coastal areas does not need to destroy the mangrove ecosystem as long as a rational arrangement is carried out. Coastal communities are those that continuously interact with mangroves. One model of mangrove ecosystem management is a community-based management approach.

Mangrove forests serve as coastal protectors against tsunamis, buffer erosion and sediment traps, recycle nutrients, ensure fishery productivity, reduce the rate of seawater intrusion, support health, maintain biodiversity, and provide habitat for other aquatic ecosystems (Nybakken 1988; Tomascik et al. 1997; Noor et al. 1999; Rochana 2010; Lapolo et al. (2018). As a result, in order to preserve the mangrove ecosystem and use it sustainably, a policy for management and utilization of the area is required.

The Waranggui area, Oransbari Sub-district, South Manokwari District West Papua Province, Indonesia, is one of the coastal areas with a mangrove ecosystem, known by the community as a mangrove forest or mangle mangle. It is rich in natural resources and widely used by people who live around it. Apart from being a place to find food, the area is also used for transportation and ports, recreation and tourism, a residential area, and a place for waste disposal. The majority of people who live in this area make a living as fishermen. This area is also used to anchor fishing fleets

that are safe from waves and strong winds, both for fishermen in Oransbari and fishermen from other areas.

The consequences of every activity carried out by the community lead to ecological problems, which are the impacts of environmentally unfriendly activities and utilization. Community activities include excessive logging of mangroves for wood use, conversion of mangrove land to agricultural/plantation areas, and pollution from the activities of the surrounding community are triggers for the destruction of mangrove ecosystems, either directly or indirectly.

Based on the potential and problems of using the mangrove ecosystem in the Waranggui area, Oransbari Sub-district, South Manokwari, it is necessary to conduct research on the coastal community activities on the condition of the mangrove ecosystem. This study aims to determine the extent to which these activities have an impact on mangrove forests so that in the future, integrated and environmentally sound management can be carried out by considering the relationship between community interests and the condition of the mangrove forest.

Community-based sustainable management is a management strategy that establishes a threshold for the rate of utilization for natural ecosystems and the natural resources contained within them. Community-based sustainable management is another strategy for utilizing natural ecosystems in which the functional capacity of the ecosystem is sought to be preserved so that it can provide benefits to human life in a sustainable manner. Dahuri et al. (1996) suggested four dimensions of sustainable management: (i) Ecological. (ii). Socioeconomic-cultural, (iii) Sociopolitical. (iv) Legal and institutional.

The objectives of this study, in relation to the problems mentioned above: (i) Determining the current area of the Waranggui mangrove forest cover in the Oransbari Sub-district and analyzing its changes related to community activities. (ii) Determining and analyzing the socio-economic dimensions and the diversity of local wisdom of the Waranggui Village community in utilizing the mangrove forest.

MATERIALS AND METHODS

Research time and site

The time required to complete all stages of the study was 3 (three) months, starting in October to December 2018. The research site was in the Waranggui mangrove forest, Oransbari Sub-district, South Manokwari District, West Papua Province, Indonesia.

Design used

This study was descriptive qualitative-quantitative and focused on a case found in the field. Researchers described the object under study based on the data and facts obtained at the time of observation and interviews. The data obtained were further tested by using non-parametric

statistics. The type of data used in this study was both primary data and secondary data.

Primary and secondary data collection

Primary data collected includes the area of mangrove cover, community perceptions of the mangrove forest area, socio-economic conditions of the community, and photos of mangrove conditions. The method used to obtain primary data during the study included field observations and interviews. Secondary data were obtained through a literature study and information gathered from related agencies of coastal management. These data were used as supporting data in assessing the mangrove forest management strategy.

Mangrove land cover

Land cover is seen by cropping the image data of the study area using Er Mapper 7.1 software, which results in a Landsat 8 composite map with RGB 654, with references to the 2009 and 2017 time series maps. Image cropping was done to limit the image according to the research area because, in the process of recording the condition of the earth's surface, the satellite would record data over a large area. It corresponded to the spatial resolution of the sensors used by the satellite. Image cropping was used to differentiate between land, forest, and water. To further strengthen the recording of this research area, photogrammetry (drone) with the Dji Phantom 4 Professional, 20 MPLx camera with flight path (Figure 1) was used.

Society's socio-economic factors

Changes in mangrove conditions are thought to be the result of community activities in the mangrove area, which are triggered by socioeconomic conditions. As a result, it is necessary to conduct a survey on social and economic activities or community activities. The cause of the destruction to the mangrove area is suspected to be the behavior of the community surrounding the area, which is based on the community's economic condition.

A score of 1-3 was assigned to each variable, with a total weight of 100 assigned to each variable. The result was a total score range of 100-300. The amount of weight assigned to each variable was determined by the probability of the variable, where the variable directly contributes to the destruction of mangrove forests. Table 1 shows the calculation of mangrove destruction due to socioeconomic factors in the community.

Criteria for drawing conclusions on socio-economic factors on mangrove forest destruction will be carried out as follows: (i) Score 100-160: Socio-economic factors have less effect on the destruction of mangrove areas. (ii) Score 161-200: Socio-economic factors affect the destruction of mangrove areas. (iii) Score 201-300: Socio-economic factors are very influential in the destruction of mangrove areas.

