Linkages of Farmer's Perception on their Livelihoods with Mangrove Forest Conservation in South Sumatra, Indonesia

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ABSTRACT

One of the wetland ecosystem having potential to be developed for some interests of all living beings is the mangrove forest, which has very high values in the ecologic, economic and environmental aspects. Therefore, it should be conserved and managed in effective, efficient and sustainable ways. The research aimed to analyze linkages of farmer's perception on their livelihoods with mangrove forest conservation in South Sumatra, Indonesia. Surveys and interviews are conducted for households around the forest. Data were collected by Focus Discussion Group (FDG) approach from 240 household surveys, interviews with respondents with and key informants with questioner, further local meetings were carried out to identify problems of the forest with AHP (Analytical Hierarchy Process) approach. The research results in conclusion that resource extraction comes from fuelwood, fodder, fish, shrimp, and fruits, especially from fuel wood, fish and lotus leaves. Fuelwood is the most extracted from forest complex by households. Household size, age, and land ownership increase household dependence on the forest resources. The forest resources contributed significantly to the total income of farmers, where middle categories of households depend on the forest resources. Although most of the livelihood of households depends on the forest resources, people who are aware of the conservation forests are very limited. No differences were observed between the perception of indigenous people and migrants on the trend of forest resource sustainability. So far, forest conservation measure is only promoted by government; while the farmer's participant is very low even though conservation could directly benefit farmers. Rehabilitation of mangrove forest land is done by *Avicennia sp., Rhizopora sp., Sonneratia sp.,* and *Bruguiera sp* through government policy reforestation.

INTRODUCTION

Wetland belongs to the most various and productive ecosystem, especially from the agriculture aspect in the broad sense, but the forest resources are finite and non-renewable, which includes regions of delta, lowland, lakes, rivers, flood basins, estuaries, ponds, coastal and marine waters where tidal depth is only about 0-4 m. Therefore, it should be conserved and managed in effective, efficient and sustainable ways [1]. One of the wetland ecosystem having potential to be developed for some interests of all living beings is the mangrove forest, which has very high values in the ecologic, economic and environmental aspects [2]. Around the world there are about 180

thousand km^2 of mangrove forests [3], of that, about 75 thousand km^2 are found in South and Southeast Asia and around 43 thousand km^2 are located in Indonesia. Mangrove and peat ecosystems are an ecosystem that contains a lot of carbon [4].

Mangrove forests in Indonesia are classified as the most productive and unique ecosystems in tidal coastal areas [5]. Mangrove forest is one of the vital ecosystems in tropical countries. The forests can provide a lot of ecosystem services that contribute directly and indirectly to human welfare. The forest benefits are utilized as the source of income and main livelihood of the local people, agriculture in a broad sense, including paddy farming, fish, fiber, water supply, fodder, fuelwood, non-timber forest products, ecotourism, and others [6].

Farmer's perceptions concluded that the importance of forests is purposed for their livelihoods and health. There is a relationship between forests, the hydrological cycle and agricultural production. This is fully understood [7,8]. Thus, they realized that forests play an important role in supporting their daily life, especially in agricultural production activities [9]. Besides that, the agricultural activity on the Eastern part of South Sumatra has been able to provide > 85% of the main livelihood source of local people with paddy as their staple crop. Other farming activities are namely fish farming ponds, shrimp farming, plantations and others [10]. The mangrove forest system plays a very important role in minimizing the impact of hurricanes and tsunamis because the mangrove forest system can act as a barrier to wind and ocean waves [11].

Mangroves provide several basic ecosystem direct functions to support coastal area systems, control pests and diseases and provide plant pollination services. Mangroves also provide other goods and services, such as sources of food, water, shelter, nutrition, and providers of biodiversity. Indirect benefits of the forest can be said as environment functions as a life support system, such as tourism and recreation, flood control, climate control, water purification, protection of coastal areas, biodiversity and others [12,13].

Mangroves are able to provide direct and indirect livelihoods for local communities [14]. Forest products as natural assets are able to support the lives and livelihoods of farmers. Recently, there is a tendency that the contribution of non-timber forest products to rural development and poverty alleviation is increasing [15]. Therefore, the total area of forest in Indonesia decreased by 5-20% and the area of primary forest also decreased by more than 10%. Over the past 50 years, about 70% of the forest area on the east coast of South Sumatra has been degraded. Forest and land fires, land clearing, erosion, illegal logging, population occupations are among the dominant factors in the threat of mangrove forests. Forest degradation causes the structure, size and diversity of vegetation to decline sharply [16].

