

The impact of water resources management on the socio-economic and ecological aspects

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The impact of water resources management on the socio-economic and ecological aspects of the coastal area of Merauke-Indonesia

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Abstract. Natural resource management in coastal areas should have a sustainable impact on the socio-economic aspects of fishing communities, including fishing communities in Merauke, Papua-Indonesia. In a descriptive qualitative study conducted on fishing communities living in the Merauke area using observation techniques to see the impact of natural resource management on the welfare level of fishermen from the social, economic, and management aspects of mangrove forests that the social and economic conditions of fishermen are quite good, but income as a fisherman is only sufficient to meet primary needs, especially for local fishermen. Meanwhile, the management of mangrove forest resources as an important ecological part in coastal areas around the coast shows that there is a tendency to expand population settlements by utilizing mangrove forest areas as new residential areas that damage the natural ecology in coastal areas. We found that it is necessary to do alternative sources of livelihood that can guarantee sources of community income to improve the welfare of fishermen in coastal areas.

1. Introduction

The population of coastal communities is defined as a group of people who live in coastal areas and the source of their economic life depends directly on the utilization of marine and coastal resources. They consist of owner fishermen, fishing workers, fish and other marine organisms cultivators, fish traders, fish processors, suppliers of fishery production facilities. In the non-fishery sector, coastal communities can consist of sellers of tourism services, sellers of transportation services, and other community groups who use non-biological marine and coastal resources to support their lives [1–3].

Coastal community development must be able to have a positive impact on improving the economy internally [4] because there is a very important link between socio-economic dynamics and the coastal



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environment in the development and assessment of integrated coastal management around the world [5]. Increasing the economic value of the community's family can use an ecological, social and economic approach [6].

The socio-economic conditions of coastal communities are highly dependent on the availability of marine natural resources, namely fish. The improvement of the social and economic conditions of fishermen is largely determined by efforts to utilize resources and environmental conditions. Coastal communities have a role in decreasing environmental quality caused by low awareness of managing ecosystem sustainability and ignoring the principles of environmental conservation [7] which will cause economic problems and increasing social vulnerability [8–10]. However, coastal communities perceive it as a normal thing and do not consider it a serious risk [11].

Climate change is one of the causes of rising water levels so that it has an impact on fishermen's catches and damage to mangrove forests can occur. Merauke, which is one of the areas experiencing the impact of climate change due to carbon emissions from land cover changes in decades, directly or indirectly [12–15]. Changes in land cover contribute to carbon emissions and have an impact on changes in marine ecology and mangrove forests due to coastal abrasion [16].

Based on the above phenomenon, we conducted a study on the management of coastal resources in fishing communities that have an impact on the social, economic and ecological/environmental aspects of the people who live in coastal areas in Merauke and Naukejerai Districts, Merauke District, Papua Province. The research objective is to identify the water resources management system by the fishing communities of the Merauke and Naukejerai districts that have an impact on the social, economic and ecological aspects/environment of the coastal area. In this paper, we will review descriptively about the life of capture fishermen in terms of social, economic and ecological aspects, especially the condition of the mangrove forest in Merauke.

2. Methods

This research framework uses a descriptive qualitative research framework using a survey research approach. Qualitative research is a research method that explores and understands the meaning ascribed to social or humanitarian problems [17]. While the quantitative research data collection used survey methods using questionnaire data collection techniques, interviews, structured note reviews and structured observations. The study was conducted in Merauke Regency by taking a sample of the observation area in 2 (two) districts, namely Merauke and Naukejerai Districts. Empirically, the reason for choosing the observation sample area is that the two districts are part of the coastal area which is the source of livelihood for the fishing communities who live in the area. The research data consists of primary and secondary data. Primary research data were collected using in-depth interviews with community groups to answer the research objectives, while secondary research data were obtained from literature studies from national and international research results, reports, books, and other supporting data sources relevant to this research topic. Data from qualitative research were analyzed descriptively with analytical steps, namely data collection (data collecting), data reduction (data reduction), data presentation (data display), verification and conclusion drawing and verification (Miles and Huberman, 1994). The analysis used is the analysis of costs, income, profits, R/C ratio, and analysis of the fisherman's exchange rate (FER).

3. Results and discussion

Coastal communities as users of aquatic resources face direct challenges to their livelihoods, ranging from environmental problems to socio-economic problems [18]. The fishing community as a diverse community can be one solution in solving social, economic and environmental problems [19].