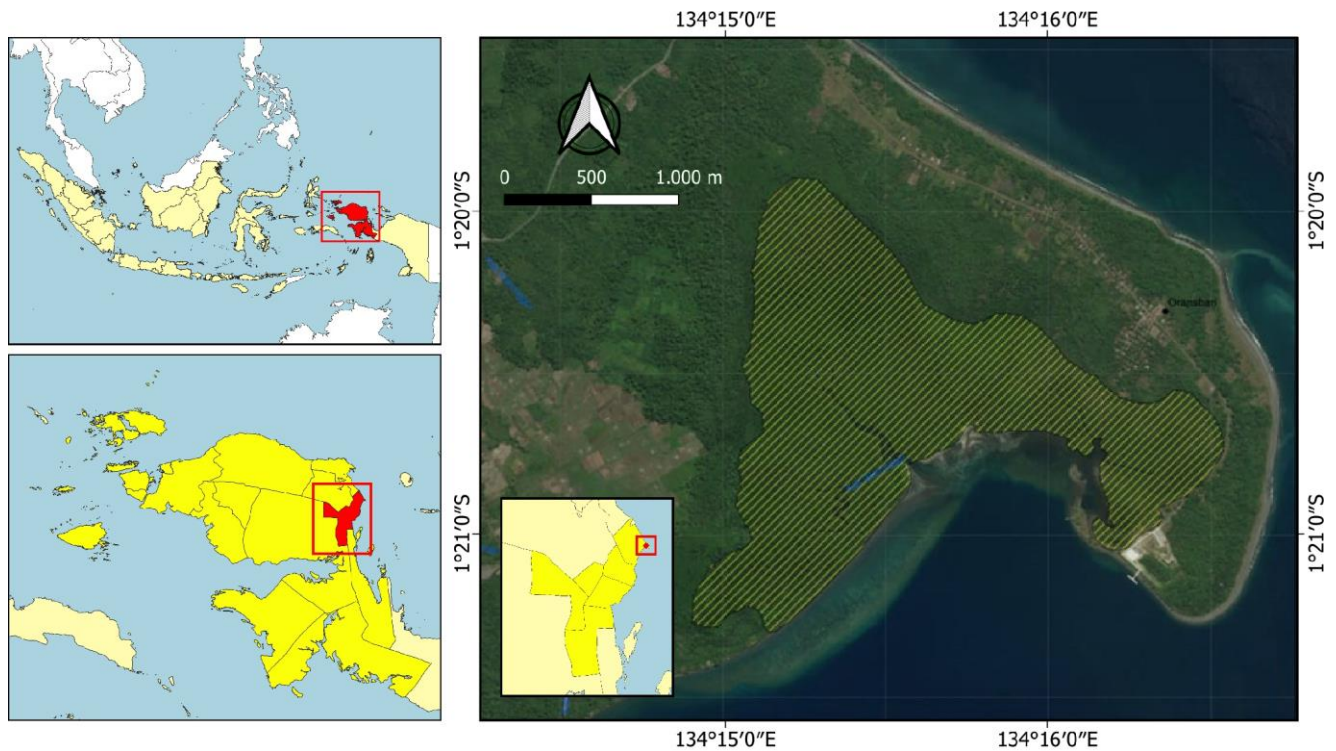


Figure 1. Drone flight path map at the research site (Waranggui mangrove forest, Oransbari Sub-district, South Manokwari District, West Papua Province, Indonesia)

Table 1. Determination of the magnitude of the weight of socio-economic factors contributing to the destruction of the Waranggui mangrove forest, Oransbari Sub-district, South Manokwari District, West Papua Province, Indonesia

Variable	Weight	Score
Livelihood	40	Fishermen
	40	Farmers
	40	Pond Fishermen
Location of Business Land	30	< 1 km from mangrove forest
	30	0.5 - 1 km from mangrove forest
Land Use	30	> 1 km from mangrove forest
	20	Forest
	20	Plantation/Mixed Plantation
	20	Settlement
Perception of Mangrove	10	To protect the environment
	30	To maintain the sustainability of aquatic animals
	30	To use the wood

Source: Directorate General of Land Rehabilitation and Social Forestry and Department of Forestry and Plantations (2000)

Coastal community perception

The perception of coastal communities is descriptive, which will provide a factual picture of the condition of mangroves and the coastal environment. Data were collected through direct observation in the field and interviews.

According to Arikunto (2007), if the number of research subjects is less than 100, it is best to take all of

them as samples; if the number of samples is greater than 100, the sample size should be around 10%. A sample is drawn using the purposive sampling method to obtain data that can represent the population surrounding the mangrove forest area. As a result, the number of samples taken will be determined using the formula below (Nazir 1988).

$$n = \frac{N}{Nd^2 + 1}$$

Where:

N = Total population

n = Number of samples

d2 = Expected precision 10%

1 = Constant

Analysis of the socio-economic dimensions and diversity of local wisdom was carried out descriptively. The analysis of the social dimension focuses on respondent characteristics, livelihoods, and local wisdom systems. Meanwhile, the analysis of the diversity of local wisdom focuses on the existence of customs that inhibit and/or support mangrove conservation, community care, and/or obedience in supporting the preservation of mangrove forests prevailing in the Oransbari village community.