The loss of this forest causes a decrease in the capacity to provide environmental goods and services as the main factor supporting human life. The indirect benefits are always higher than the direct benefits because of a market failure, thus the indirect benefits are extremely difficult to be quantified financially. However, if the indirect benefits have fallen sharply, thus not only the direct benefits decline, but all human life support system will be degraded [17,18].

This issue is mentioned as serious problem because majority of the local people are very dependent on the forest resources as their main

livelihoods. The decrease in the forest resources have forced local people to find out alternative livelihoods, such as raising poultry and large animals, agricultural crops, crafts, and non-agricultural work. It can be concluded that the conservation of the forest and biodiversity is very important to be executed, so that rural life can be sustainable [19,20].

Forest resources are considered as sustainable if the forests have the ability to recover from the pressure and stress that works on these resources. This self-recovery function is very important to keep a presence in the future. The needed condition to preserve this forest is that the local people should have capability to detect and measure the ecological changes [21,22].

Mangrove forests on the east coast of Sumatra have high biodiversity. Around 35-45% of the local east coast population depend directly on mangroves for their main livelihood. However, their income from non-timber forest products did not increase, tended to be the same or even decreased compared to their farming (agriculture). However, the local people are poor and has less chance to get alternatives livelihoods. Consequently, they still harvesting forest resources for their subsistence despite fully aware of the importance of sustainable forest resource conservation. Based on the above explanation, this research aimed to analyze linkages of farmer's perception on their livelihoods with mangrove forest conservation in South Sumatra, Indonesia.

METHOD

Data were collected by Focus Discussion Group (FDG) approach from 240 household surveys, interviews with respondents with and key informants with questioner, further local meetings were carried out to identify problems of the forest with AHP (Analytical Hierarchy Process) approach. FGD was respondent consist of: (1) Local Farmers, (2) New Comers, and (3) Spontaneous Migrants. Variable of household are AGE (age of the respondents); HHS (household size); EDU (education level); DIST (walking distance to the mangrove forest from the houses, one way in 5 minutes); LAND (agricultural land belongs to the household); OHSM (outstay of the household head from their home for > 3 months); WORK (household member work for forest conservation).

The AHP method is a way to find a solution to a complex condition, unstructured into components and hierarchical arrangements, assigning subjective values to the importance of each variable, and determining the variable that has the highest priority that affects the situation. AHP is defined as a problem solving tool for the following reasons: (1) there is a hierarchical structure as a consequence of the selected criteria; (2) Provide validity of tolerance inconsistencies against various criteria and selected alternatives; (3) Provide sensitivity analysis to make decisions. The field data were analyzed using SPSS version 22 and statistical tests performed by using Ordinary Least Squares (OLS) regression. Furthermore, the data displayed descriptively and in table and figure forms.

RESULT AND DISCUSSION

Results and discussion are focusing on several aspects of the research, namely characteristics of research area; respondent characteristics; farmer's perceptions on mangrove forest conservation; mangrove forest extraction, degradation and household economy; and socio-economic factors affecting mangrove forest extraction.
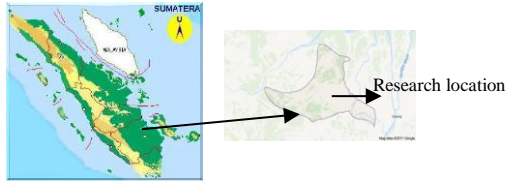
Figure 1. Research location in Tanjung Lago, Banyuasin District, Indonesia

1.1. Characteristics of Research Area

The research has been conducted in the Sub-district of Tanjong Lago Banyuasin, South Sumatra which belongs to the potential reclaimed tidal wetlands with an area of about 82,940 ha. This area is purposed as transmigration area for expansion of food crops and horticulture (Figure 1). It is geographically located at the coordinates of 2° 8'55" South Latitude and 2° 35' 50" North Latitude and 104° 35'40" West Longitude and 104° 47' 00" East Longitude.

