

CONTRIBUTION OF MANGROVE FOREST AND SOCIO-ECONOMIC DEVELOPMENT OF LOCAL COMMUNITIES IN KUDAT DISTRICT, SABAH MALAYSIA

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ABSTRACT

Mangroves provide many direct and indirect benefits to humans of which also identified as ecosystem services of the forest. Villagers living within, and around the mangrove area use goods and services from the forest as their source of livelihood. The purpose of this study was to identify goods and services taken from the mangrove forest and to determine its value based on income derived by the local community. Six villages were selected as study sites located in the division of Kudat, Sabah. The method used was semi-structured interview involving 60 respondents representing the head of households. The results indicate that the primary products collected from the mangrove forest are of two main categories namely non-forest products (mud crab (*Scylla serrata*), fishes, 'lokan' (*Geloina coxans*) and mud creepers (*Cerithidea obtusa*)); and the forest products (fuelwood and firewood (*Rhizophora*'s), Tannin (bark), flavorings (Tengar bark), nuts (*Sonneratia*'s), piling poles and medicinal plants). The non-forest products generated the highest income with an average of RM432.75 per household/month, whilst forest products contributed to an average of RM40.85. The study also revealed that 73 percent of the total respondents were living under the hardcore poor earning bracket with a monthly income of less than RM500. Further studies are required to learn more on the adaptation of the community towards the importance of mangrove forest and their livelihood.

Key words: Mangrove forest, Good and Services, Ecology, Community Livelihood, Socio-economic, Malaysia

Introduction

Mangrove forests are particularly found in tropical and subtropical regions within 30° of the equator. These tidal areas, such as estuaries and marine shorelines, are frequently inundated with salt water. Strongly in decline, mangrove forests occupy about 15.2 million hectares of tropical coast worldwide: across Africa, Australia, Asia and America (Spalding et al., 2010).

Mangroves ecosystems provide significant socio-economic benefits such as timber, fish, and environmental services such as coast protection, water regulation and nursery habitat for a wide-ranging diversity of species. Global damage of mangroves became substantial in latest years, even though some areas still have very rich mangroves forests (Alongi 2002). Mangroves are threatened by both natural impacts such as climate change, hurricane, and human impacts like cutting and pollution, and alterations by freshwater management (Lo et al., 2011). Approximately 35% of mangroves were lost in the last two decades and this was mainly due to the rapidly growing and unsustainable land use practices (MEA 2005). Mangroves are every so often considered as unpleasant areas with low value (Dahdouh-Guebas et al., 2005).

Studies by Narendran et al., (2001); Delang (2006) highlighted that the consumptive contribution of mangroves to the livelihoods of coastal communities is often ignored and receives little recognition from the policy makers and practitioners. One of the reasons is that little information is available on the types of goods and the quantity extracted, processed or sold. Vo et al (2012) confirms that both goods and services provided by mangrove ecosystems contribute to human well-being, both directly and indirectly. While, knowing the economic value of an ecosystem and its services is an important asset, because a major demand is the support of human well-being, sustainability, and distributional fairness. Available data are also needed for decision making processes (Costanza and Farber, 2002). Numerous numbers of studies has been done for assessing the economic values for mangrove ecosystem services. No particular valuation method can be considered suitable for the whole ecosystem services, however collection of methods have been used according to service type, available data and timeframe of the study (Mahmoud Sarhan, 2014).

Bann (1999) estimated the ecosystem service benefits for Johor mangrove forest in Malaysia using contingent valuation (CV) for the biodiversity hotspot "Benut Mangroves". He estimated the use values delivered from site conservation in terms of capture fisheries, tourism and shoreline protection to be US\$1,375 per hectare in addition to non-use values of US\$7,512 per hectare. That figure, which doesn't include the potentially high existence value, refers to the importance of this site especially at the local level. The study has recommended that the site should be under better conservation policy such as a protected forest reserve or State park.

While, assessing the economic value of the ecosystem goods and services is ever more became essential condition for environmental decision-making (Vo et al., 2012). According to Tomlinson (1986), the value of a mangrove forest depends on how a person value it, whether as a harvested product or usage product or to be converted into something more profitable. In reflection to the issues as mentioned above this study has been conducted to access the information of local community who live in the vicinity of mangrove area. The purpose of this study was to identify goods and services taken from the mangrove forest and to determine its value based on income derived by the local community in Kudat district, Sabah Malaysia.