Research variables

The variables measured in this study were: (i) Visualization of the Waranggui mangrove land cover

conditions in Oransbari Sub-district in 2018 juxtaposed with the land cover conditions of the previous 5 to 10 years using time series maps and land cover maps in 2009 and 2017 and reinforced with photogrammetry (drone) to obtain factual cover data accuracy land and the impact of community activities on the Waranggui mangrove forest. (ii) Socio-economic activities of the community around the Waranggui mangrove forest area, Oransbari Sub-district can affect the ecological functions of the mangrove forest. (iii) Community perception of the benefits of mangrove forests in the process of sustainable management. (iv) The values of local wisdom of the community of Oransbari village in benefiting from Waranggui mangrove forest.

RESULTS AND DISCUSSION

Geographical, topographical, and demographic conditions

Oransbari Village is one of fourteen villages located in the Oransbari Sub-district. Oransbari Village is also the oldest village in this sub-district. Based on monograph data from Oransbari Village, the area is 111.67 km², consisting of three neighborhood units (RT) with administrative boundaries as follows: (i) The east border is the free ocean (Pacific Ocean). (ii) The south border is Muari Village. (iii) The west border is Waroser Village. (iv) The north border is the free ocean (Pacific Ocean).

Meanwhile, the geographical location is as follows: (i) North: 1°19' South Latitude. (ii) South: 1°21' South Latitude. (iii) West: 134° 14' East Longitude and (iv) East: 134° 16' East Longitude. The Waranggui mangrove forest area is bordered by three villages, including (i) The north border is Oransbari Village. (ii) The south border is Muari Village. (iii) The east border is the sea and (iv) The west border is Waroser Village.

The Waranggui mangrove forest area is included in the administrative area of Oransbari Village and is part of the customary rights of tribal chiefs from Oransbari Village. Oransbari Village is located on a sloping coastal area with a land elevation of 0-6 meters above sea level. The length of the coastline is approximately 10 km with an estuarine coastal ecosystem consisting of mangrove forests, seagrass beds, and coral reefs in the interior of the bay while on the outside it is a type of coral beach.

The inhabitants of the Oransbari Village consist of various indigenous Papuan tribes such as the Hatam, Biak, Serui, Wandamen, Sough tribes, and several immigrant tribes including Buton, Makassar, and others. Most of the people in the Oransbari Village make a living as fishermen, farmers, traders, and civil servants. The largest clan is the Waran clan, along with the Anari clan, and holds customary rights in the Oransbari Sub-district. There are 136 families in total, with a total of 577 people (Table 2).

Visualization of the Waranggui mangrove land cover condition

Monitoring changes in land cover can be accomplished by conducting an ongoing analysis of changes in land cover

from year to year. Monitoring is only possible if time series data for the observation interval is available. The land cover time series data available at the Ministry of Environment and Forestry (KLHK) is quite complete. Land cover data is available from the Ministry of Environment and Forestry from 1990 to 2017, with data series for 1990, 2000, 2003, 2006, 2009, 2011, 2012, 2013, 2014, 2015, and 2016. The Ministry of Environment and Forestry created a Land Cover Map in accordance with Regulation of the Directorate General of Forestry Planning No. P.1/VII-IPSDH/2015, which divides land cover into twenty-three (23) land cover classes (Table 3).

There are two categories of mangrove forest cover, including Primary Mangrove Forest (2004-HMP) and Secondary Mangrove Forest (20041-HMS). A comparison of KLHK mangrove cover area with mangrove cover using very high resolution (60 cm/pixel) imagery is shown in Table 4.

Table 2. Number of residents of Oransbari Village, Oransbari Sub-district, South Manokwari District, West Papua Province, Indonesia

Neighborhood units (RT)	Number of head of the family	Gender		Number of Residents
		Male	Female	
RT. 01	44	95	79	174
RT. 02	37	73	73	146
RT. 03	55	140	117	257
TOTAL	136	308	169	577

Source: Oransbari Village monograph data in 2019

Table 3. Ministry of Environment and Forestry, Indonesia, land cover

Code	Land cover	Abbreviation
2001	Primary Dryland Forest	HLKP
2002	Secondary Dryland Forest	HLKS
2004	Primary Mangrove Forest	HMP
2005	Primary Swamp Forest	HRP
2006	Plantation Forest	HT
2007	Shrubs	SB
2010	Plantation	Perkebunan
2012	Settlement	Pemukiman
2014	Open Ground	TT
2500	Cloud	Awan
3000	Savanna	Savana
5001	Water Body	TA
20041	Secondary Mangrove Forest	HMS
20051	Secondary Swamp Forest	HRS
20071	Swamp Scrub	SBR
20091	Dryland Farming	PLK
20092	Dryland Mixed Bush Farming	PLKC
20093	Ricefield	Sawah
20094	Pond	Tambak
20121	Airport	Bandara
20122	Transmigration	Transmigrasi
20141	Mining	Pertambangan
50011	Swamp	Rawa

Source: Ministry of Environment and Forestry (2015)

According to the data in the table above, there is a difference in the area of mangrove forest covering an area of 82.30 ha, with details of the difference between primary and secondary mangrove forest being 93.33 ha and 11.03 ha. This wide disparity is caused by the various image data sources used in land cover interpretation. Landsat imagery with a resolution of 30 meters/pixel is used by KLHK land cover, and high-resolution satellite imagery with a spatial resolution of 60 cm/pixel is used by land cover. Furthermore, the difference in area is caused by different interpretations of the coastline on KLHK land cover, with the farthest and closest bias values to the coastline sourced from the Geospatial Information Agency's Indonesian

Earth Map (RBI) scale 1:50,000 in 2018. The greatest distance and proximity to the RBI coastline (Table 5).