The topography and physiographic condition consists mostly of tidal wetlands and relatively flat surface with elevation of 1.00-2.50 m above sea level. Overflow types are classified as Type B and Type C where most of the land is overflowed by the tides in the rainy season and some area will not, but the ground water level is influenced by the tides with a height of <50 cm of the soil surface. Land uses in the Sub-district of Tanjung Lago were interpreted from Landsat imaginary 2020 and presented in Figure 2.

The most areas are already developed for oil palm plantation covering almost half (33,404 ha or 40.79%) of all sub-district area. The focused area of the research is the mangrove forest with an area of about 23.415 ha (28.23%) and upland farming occupied around 12,210 ha (14.91%). Other landuses (namely water body, paddy fields, and housing) occupied areas of around 6,066 ha (7.51%); 4,938 ha (5.93%) and about 1,867 ha (2.28%) respectively.

Local people have become accustomed to harvesting and utilizing the forest resources to support their everyday live for a very long time. This research focused only on households living, which close to the forest area and only consider the direct benefits of the mangrove forest resources without taking consideration the other environmental benefits (i.e., indirect use, option, existence, and bequest).

1.2. Respondent Characteristics

Respondent will be characterized in some terms, especially age, experiences, land size, education level, household member, paddy yield and income, which are summarized in Table 1.

Age of farmers is predominantly categories between the ages of 50-55 years with a mean value of 48.56% of the total respondents, which can be classified into old age. In this age period the body functions possessed by human beings has declined. This is due to worsen lifestyle in consuming food, smoking, and lack of activity in everyday life. Actually that age category is fairly productive. The smallest category is at the age of > 66 years, classified as old age for the head of the family, is not productive for agricultural activity and is caused by lifestyle.
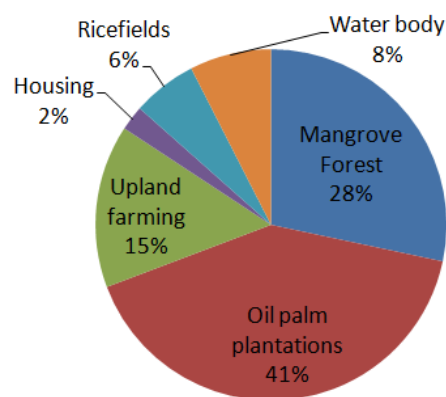

Figure 2. Land uses in the Tanjung Lago Sub-District
Source: Interpretation result of Landsat imaginary (2020)

Table 1. General characters of the sampled respondents

Research parameters	Tribes of farmers[a/]			Average means
	A	B	C	
Age (years)	48.34	48.52	51.31	49.39
Experiences (years)	28.31	29.56	31.99	29.95
Land size (ha)	0.71	2.02	3.29	2.01
Education level (years)	7.91	9.34	9.31	8.85
Household member (people)	3.51	3.45	3.68	3.55
Paddy yield (ton MDG/ha/year)[b/]	2.4-3.2	3.6-4.8	3.1-4.6	2.4-4.8
Income (million Rp/year)	24.45	38.42	51.02	37.96

The average **farmer experience** is around 29.95 years. With this much experience, farmers have been able to manage their agricultural activities. In addition, experienced farmers are able to overcome crop failures or at least minimized agricultural business failures. The average experience of local farmers is 28.31 years, new arrivals experience 29.56 years and the highest is spontaneous migrants (about 31.99 years) because they are the first tribe to start agricultural activities in the research area.

Land size, if the land is cultivated, the land area will determine the total household income. The average land area of farmers is around 2.01 ha. Local farmers have the minimum land area (0.71 ha), then newcomers (2.02 ha) and spontaneous entrants (3.29 ha). Large land demands a lot of labor allocation. The use of land for paddy plants is the maximum that requires labor.

The most dominant category of **education** is the primary school (SD) of 46.51%, while college is the lowest category of education level about 11.23%. This education level is still very low and is one way to increase knowledge of farmers. Low education will generally lead to a lack of knowledge, especially the perception of the local farmers about the need for forest conservation. However, education level cannot guarantee that the forest conservation would go smoothly. Education is only an indicator in knowledge of farmers which affect cognitive in increasing knowledge of the forest conservation. Respondents having college education is the lowest. Generally higher knowledge will be an impact on increasing the awareness of farmers in an attempt to understand the benefit of the forest conservation. Nevertheless, a high education does not determine whether a person will have a negative perception or not about forest conservation. Other factors such as occupation, lifestyle, heredity and others also affect a person in understanding the forest conservation.