Materials and Methods

Study area

The study areas that have been chosen are Kudat Division which includes Kudat and Banggi Island, both located at the northern part of Sabah. Three villages are chosen from each area, making a total of six villages. The three villages chosen in Kudat district are Kg. Longgom Kecil, Kg. Bukit Kelapa and Kg Parapat Laut while the other three villages at Banggi Island are known as Kg. Sabur, Kg. Maligu and Kg. Laksian. These six villages were chosen because of their accessibility and located near the mangrove forest (Sabah Forestry Department, 2014).

Interview and Questionnaire survey

The methods that were used were direct interview with structured prepared questionnaires. The questionnaires consist of three sections which includes demography, uses of mangrove products in monetary and nonmonetary value, and respondent perception on the awareness and the importance of mangrove forest. The approach is by interviewing the head of family, village head and people representative for Village Development Committee (JKKK). Interviews with village head and JKKK were aimed at getting information on local history, village background, different forms of government aids or non-government aids and other social problems. The interviews were conducted in Bahasa Malaysia with a translation by a translator if the respondents using their own languages.

Observation

The other method used was observation. A digital camera was used to record the activities and their usage of mangrove products by the local communities. Free listing has been used to rank the priority of mangrove product used by the communities. Global Positioning System (GPS) was used to locate the position of the villages as well as the mangrove forests.

Economic valuation and data analysis

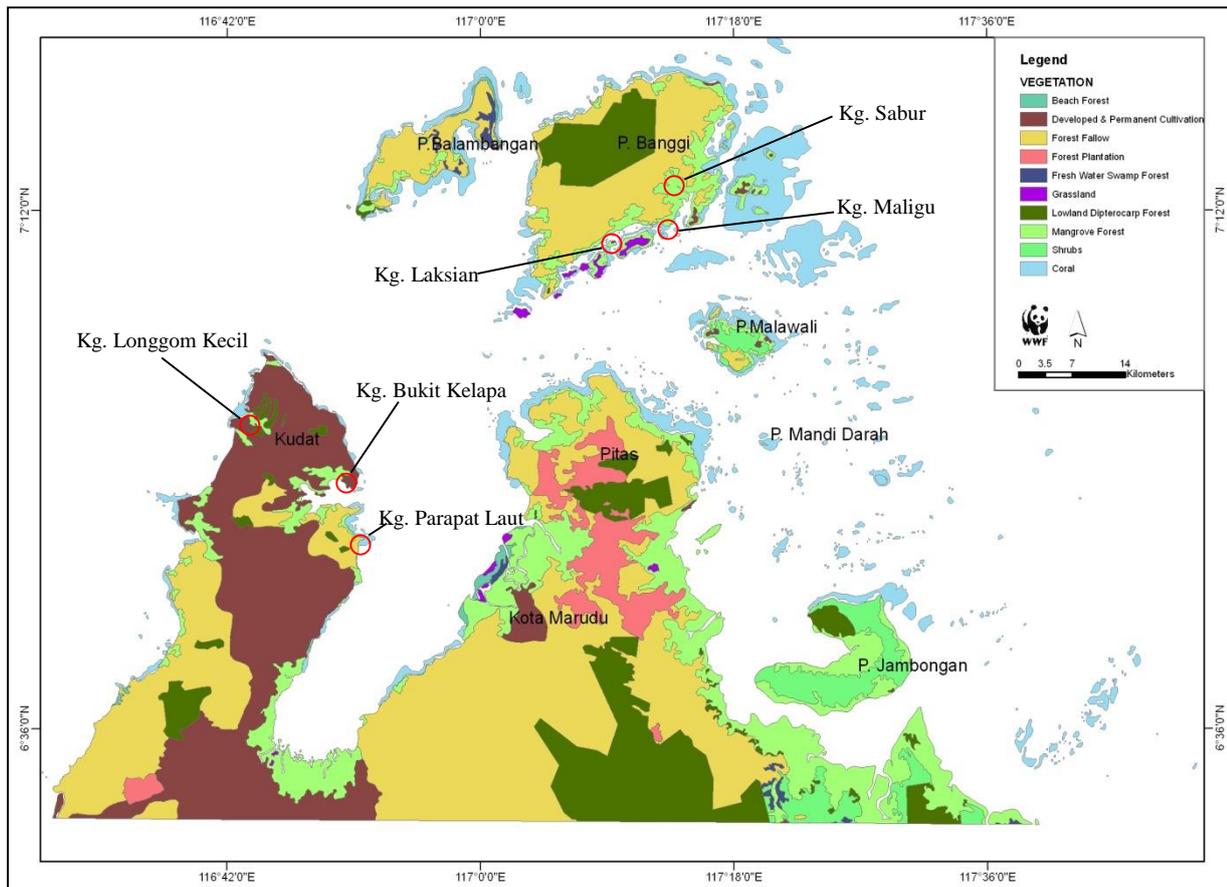
Questionnaires on gross income and expenditure as well as frequency on collection of mangrove products were put forward to respondent. The value of mangrove products is calculated by the equation as follows the study from Sathirathai, (2003) and Izarenah & Sulong, (2009).