3.1. The social condition of the fishing community

Fishermen's behavior in terms of social aspects if viewed from education indicators is quite good. Fisherman families, especially fishermen's children, generally go to school. Currently, the education of fishermen's families, especially children, can be said to be quite good where 54% of the education

level of local fishermen's children is junior high school, compared to the education level of local fishermen which is much lower where 63% of non-local fishermen's education level only reaches elementary school level. some even did not finish elementary school. The awareness of parents in sending their children to a higher level of education is because there is support from the local government and the central government which promotes 9 years of compulsory schooling with free school programs throughout Indonesia. In addition, public awareness is supported by the availability of adequate educational infrastructure in their environment. Through the education of fishermen's children, they hope to change the fate of their next generation's lives due to the fact that the education of the fathers and mothers of fishermen's families has low education [20]. The level of education of fishermen will have an impact on the ability of fishermen's families to face future changing scenarios, such as climate change, the challenges of social modernization pressures for life in an increasingly modern society, and the pressures of future economic needs that may increase.

Health services for fishing communities in Merauke are adequate. There is a community health center (Puskesmas) that can be accessed by fishing communities at any time and without any cost for health because public health services are free. The fishing communities in the coastal areas all have a Healthy Papua Card which is used when they go to the Puskesmas or go to a government referral hospital. If the community experiences illness that cannot be treated at the Puskesmas, a referral is made to a regional general hospital, which is located in the district capital. However, there are some fishing communities who use traditional medicine systems inherited from their ancestors without any medical treatment. So the income of fishermen is more dominantly used to meet the basic needs of the family, namely food [20].

3.2. *The economic condition of the fishing community*

The results of field observations illustrate that fishing communities in catching marine products in coastal areas are strongly influenced by the uncertain fishing season. From December to March is the wave season or commonly called the west wind season by local people. If people keep looking for fish, it is usually only enough for household consumption. Meanwhile, April to July is the shady season and in other words, these months are the season for high production of fish and shrimp. In August to November the production of fish and shrimp is not too high but the selling price is high. However, when marine fish production is low, people switch to catching snakehead fish in swamps. This activity is carried out by fishing communities in Naukenjerai when the water in the swamps begins to decrease or dries up.

In general, the economic activities of the fishing communities in the research area are carried out individually and in groups. This is like what happened in the activities of the fishing community of Nagari Tiku Selatan [21]. Group activities in fishing are only carried out by the people in Naukenjerai. In general, community activities are carried out individually because based on interviews with respondents that group activities lead to potential conflicts between group members.

In general, fish and shrimp are sold in kg. The price of fish and shrimp is influenced by the season and is generally sold to collectors in the village or who come from the district city. Economic data from fishing and marine shrimp business activities are presented in Table 1.

The difference in the number of fishery catches results in a gap in fishermen's profits. Based on Table 1, the average profit for local fishermen is lower than for non-local fishermen in the fishing season from March to November. The average profit for local fishermen is IDR 3,994,164,-/month in fish and shrimp season with an average R/C ratio of 3.96. it means that every IDR 1,- the costs incurred by local fishermen, the fishermen's income generated is IDR 3.96,-. Meanwhile, the non-local fisherman's profit is higher, namely IDR 4,523,217,- per month in the fish and shrimp season with an average value of R/C ratio of 3.64, which means that for every IDR 1,- the cost or capital spent by fishermen, the income generated is IDR 3.64. These results conclude that fishing and shrimp fishing businesses on the coast are feasible because the R/C ratio value is > 1 . Fishermen's income can be increased by reducing the production costs of capture fisheries, such as reducing fuel costs [22].

Table 1. Data Production, income, costs, and profits of local and non-local fishermen.

No.	Description	Fisherman -											
		Local						Non-Local					
		High production (4 months)		Low production (5 months)		High production (4 months)		Low production (5 months)		High production (4 months)		Low production (5 months)	
	Fish	Shrimp	Fish	Shrimp	Fish	Shrimp	Fish	Shrimp	Fish	Shrimp	Fish	Shrimp	
1	Productions (kg/month)	236	194	63	27	293	206	81	38				
2	Prices (IDR/kg)	10,000	35,000	15,000	50,000	10,000	35,000	15,000	50,000				
3	Income (IDR) (1 x 2)	2,360,000	6,790,000	945,000	1,350,000	2,930,000	7,210,000	1,215,000	1,900,000				
4	Income per season per month (IDR) (Fish + Shrimp)		9,150,000		2,295,000		10,140,000		3,115,000				
5	Total income per season (IDR)		36,600,000		11,475,000		40,560,000		15,575,000				
6	Total income in 9 months (IDR) (high production + low production)				48,075,000				56,135,000				
7	Average income per month in season (IDR)				5,341,667				6,237,222				
8	Cost												
8a	Fixed cost (IDR)				805,475				1,017,315				
8b	Variable cost (IDR)				542,028				696,690				
8c	Fixed cost per month (IDR) (8a+8b)				1,347,503				1,714,005				
9	Average Profit per month in season (IDR) (7-8c)				3,994,164				4,523,217				
10	Total profit in season (9 months) (IDR) (9 x 9 month)				35,947,473				40,708,955				
11	Average profit per month in a year (IDR) (10/12)				2,995,623				3,392,413				
12	R/C Ratio				3.96				3.64				