The most dominant **employment** category is farmer amounting to 63.41%, while the lowest category is civil servants. The employment category has generally an important impact in the effort to correct understanding about forest conservation. The work of farmers is identical to heavy work because it involves more use of muscle compared to the other jobs. In general, the knowledge of the respondents worked as civil servants are higher, but many civil servants among respondents have a negative view towards forest conservation. The influencing factors are economic pressure, unhealthy lifestyles or consumption and opportunity to exploit the forest resources.

The number of household members certainly affects spending, especially for food. The average number of farming households is 3.55 people, where the highest number is indicated by spontaneous immigrants (3.68 people), immigrants (3.51 people) and local farmers (3.45 people).

1.3. Farmer's Perceptions on Mangrove Forest Conservation

Participation awareness of local people in conservation programs is very low, only about 17% of sampled households (e.g., meetings, workshops, training, breeding, raising consciousness to not perform illegal logging, land clearing by burning, and peat and the harvest remaining burning). The Government and private programs have been implemented for many years working in the research area with thematic issues as appropriate spatial and the forest conservation. However, perceptions of local people to the organizations are also very low.

If the forest conservation can be classified based on local people's interest, which is less useful, helpful, very helpful, thus the majority of households (73% local farmers; 81% of the newcomers and 78% of spontaneous migrants) provide answers that the forest conservation, while the rest (27% of local farmers; 19% of the newcomers and 22% of spontaneous migrants) judged that the forest conservation activities considered to be very helpful. This means that local people responding positively to welcome the forest conservation, only if they are able to see long-term benefits and involving the participation of local people.

Question regarding the forest conversion into oil palm plantations and industry area was expressed in four options, namely strongly disagree, disagree, agree, and strongly agree. About three-quarters of respondents (74.31%) agreed that the forest conversion can be done if accompanied by greater availability of access for the benefit of the local people (e.g., provision of employment opportunities, easy transport, access for roads, housing, electricity, etc.). The percentage of households stating do not agree, if the forest conversion is conducted without paying attention to the interests of the local people.

Local people depends on the forest resources, emergence of awareness of the need for conservation measures once they understand and realize that the economic value of the forest ecosystems can be entered into the subsistence of their families. Most of the perceptions and attitudes of local people, formed by the direct benefits are visible increase of the resources of these ecosystems.

Approach to the forest conservation in general is commonly promoted by the government. It has restricted the participation of local people in decision making and planning. Most households (especially local farmers and new comers) believe that there are decreasing amount of available fruits and animals in the forest complex.

Direct environmental impacts on humans such as landslides, sedimentation, silting channel and soil acidity was found increasing, resulting in degradation of vegetation and ecosystems. Intense social and economic activities and poor management practices are a major cause of damaged forest ecological status in the research area. About 79% of respondents felt that the condition of the forest ecosystems was degraded due to overexploitation action. All tribes argue that a decline in water quality and availability due to the impact of wetland degradation are serious. There are at least three scenarios for implementing the concept of conservation of forest resources, namely:

1) Scenario 1 is the direct adoption of social forestry models that have been developed by the government. The local people will have the opportunity to participate actively and fully to the management of forest resources.

2) Scenario 2 is to promote forest resource-based companies. The company was formed by the government or the private sector and local people to participate actively in the company's stock holdings.

3) Scenario 3 is introducing ecotourism to improve the diversification of the local economic opportunities, which is able to reduce the dependence of local people on forest resources.

1.4. Mangrove Forest Extraction, Degradation and Household Economy

Nowadays local people gathered forest products, such as fuelwood, fodder, fruits and fishes. Fuelwood found in the forest is the most widely extracted resource by the local people. Approximately 94% of households collect fuelwood from the forest as energy for cooking. Around 49% of farmer's households go fishing for food or to be traded in the local market, and fruits are important resource for the local people to consume. Nearly 31% of households depend on the forest resources to meet their needs for livestock as fodder. All the tribes take virtually the same, mainly fuelwood (Table 2).