$$\text{Value of mangrove product} = \text{Total net income from the use of local residents} = \sum\{P_i Q_i - C_i\}$$

Whereas; P_i = Prices of product i
 Q_i = The amount of product i obtained
 C_i = The cost of taking the product of i

If the product is being sold, the market price is used to calculate the gross income generated whereas if product is being used for subsistence purposes, the gross income is estimated based on surrogate price (Sathirathai and Barbier, 2001). The data collected was classified, tabulated and analysis by Statistical package for Social Science (SPSS) and was presented in table form.

Figure 1: Map of Kudat Division with the location of six villages as study areas in Kudat and Banggi Island



Source: WWF Kota Kinabalu (2007)

Results and Discussion

A total of 60 respondents from 6 villages have been interviewed. Out of these, 32 percent's are from Bajau's that representing the majority ethnic in these research areas. Other minor tribes included the Rungus, Sungai, Binaden and Bonggi with represent 17 percent's respectively. Out of these 60 respondents, 53 respondents are male and the rest are female. From these 7 female respondents, 6 are from Kudat district and only 1 was from Banggi Island.

Most of the respondents are within the age group of 41 to 50 years, representing 30 percent of the total respondents whereas the age group between 11 to 21 years comprising only 10 percent. Respondents in the age group of between 41 to 50 and 51 years above (20 percent respectively) are mostly found in Banggi Island whereas those in the age group between 31 to 40 years (20 percent) are mostly in Kudat district.

Educational level of the respondents in both Kudat district and Banggi Island are about the same. The highest educational levels are only achieved until secondary school with only 20 percent. While 37 percent of the total respondents have no formal education at all and those achieving Primary level are at 43 percent.

The total household income with less than RM500 per month reaches 78 percent. Most of the respondents are among those in the hardcore poor earning. Those household with total monthly income of more than RM500 is only at 15 percent. Their income are mostly generated by the selling of non-timber forest products collected from the mangrove forest such as fishes, crab, shells and prawns. The main contributors in both areas are crabs and fishes. Their usage of timber forest products collected from the mangrove forest is mostly for subsistence purposes such as construction materials or fire wood when they have run out of fuel.

Table 1: Monthly average market value and income generated from non-timber forest productions in Kudat

Product	Scientific name	Market Price /kg (RM)	Harvest (Kg /month)	Estimated expenses (RM/month)	Income /household (RM/Month)
Crab	<i>Scylla serrata</i>	4.00 – 10.00	75.30	177.40	349.70
Fishes	With different species	2.00 – 12.00	74.60	265.50	256.70
Bivalve	<i>Geloina coaxans</i>	3.00	11.25	-	33.75
Seashells	Various species	1.00 – 2.00	10.30	-	15.45
Total		17.00	171.45	442.90	655.60

The tables no. 1 and 2 shows that the market price for the four main types of non-timber product collected from mangrove forest is higher in Kudat with an average estimated income of RM655.60 per household per month. In Banggi Island, the same types of non-timber product only generate an estimated monthly income of RM209.90 per household. The recruitment for this product is due to the influence of seasonal monsoons and most of the fishermen will not go to the sea during the northeast monsoon started from the month of November and ended at early March every year.