Fisherman's Exchange Rate Analysis (FER) was conducted to find out whether fishermen can meet their substantive needs. The results of the FER analysis in Table 2 show that the fishing effort of local and non-local fishermen on the Merauke coast shows that the FER value for local fishermen is 0.9 and 1.2 the FER value for non-local fishermen. This shows that non-local fishing families are more prosperous than local fishermen because the FER value is >1 , which means that fishing families are able to meet their primary, secondary and tertiary needs or have the ability to save. The potential ability of non-local fishing families to save is IDR 1,122,217/month. Meanwhile, the FER value for local fishermen is not good enough because the IDR value is <1 , which means that the local fishermen's families have not been able to fully meet the basic consumption needs of the fishermen's families, even a budget deficit of IDR 923,836/month.

Table 2. Fisherman Exchange Rate (FER) of Local and Non-Local Fishermen.

Description	Fisherman	
	Local	Non-Local
The total income of fishermen from fisheries business (IDR/month) (Y_F) (IDR)	5,341,667	6,237,222
Total income of fishermen from non-fishing businesses (IDR/month) (Y_{NF}) (IDR)	600,000	1,000,000
Total income (IDR/month) (Y_t) (IDR)	5,941,667	7,237,222
Total expenditure for fishery business (IDR/month) (E_F) (IDR)	1,347,503	1,714,005
Total expenditure for non-fishing businesses (IDR/month) (E_{NF}) (IDR)	5,518,000	4,401,000
Total fishermen spending (E_t) (IDR)	6,865,503	6,115,005
$FER_t = Y_t/E_t$	0.9	1.2

The main source of livelihood for the people in the two research areas is as fishermen, but there are alternative sources of livelihood that are used as side jobs, namely as farmers, laborers and others. This is the same as what happened in the fishing community in Lungkak, that the community has a side job other than being a fisherman [22,23]. The income from fishermen's side jobs is used to meet the secondary and tertiary needs of the fishing community. However, modernization of fisheries in fishing communities can be tried to be able to further increase fishery catches and fishermen's income [24], so that people do not need to look for side jobs to meet family needs and focus on developing fishery businesses.

The welfare of local fishermen can be improved if it can reduce household consumption or non-fishing consumption. It is known that from the results of deepening of information in the field that fishermen's families have a consumption pattern that is different from the consumption pattern of non-local fishermen's families, namely the consumption of betel nut which is quite high. Consumption of betel nut is a type of consumption of spices that has been entrenched among indigenous Papuans, including fishermen (local). Consumption of betel nut for them is more important than rice consumption. This consumption pattern occurs in all fishing families surveyed and carried out by all family members, both fathers, mothers, and even children from childhood who have been very consumptive with the consumption of betel nut. In addition, the consumption pattern that is difficult to suppress in fishing families is the consumption pattern of tuak or alcoholic beverages by the head of the family. The family environment of local fishermen is very influential on this consumption. The financial management system by housewives cannot prevent the use of family finances for consumption because the authority of the head of the family in making decisions for local fishing families is very strong.

3.3. Management of Mangrove Forest Resources in Coastal Area

Damage to mangrove forests in the coastal area of Merauke Regency has threatened the ecology of the coastal environment in Merauke Regency which has an impact on the aquatic ecosystem and has an

17 impact on the social and economic aspects of fishermen in the future. The area of Merauke's mangrove forest is 216,196 ha based on satellite imagery [25] Meanwhile, according to 2009 data from Bakorsurtanal, Merauke Regency has a mangrove area of 293,061,159 hectares. Data analysis of the main land use change in the planning unit of Merauke Regency from different time periods shows that each period of mangrove forest land cover changes from primary mangrove forest to eucalyptus forest in the 2000-2005 period covering an area of 2,416 ha, in the 2005-2010 period an area of 2,233 ha [26]. According to the land use planning unit, Merauke Regency has a coastal area of mangrove forest covering an area of 242,348.01 Ha, which is based on the definition of the planning unit. Mangrove forest area is a coastal area which is a natural habitat for mangrove forests and a breeding ground for mangrove forests. Habitat for various marine biota that function as beach protectors and resist the erosion of sea water and protect the cultivation business or the life behind it.