The analysis of land cover changes in the Waranggui mangrove area was then refined using aerial photos taken by the DJI Phantom 4 Professional Drone at a flying height of 200 meters at the end of December 2018 and compared to the KLHK Land Cover Map from 2009. Based on land cover data, the total area of the Waranggui mangrove forest was calculated. The Ministry of Environment and Forestry reported 414.218 hectares in 2009, with primary mangrove forest covering 361.5 ha and secondary mangrove forest covering 52.7 ha. The forest cover can be seen in Figures 2 and 3.

Table 4. Comparison of Ministry of Environment and Forestry mangrove cover and very high-resolution imagery in Waranggui, Oransbari Sub-district, South Manokwari District, West Papua Province, Indonesia

Land cover	Area (ha)		
	KLHK 2017 (30m/pixel)	Very high-resolution imagery (60 cm/pixel)	Total difference
Primary Mangrove Forest	354.31	260.98	93.33
Secondary Mangrove Forest	52.56	63.59	-11.03
Total	406.87	324.57	82.03

Table 5. The furthest and closest distances to mangrove cover in Waranggui, Oransbari Sub-district, South Manokwari District, West Papua Province, Indonesia

Mangrove forest	Region	Distance (meter)	
		Furthest	Closest
Primary Mangrove Forest	In the coastline	201	22
	Beyond the coastline	115	38
Secondary Mangrove Forest	In the coastline	-	-
	Beyond the coastline	35	1

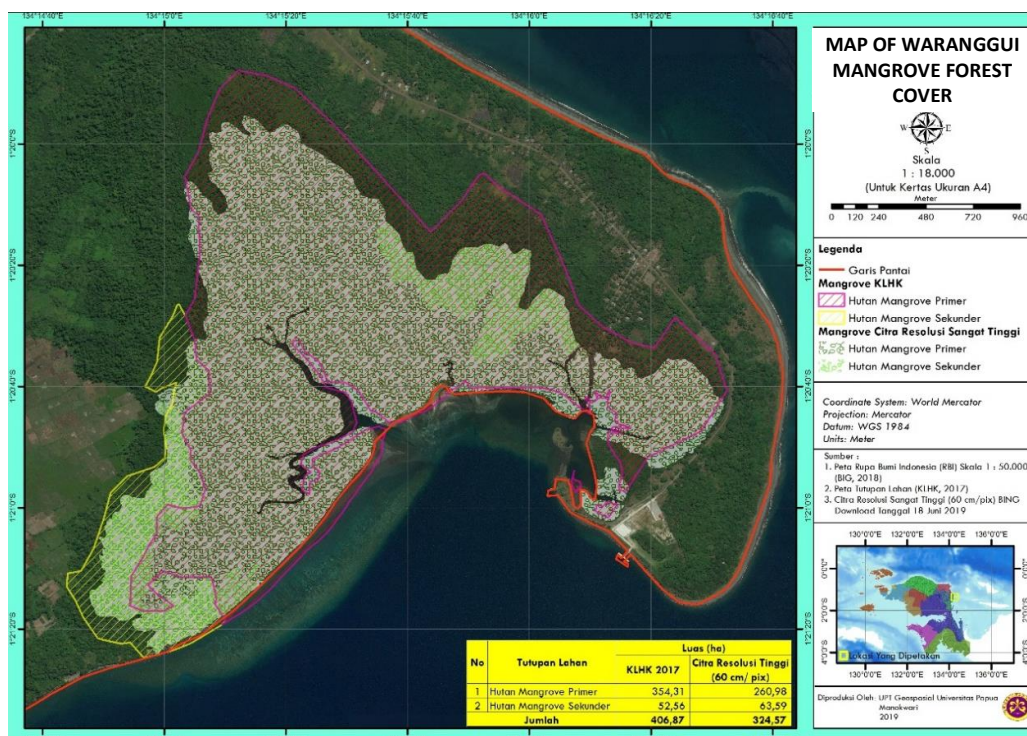


Figure 2. Map of Waranggui mangrove forest cover, Oransbari Sub-district, South Manokwari District, UPT Geospatial, Universitas Papua, Manokwari, Indonesia in 2019