Table 2: Monthly average market value and income generated from non-timber forest productions in Banggi Island

Product	Scientific name	Market price/kg(RM)	Harvest (Kg/month)	Estimate expenses (RM/month)	Income/ household (RM/month)
Crab	<i>Scylla serrata</i>	3.00 – 5.00	52.90	93.40	118.20
Fishes	With different species	3.00 – 7.00	27.85	77.25	62.00
Bivalve	<i>Geloina coaxans</i>	1.00 – 3.00	15.00	7.00	23.00
Seashells	Various species	1.00	6.70	-	6.70
Total		11.50	102.45	177.65	209.90

Frequency of Collection of Non-Timber Products

From the four main types of non-timber products, crabs and fishes represents the most frequent collected by the local communities in Kudat district and Banggi Island (Table 3). Almost half of the respondents in Kudat district and Banggi Island collected crabs and fishes at a frequency of 1 to 5 times a month. There were 8 respondents in Kudat who collected crabs at a frequency of 11 to 15 times monthly whereas 9 respondents collected crabs at the same frequency per month at Banggi Island. There were 9 respondents who collected fishes at a frequency of 11 to 15 times a month at Kudat district but only 1 respondent did the same at Banggi Island with the same frequency. The collection of lokan and seashells at a frequency of 1 to 5 times a month were done by 16 and 14 respondents respectively in Kudat district. In Banggi Island only 6 respondents collected lokan and 10 respondents collected seashells at the same frequency of 1 to 5 times monthly.

According to Fisher (2000) in her study on 'Socio-Economic Assessment of Coastal Communities of Pulau Banggi Sabah', found that 85 percent of Banggi villagers are involved in fishing. Data gathered from Fisher (2000) supported that fishing activity is a very important livelihood to the communities at Banggi Island rather than collecting mangrove timber or fuelwood. Fishing is an important occupation which has been, by traditional, practiced by the communities living on the island of Banggi. In table 3, the frequency of the respondent going to the sea for collecting non-timber forest product (i.e. crabs, fishes, bivalve and seashells) are within 1 to 5 times per month. However the collecting for crab and fishes are more and sometimes can reach to 11 and 15 times per month.

Table 3: Frequency of collecting non-timber products at Kudat and Banggi Island

Frequency/month	Products			
	Crabs	Fishes	Bivalve	Seashells

Kudat				
1-5 times	11	12	16	14
6-10 times	4	4		
11-15 times	8	9		
Total respondents (a)	23	25	16	14
Banggi Island				
1-5 times	15	17	6	10
6-10 times	1	8		
11-15 times	9	1		
Total respondents (b)	25	26	6	10
Grand total (a) + (b)	48	51	22	24

Contribution of Mangrove Timber Products in Kudat and Banggi Island

From the 60 respondents that had been interviewed for mangrove timber product only 4 respondents in Kudat and 8 respondents gave information about the collecting of timber products from the mangrove forest. According to the information obtained, table 4 shows the contribution of timber forest products used as fuel wood in both areas of research. Timber forest products generated RM30.00 per month in Kudat district and RM22.50 at Banggi Island. The same data also shows that all respondents used the timber products as a fire wood when they have run-out of fuel for cooking. Market price for fire wood depends on the price that was given by respondents at any one time at both areas of research.

Table 4: Contribution of timber product as fuel wood

Area	Wood type	Scientific name	Market price (RM)/(2' x 2'')/pc	Average collection/month (2' x 2'')/pc	Respondent	Household income (RM/month)
Kudat	Tangar	<i>Ceriops tagal</i>	0.30	100	4	30.00
	Bakau	<i>Rhizophora sp</i>				
Banggi Island	Tangar	<i>Ceriops tagal</i>	0.30	75	8	22.50
	Bakau	<i>Rhizophora sp</i>				
Total						52.50

Note: 2' x 2'' = wood size of 2ft long and 2in width.