Data on changes in mangrove area which is always decreasing and seeing the potential economic value of mangrove forests from the use of wood and non-timber living in them can cause the poverty rate in the coastal area of Merauke Regency to potentially increase. Utilization of mangrove forests by communities in coastal areas from the results of observations that are used as firewood and expansion of residential areas by people who live on the coast. Land in Merauke in particular and Papua in general is controlled by customary ownership so that coastal mangrove forest lands are traded by ulayat rights owners over the land to people who want to build houses on the coast. This is in line with the results of previous studies that damage to mangrove forests occurs in coastal areas close to settlements because people use mangrove forests as a source of firewood and building materials so that natural mangrove ecosystems are disturbed such as mangrove crabs and other aquatic biota [16]. Even the mangrove forest area is used as an expansion of new settlements for people on the coast. If the mangrove forest management system in Merauke is managed properly, it can provide environmental services to the community in the form of using wood and aquatic biota that live around 8.6 million/head of family.

The results of Adrianto's research in 2016 that some people in coastal areas are in the poverty line due to the low level of income caused by the low level of community knowledge about the use of non-timber forest products [27] In addition, an unplanned and unstructured management system can cause the decline in the role of mangrove forests for the environment and the lives of people living around the forest [28], for this reason, a strategy is needed that supports the growth of mangrove forest management policies by involving relevant stakeholders for the sustainability of mangrove forest management by increasing the development of appropriate science and technology in mangrove forest management [29,30], because so far there is still dualism in government policies, where on the one hand the policy seeks to protect mangrove forests but on the other hand provides opportunities for exploitation of mangrove forests for the benefit of the regional economy and society as well as the inconsistency of national policies and regional policies regarding protected forest management systems such as mangrove forests [31]. For this reason, efforts to improve management by restoring mangrove forests must be considered for several reasons, namely to increase the ecological and environmental value of mangrove forests, the high dependence of the subsystem on mangrove forests and to prevent coastal erosion, decrease fishery resources and others [32].

The existence of mangrove forests in coastal areas is not only limited to a protection function to prevent abrasion. However, the existence of mangrove forests can be a source of income and a source of food for local communities living in the vicinity. In Merauke, the mangrove forest is one of the natural places for crab cultivation. This means that people can catch crabs in season without any intensive cultivation efforts.

4. Conclusion

Our research concludes that from the social dimension seen from the education and health aspects of the fishing community, it is quite good. Fisherman families, in this case, fisherman's children above 54% to 64% go to junior high school and even college. As for access to health services, fishing communities have received good health services. Support for adequate education and health facilities and infrastructure enables the community to access education and health for families. Government support

with education and free medical treatment is very helpful and reduces the household costs of fishermen on the coast. The coastal communities of Merauke generally become capture fishermen. The job of being a capture fisherman in reality has not been able to meet the consumption needs and welfare of the fishing community. Capture fisheries businesses are generally feasible to be cultivated by local and non-local communities, which are marked by the value of the payback period for fishery businesses that are economically viable. The local fishing community every month experiences a household expenditure deficit with a high level of household consumption, namely IDR. 923,836.-/month. Meanwhile, non-local fishermen have the ability to save IDR. 1,122,217.-/month. The level of welfare of fishermen can be done by reducing consumption in the fishing business and family consumption. Ineffective and efficient financial management can be one of the financial deficits of fishermen's families. In addition, efforts to modernize fishing gear technology are needed to increase fish catches and increase fishermen's income. Damage to mangrove forests in coastal areas that occurs naturally due to tidal waves that cause coastal land degradation, as well as due to human exploitation for firewood and building materials, and expansion of settlements. Natural coastal ecology, namely mangrove forests, must be returned to its initial function by making policy regulations that suppress and regulate sustainable coastal area management by local governments by prioritizing the local wisdom system of the local community and carrying out conservation and reforestation of mangrove land with a participatory approach and providing incentives as motivation. community in planting and caring for plants to expand mangrove forests.

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