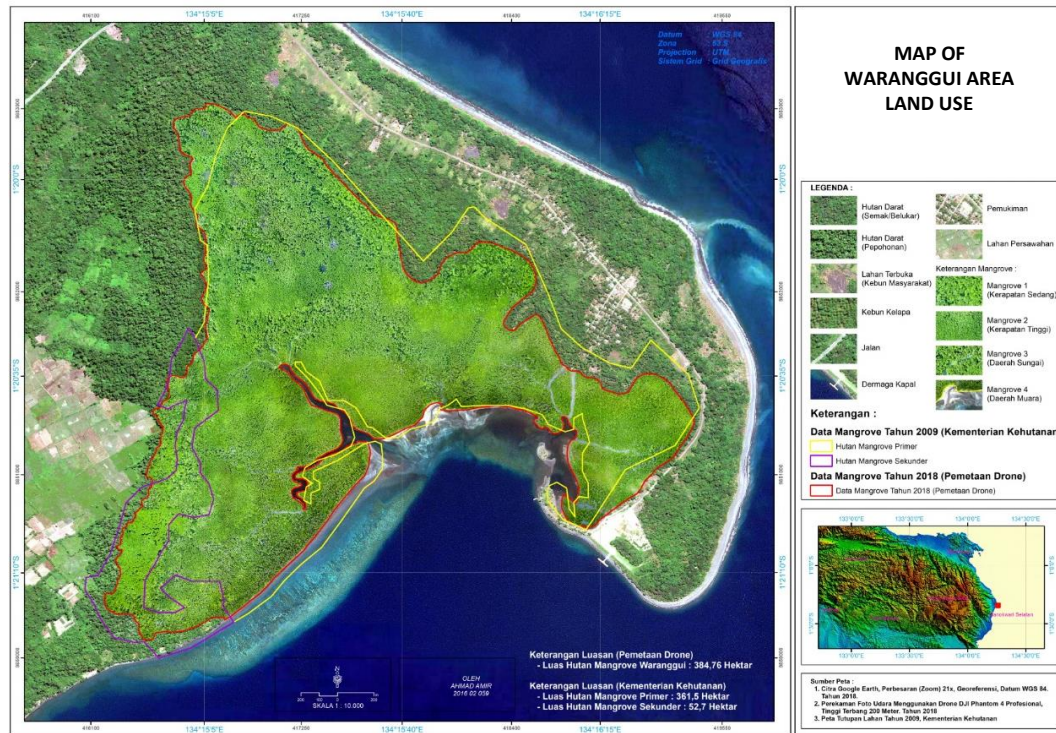


Figure 3. DJI Phantom 4 professional drone map Waranggui, Oransbari Sub-district, South Manokwari District, West Papua Province, Indonesia in December 2018

At the end of 2018, the results of mapping using drones were 384.76 hectares. According to the Ministry of Environment and Forestry data on land cover in 2009, there is a difference in the area of the Waranggui mangrove forest as a whole, which is 29.46 ha, but the researcher does not want to display the distribution of data on the area of primary and secondary mangrove forests solely for the sake of preserving the Waranggui mangrove forest in a comprehensive manner in this research. In the near future, Land cover area data was processed based on photogrammetry results from the DJI Phantom 4 Professional Drone and compared to the 2009 KLHK map (Table 6).

Table 6. Comparison of KLHK mangrove forest cover in 2009 and the results of drone mapping in December 2018 in Waranggui, Oransbari Sub-district, South Manokwari District, West Papua Province, Indonesia

Land cover	Area (ha)		
	KLHK 2009 (30 m/pix)	Photogrammetry Drone (5,1 cm/pix)	Total difference
Primary Mangrove Forest	361.510	384.76	-23.25
Secondary Mangrove Forest	52.718	-	52.718
Total	414.218	384.76	29.46

Comparison of the three map models used in the approach to obtain data accuracy for the Waranggui mangrove land cover area, including the 2009 and 2017 KLHK maps, UPT Geospatial of Universitas Papua maps, and drone results (Table 7).

Table 7. Comparison of Waranggui mangrove cover area, Oransbari Sub-district, South Manokwari District, West Papua Province, Indonesia

Land cover	Area (ha)			
	KLHK 2009	KLHK 2017	Very high-resolution imagery (60 cm/pixel)	Photogrammetry drone (5,1 cm/pix)
Primary Mangrove Forest	361.51	354.31	260.98	384.76
Secondary Mangrove Forest	52.718	52.56	63.59	
Total	414.218	406.87	324.57	384.76

Source: KLHK (2015), Waranggui drone (2018), UPT Geospatial of Universitas Papua (2019)

The total area of the Waranggui mangrove area when viewed from the data above based on the KLHK land cover map between 2009 and 2017 has seen a degradation of 7.35 ha of mangrove forest area. And when juxtaposed with the results of the map issued by the Geospatial UPT, Universitas Papua, Manokwari in 2019 with the KLHK 2009 map, there is a comparison of the difference in the number of mangrove forests as much as 89.65 ha and with the KLHK 2017 map, there is a difference of 82.3 ha.

Meanwhile, this study's current mapping relies on data from the DJI Phantom 4 Professional Drone. The data on the area of mangrove forests produced by the flying height of 200 meters with a resolution of 5.1 cm/pixel differs from the two maps referred to in the previous table. The difference in area between the maps is thought to be due to the interpretation of the coastline and the identification of mangrove forest coverage, as well as the map's resolution. Drones can also detect destruction to the periphery and inside the Waranggui mangrove forest area. The state of mangrove forest destruction from drone mapping can illustrate the findings of interviews with people in Oransbari Village about their activities in utilizing mangrove forests. Government programs, in addition to community activities, are thought to have contributed to the degradation of the Waranggui mangrove forest as a result of the development program. The development program in question involves the building of a pier, the expansion of rice fields, and the opening of access roads to the Sawmiyen beach tourism area, which is directly adjacent to the Waranggui mangrove forest. Researchers, on the other hand, traced the traces of destruction done by the community with photos taken during field observations using aerial photos (Figures 4 and 5).