Table 5 show the contribution of mangrove forest as construction materials that used for building of houses, bridges, fences and others. The market price depends on the labor charges to collect the rare material from the forest. The total contributions of mangrove wood towards the social economy development of the respondents are RM140.00 in Kudat district and RM210.00 at Banggi Island for one year. This contribution is depending on the permit released by the forest department for the permission of cutting.

Table 5: Contribution of timber products used as building materials

Area	Local Name	Scientific name	Market price (RM)	Collection /1 year	Respondent	Household income (RM/year)
Kudat	Tangar	<i>Ceriops tagal</i>	7.00	20 tree	4	140.00
	Bakau	<i>Rhizophora sp</i>				
Banggi Island	Tangar	<i>Ceriops tagal</i>	7.00	30 tree	8	210.00
	Beus Bakau	<i>Bruguiera sp</i> <i>Rhizophora sp</i>				
Total						350.00

The following table 6 shows the list of main products collected by the respondents at both areas and different ways of harvest/collecting. There were only 2 timber-products and 4 non-timber products that were normally collected by the respondents at both areas of research.

Table 6: List of mangrove forest products collected at Kudat District and Banggi Island

Local name	Scientific name	Harvest/collection method
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Tangar	<i>Ceriops tagal</i>	Axe and parang.
Bakau	<i>Rhizophora apiculata</i> <i>Rhizophora mucronata</i>	Axe and parang
Crab	<i>Scylla serrata</i>	'Bintur' / 'selambau' and crab net.
Fishes	Various types (n/a)	Fishing and netting.
Bivalve	<i>Geloina coxans</i>	Using machete (Parang) to detect the location of the bivalve inside the mud.
Seashells	With different types (n/a)	Only hand picked because they are found mostly on the forest floor or stuck on mangrove trees trunks.

Note: n/a= not available

According to Zubaidah (2010), the local communities in Kudat are not depending directly on the resources derived from the mangrove wood but instead, more on fishing activity. In this study it was also found that most of the respondents not utilized mangrove timber as a main source of income but rather in small scale for their own consumption.

Mangrove Ecosystem Contribution: Good and Service

The categories of mangrove ecosystem contribution from fuel wood and marine products are more important to the respondents in this study area while the categories from food / drink and others (handicraft and decoration) are less important (Table 7). The categories from construction materials, fishing equipment, medicinal values and domestic uses are moderately important. According the study by Admawidjaya (1986) in Denpasar Indonesia, stated that majority of the local communities stay near the mangrove forest were less aware of the usefulness of mangrove product as food source, medicinal values, domestic uses, or making handicraft and decoration. Vo et al (2012) confirms that both goods and services provided by mangrove ecosystems contribute to human well-being, both directly and indirectly. While, knowing the economic value of an ecosystem and its services is an important asset, because a major demand is the support of human well-being, sustainability, and distributional fairness.

Most of the mangrove timber product were not utilized as a source of income but rather for own consumption. Marine products or aquatic organisms like fishes, crab and bivalve are the important categories because it is a source of immediate cash, as well as food, for the communities. After marine products, firewood and charcoal are used by the respondents. Ong and Petol, (2007) stated that charcoal is wood that has been carbonized by partial burning with little air. It has about twice the calorific value of wood and because it burns hotter and cleaner, it is considered superior to the fuel wood.

Under favorable conditions, mangrove trees can grow to large sizes and be useful in the construction. Mangrove trees always used as timber, piling, flooring, thatch, for fence, fence posts, poles, bridge, stairs and cottage. Poles extracted are used as agricultural stakes and fencing material. The extraction of medicine from mangrove trees, domestic uses and food or drink are not many know or recognized by the respondents except for the older respondents. Limiting knowledge about these special uses of mangrove can make them disappeared especially for medicinal use (Mojiol et al, 2010).

Others uses are included handicraft and decoration from mangrove trees that can be commercialize, and same with the domestic uses especially for making cosmetic (Chan & Salleh, 1987). It will give beneficially to local communities which also can bring in an additional income. However, it is not easy and need support from the government or Non-Government Organizations (NGOs). For making fishing equipment, it was less used by the respondents and only used in their free time.