Table 2. Financial values of Mangrove forest based on interviews with respondents

Harvested component	Harvested quantity (household/year)	Capitalization value (Rp/year/household)
Fuelwood (kg)	2,120.42	600,000
Fodder (kg)	201.62	300,000
Fishes (kg)	25.51	382,650
Fruits (kg)	85.45	640,875
Total		1,923,525

Source : The results of primary field survey (2021)

It is found that > 65% of the population who live near wetland depends on the forest resources to ensure household food security and livelihoods. It is found that 68% of local people living around forest depend on the forest resources for income and food. Overall, the average income of the local people varies (local farmers; new comers; spontaneous migrants), respectively Rp 24.45; Rp 38.42; and Rp 51.02 million/year (Table 2). The average income of the population is Rp 37.96 million/year. Additional financial value of the forest resources contributed by the farmers' additional household income is in the range 3.76-7.85% of total income. When compared to the contribution of forest resources in dry land, it was reported that the average contribution of forest resources in dry land is around 15.61% [11]. Forest resources (fuelwood, fodder, fish and fruits) can make a significant contribution to the total income of households of farmers.

1.5. Socio-economic Factors Affecting Mangrove Forest Extraction

These various socio-economic variables have an influence on the extraction of forest resources. Results of statistical processing of the data presented in Table 3 and Table 4 for the OLS regression.

Table 3. Explanatory variables and descriptive statistics for the forest resource use

Descriptive statistics	Variable[1]/						
	AGE	HHS	EDU	DIST	LAND	OHSM	WORK
Direction of hypothesis	+	+	-	-	-	-	-
Minimum	17	1	1	4	0.5	0	0
Maximum	68	31	12	98	6.5	1	1
Mean	43.52	5.27	7.72	40.53	2.01	0.16	0.17
Standard deviation	9.523	2.012	1.089	17.341	1.214	0.356	0.327

Note: [1]/AGE (age of the respondents); HHS (household size); EDU (education level); DIST (walking distance to the Mangrove forest from the houses of farmers, one way in 5 minutes); LAND (agricultural land belongs to the household); OHSM

(outstay of the household head from their home for > 3 months); WORK (household members work for forest conservation).
Source: Results of statistical analyses (2021).

Forest revenue is significantly affected by the size of the farm households. The age of respondents is positive and significantly influenced the forest income of households. Older farmers extract more forest resources and get more income. This happens because older people have more experience and are familiar with the condition of the forest, so they work faster and more efficient to harvest forest resources.

Household size is also positive and significantly affected the income of the forest resources. This increase is closely linked to an increase in the number of people to harvest the forest resources. So the more family members of households determined, the more that can be harvested from the forest resources. Explanatory variables and descriptive statistics for the forest resource use summarized in Table 3 and determinant factors of forest-based income in Table 4.

Table 4. Determinant factors of forest-based income

Analyses of statistics	Variable[1]/						
	AGE	HHS	EDU	DIST	LAND	OHSM	WORK
Coefficient	25.78*	240.07**	184.87	7.04	20.38*	663.78*	1049.41*
Standard error	12.86	46.87	331.76	6.31	8.78	313.03	476.03
t-ratio	1.99	5.42	0.65	1.12	2.28	-2.04	-2.19

Note: $R^2 = 0.254$, adjusted $R^2 = 0.213$; [1]/Variable is explained in Table 3.
*/ It is significantly different at 5% (p<0.05)
**/ It is very significantly different at 1% (p< 0.01)
Source: Results of statistical analyses (2021).

CONCLUSION

There are so many forest resources that can be extracted, which are fuelwood, fodder, fish, shrimp, fruits, etc. Fuelwood, fish, and lotus leaves are dominantly extracted while fuelwood is the most extracted resource. Household size, age, and land ownership increase household dependence on the forest resources. The forest resources contributed significantly to the total income of farmers, particularly middle categories of households. Although most of the livelihood of households depends on the forest resources, people who are aware of the conservation forests are very limited. No differences were observed between the perception of indigenous people and migrants on the trend of forests resource sustainability. So far, forest conservation measure is only promoted by government, while the farmer's participant is very low even though conservation could directly benefit farmers. Rehabilitation of mangrove forest land is done by *Avicennia* sp., *Rhizopora* sp., *Sonneratia* sp., and *Bruguiera* sp through government policy reforestation.

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