Identification of drone mapping on Waranggui mangrove forest area

The condition of the land as revealed by the drone mapping results indicates that there has been destroyed at several points. The exposed areas represent the previous logging done by the community to reduce the existing mangrove forest. Some of the identified areas are open land, specifically land that is no longer covered by mangroves because it has transitioned from mangrove forest to shrubs and grass, and some have even been converted to other uses such as gardens (Tables 8 and 9).

The surrounding community's pattern of mangrove utilization is by pruning or cutting down from within the forest, or more precisely, the community uses a thinning technique so that it is not as visible significantly by aerial photography observations, identification of mangrove forests occurs when the density decreases in the parts closest to settlements, for example in Muari and Oransbari (Figure 6).

Factors of the community's socio-economic activities

In conducting a study to determine the extent to which community activities in the Waranggui mangrove forest area have an impact. Field observations were conducted in addition to quantitative methods such as photogrammetry using drones and KLHK land cover maps. A qualitative

approach was also used in this study, with interviews conducted with 55 representative respondents (purposive sampling) in three Neighborhood Units (RT) in Oransbari Village. The total scoring value (TNS) is 270 based on the results of questionnaires and interviews with respondents (Table 10).

This value serves as the foundation for calculating the magnitude of the socioeconomic factors that contribute to the destruction of the Waranggui mangrove forest. This value indicates that socioeconomic factors have a significant impact on mangrove destruction.

Table 8. Waranggui mangrove land, Oransbari Sub-district, South Manokwari District, West Papua Province, Indonesia, identification

Land identification	Area (ha)	Area (m ²)
Logging Indication	3.38	33,793.08
Open Land	0.96	9,588.28
Sand/Coast	0.14	1,369.00
Coconut Trees	0.22	2,236.14
Water Body	2.08	20,812.87
Water Body and Boat Mooring	1.13	11,315.46
Mangrove	376.86	3,768,555.15
Total Land Identified	7.91	79,114.82
Total Mangrove Land	376.86	3,768,555.15

Source: Drone map results (2018)

Table 9. Information on the identification of the Waranggui mangrove forest land, Oransbari Sub-district, South Manokwari District, West Papua Province, Indonesia

Identification	Notes
Logging Indication	The location shown on the map is indicated by the appearance of open land with fallen tree stands and land conditions that are starting to become barren and dry.
Open Land	The location is shown on the map with the appearance of open land only consisting of the land cover of shrubs to grass. Some bare land is seen in the area.
Sand/Coast	The location is shown on the map with the appearance of land close to the coast that is not overgrown with mangroves and an accumulation of beach sand.
Coconut Trees	The location is shown on the map with the appearance of a tree canopy of a coconut plant. In some locations, coconut plants grow in the middle of a mangrove forest.
Water Body	The location is shown on the map with the appearance of the river water body.
Water Body and Boat Mooring	The location is shown on the map with the appearance of the river water body. Mooring boats used by local fishermen can be seen on some land leading to the mainland.
Mangrove Forest	The location is shown on the map with the overall cover of mangrove forests, both primary and secondary, in the Waranggui forest.

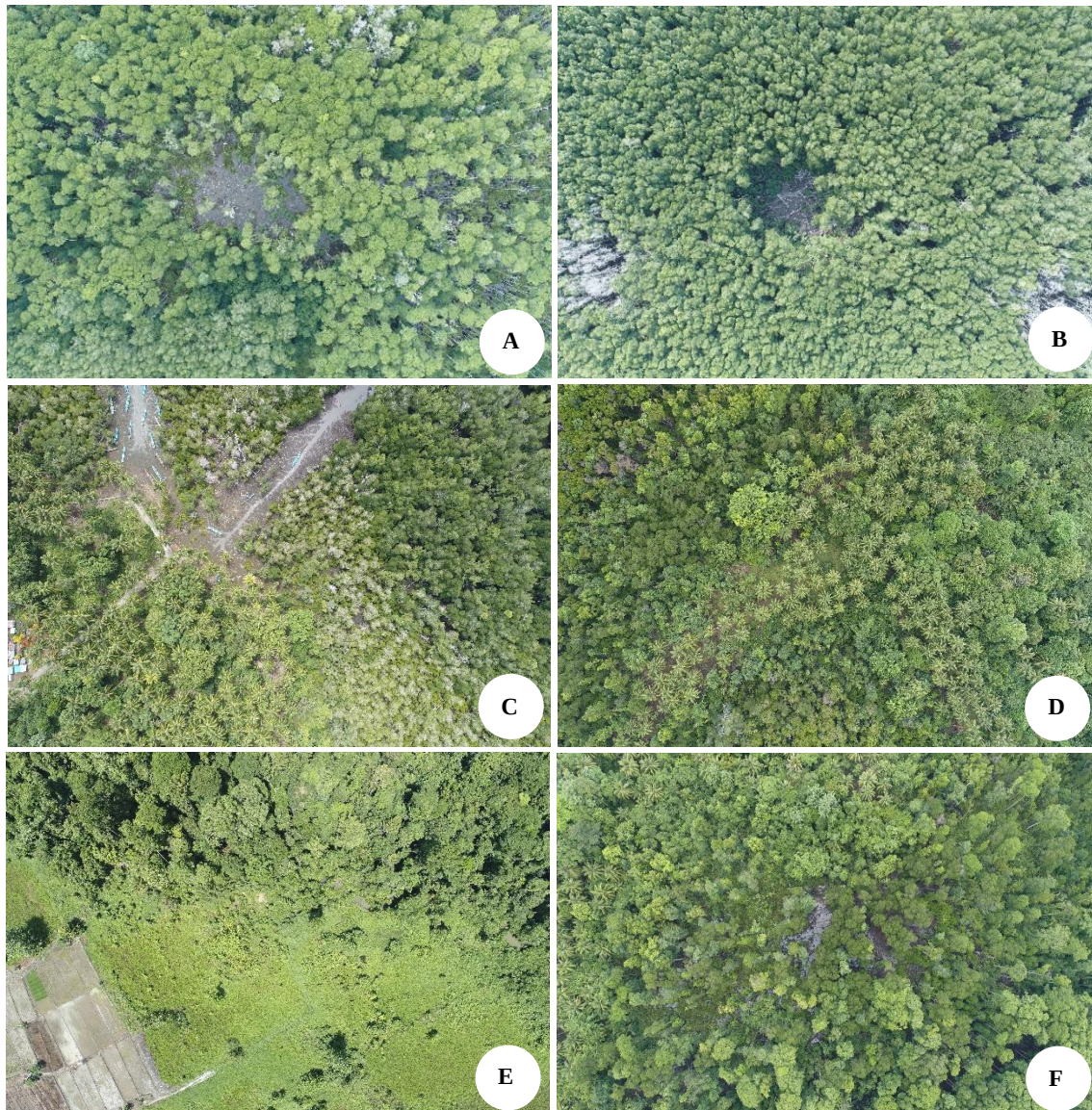


Figure 4. Drone aerial photos. A. Conditions in the middle, B. Conditions near the Waranggui estuary, C. Conditions at the boat mooring area, D. Conditions with coconut plantations bordering, E. Conditions with paddy fields bordering, and F. Conditions near the settlement

Elements of respondents and mangrove forest utilization

Purposive sampling was used to interview 55 respondents in order to be more objective and represent all elements. This questionnaire also included traditional Oransbari Village stakeholders. Based on the findings of 55 interviews conducted over a one-year with 55 respondents about the utilization of mangrove forests in the Waranggui area, Oransbari Sub-district, South Manokwari District, it was discovered that 100 percent (one hundred percent) of respondents said they had utilized the Mangrove area, particularly looking for marine biotas such as fish, snails, and others (Table 11).

Wood

When the community was asked about using wood from the mangrove forest for any purpose, whether for

personal use or for sale to buyers outside the village, the results are shown in the Table 12.

In accordance with the interview results, when the researchers conducted field observations to test the validity of the interview results, facts from community activities in utilizing wood in the Waranggui Mangrove forest area for daily needs or needs were discovered, as shown in Figure 7.

Non-timber forest products

Aside from wood, the community uses mangrove trees for a variety of other purposes, including food from tree fruit, medicines, ant nests, and orchids attached to mangrove trees. Table 13 presents the findings of interviews on these activities.



Figure 5. Field observation photos (mangrove forest destruction by the community)

Aquatic biota

In addition to using wood, the intensity of community activities in utilizing the waters of the mangrove area is quite high as presented in the Table 14.

Community perception of mangrove forest

According to the results of the interviews, 55 respondents (100%) said they were familiar with mangroves, also known as *mange-mange* to locals. The community is also aware of the role of mangroves as beach protectors and sources of daily necessities, particularly wood extraction, as well as other ecological functions such as fish feeding grounds, nursery grounds, and spawning grounds. Mangrove forests, according to 100 percent of community respondents, must be maintained and preserved.

Table 10. Total scoring value

Variables	Weight	Score	Yes	No
Livelihood	40	Fishermen	✓	
	40	Farmers	✓	
	40	Pond Fishermen		✓
Location of business land	30	< 1 km from mangrove forest	✓	
	30	0.5 - 1 km from mangrove forest	✓	
	30	> 1 km from mangrove forest		✓
Land use	20	Forest	✓	
	20	Plantation/Mixed Plantation	✓	
	20	Settlement	✓	
Perception of mangrove	10	To protect the environment	✓	
	30	To maintain the survival of aquatic animals	✓	
	30	To use the woods	✓	

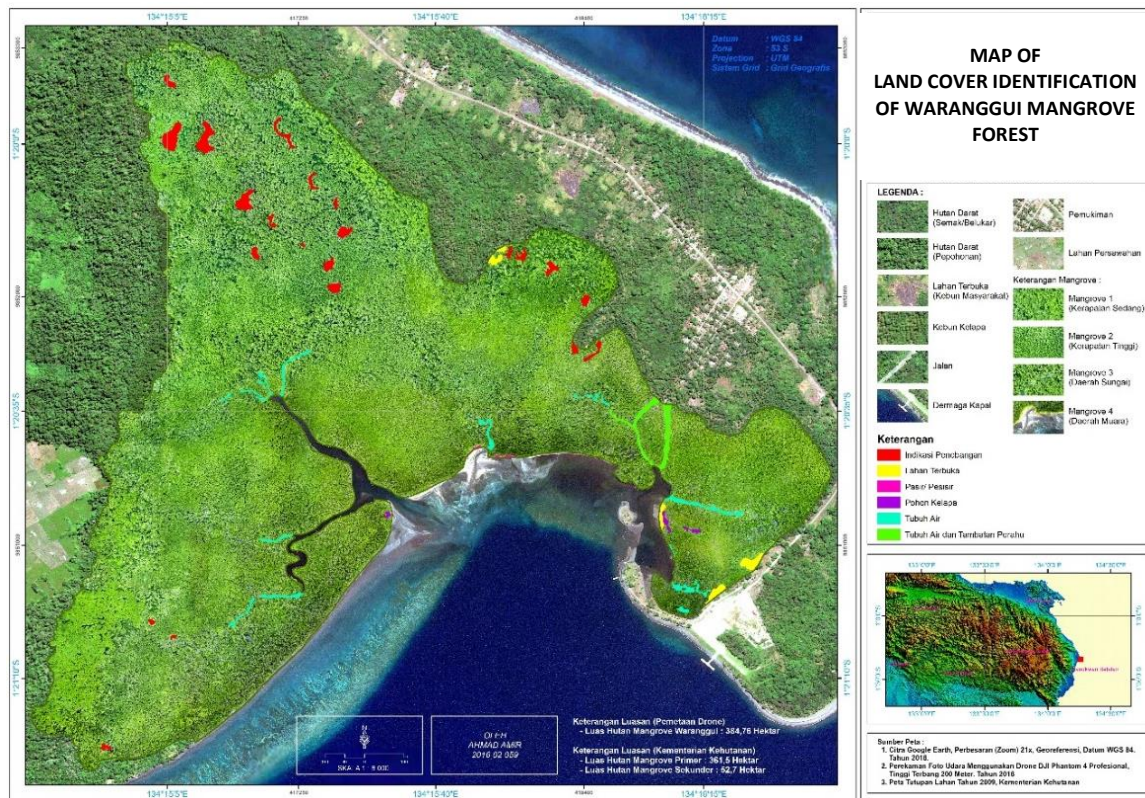


Figure 6. Drone map of land cover identification of Waranggui forest, Oransbari Sub-district, South Manokwari District, West Papua Province, Indonesia



Figure 7. A. Utilization for firewood, B. Utilization of fence poles and other building needs, C. Utilization of garden fences and stakes for plants

Table 11. Types of mangrove forest utilization

Types of utilization	Total of 55 respondents	%
Woods	47	85.45
Non-Timber Forest Products	11	20
Aquatic Biota	55	100

Table 12. Use of mangrove wood

Types of utilization	Total of 55 respondents	%
House Fence Poles	23	41.81
Garden Fence Poles	15	27.27
Construction of Houses/Other Buildings	11	20
Firewood	27	49.09
Stakes for Plants	8	14.54
Fishing Fleet Equipment	38	69.09

Table 13. Utilization of non-timber forest products

Types of utilization	Total
Food Products	11
Medicines	11
Orchids	5

Table 14. Utilization of mangrove forest waters

Types of utilization	Total respondents
Fishing	43
Looking for Crab	12
Looking for Snails	17

The following conclusions can be drawn from research on the effect of coastal community activities on the Waranggui mangrove forest in Oransbari Sub-district, South Manokwari District: (i) The total area of the Waranggui mangrove area based on the KLHK land cover map in 2009 is 414.218 ha, and the 2017 map is 406.87 ha, indicating a 7.35 ha reduction in the area of mangrove forest over an 8-year period. (ii) The results of the map issued by the Universitas Papua's Geospatial Unit in 2019 using high-resolution satellite imagery at 60 cm/pixel are 324.57 ha. When compared to the 2009 KLHK map, there is a difference in the area of the Waranggui mangrove forest of up to 89.65 ha, and there is a difference of 82.3 ha when compared to the 2017 KLHK map. (iii) Data from the DJI Phantom 4 Professional Drone at a flying height of 200 meters and a resolution of 5.1 cm/pixel, yielded data on the Waranggui mangrove forest covering 384.76 ha. After subtracting the measurement of the open land area of 7.91 ha, the actual area is 376.86 ha. The difference in area between the maps is thought to be due to the interpretation of the coastline and the identification of mangrove forest coverage, as well as the map's resolution. (iv) The use of drones can detect destruction to the periphery and inside the Waranggui mangrove forest. The extent of destruction to mangrove forests caused by drone mapping is 3.38 ha. (v) The variable factor's total scoring value is 270. This demonstrates that socioeconomic factors have a significant impact on the destruction of the Waranggui Oransbari mangrove forest in the South Manokwari District. (vi) As many as 100 percent of the community said they knew about mangroves and that their condition had begun to deteriorate and that they needed to be treated.

Given the various functions and roles of mangrove forests, as well as the consequences of using mangrove land, it is necessary to include the following perspectives from the Regional Government and traditional stakeholders in mangrove management: (i) Any conversion of mangrove forest area for development or cultivation purposes should carefully consider a feasibility study in order to maintain the function and role of the mangrove forest to the

surrounding aquatic ecosystem. This was done to ensure that the Waranggui mangrove forest area was not destroyed. (ii) The local government should designate the Waranggui mangrove area as an ecotourism/nature education area as well as a natural laboratory. (iii) It is necessary to increase community knowledge and awareness of ecological, economic, and social values while also paying attention to local wisdom in order to use the Waranggui mangrove area sustainably.

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