Demographic characteristics of age, income and part-time employment factors have a strong relationship with the dependency on mangrove. Age factor ranges between 50 to more than 60 years old have more experience in the utilization of mangrove product. Meanwhile, younger respondents did not have more experience and often some of them never been in the mangrove forests. Self-employment showed that majority of the respondents earned less than RM500 per month and need additional job to increase their income. Most of them are worked as a fisherman.

Table 7: List of good and services from Mangrove Forest in Kudat and Banggi Island

Category	Parts	Products/ Uses	Local Name	Scientific Name	Important rank
Mangrove Wood Products					
Fuel Wood	Wood, Branches	Charcoal Firewood	Tengar Bakau	<i>Ceriops tagal</i> <i>Rhizophora spp.</i>	5
Construction Materials	Wood	Timber Piling Flooring Thatch	Tengar, Bakau, Santing Tengar	<i>Ceriops tagal</i> <i>Rhizophora spp.</i> <i>Lumnitzera littorea</i> <i>Ceriops tagal</i>	

		Fence Fence Posts Poles Bridge, Stairs, Cottage Cage	Bakau Bakau Bakau	<i>Rhizophora</i> spp. <i>Rhizophora</i> spp. <i>Rhizophora</i> spp.	4
Fishing Equipments	Small Wood, Branches	Fish Traps Fishing Rod Fishing Poles Crab Traps	Perangkap Ikan Pancing Pancing Perangkap Ketam	<i>Rhizophora</i> spp. <i>Rhizophora</i> spp. <i>Rhizophora</i> spp. <i>Rhizophora</i> spp.	2
Mangrove Non-Wood Products					
Marine Products		Fish Crab Bivalve etc.	Ikan Ketam Bakau Lokan	<i>Scylla serrata</i> <i>Polymesoda expansa</i>	5
Domestic Uses	Shoots, Barks, Fruits, Seeds Barks Barks	Cosmetic Tannin Dyes Coloring	Perepat, Terbigit Tengar Tengar	<i>Sonneratia alba</i> <i>Xylocarpus granatum</i> <i>Ceriops tagal</i> <i>Ceriops tagal</i>	3
Medicinal Values	Fruits, Barks, Seeds, Shoots	Constipation Bleeding Sore Throat Dysentery Stingray Stings Smell Breath Catarrh, Swollen, Fever, Diarrhea	Bakau Santing Tengar Terbigit Api api Bakau Perepat,	<i>Rhizophora</i> spp. <i>Lumnitzera littorea</i> <i>Ceriops tagal</i> <i>Xylocarpus granatum</i> <i>Avicennia marina</i> <i>Rhizophora</i> spp. <i>Sonneratia alba</i>	3
Food/Drink	Barks Fruits, Barks Fruits, Shoots	Fermented Drinks Seasoning Vegetables	Tengar Perepat	<i>Ceriops tagal</i> <i>Sonneratia alba</i> <i>Bruguiera</i> spp. <i>Avicennia marina</i>	1
Others: Decoration Handicraft	Dead Wood Fruits Wood, Roots	<i>Bonsai</i> Oil Lamp Short Machete Head	 Terbigit	<i>Lumnitzera littorea</i> <i>Xylocarpus granatum</i> <i>Xylocarpus granatum</i>	1

1= Strongly Not Important, 2= Not Important, 3= Medium Important,
4= Important, 5= Strongly Important

Conclusion

As a whole, the research has been done successfully. Mangroves ecosystems provide significant socio-economic benefits such as timber, fish, and environmental services such as coast protection, water regulation and nursery habitat for a wide-ranging diversity of marine species. The goods and services taken from the mangrove forest can be categories into two namely non-forest products (mud crab (*Scylla serrata*), fishes, 'lokan' (*Geloina coaxans*) and mud creepers (*Cerithidea obtusa*); and the forest products (fuelwood and firewood (*Rhizophora*'s), Tannin (bark), flavorings (Tengar bark), nuts (*Sonneratia*'s), piling poles and medicinal plants).

The non-forest products generated the highest income with an average of RM432.75 per household/month, whilst forest products contributed to an average of RM40.85. The study also revealed that 73 percent of the total respondents were living under the hardcore poor earning bracket with a monthly income of less than RM500.

The mangrove forest products (MFPs) can be divided into 8 categories; there are marine products, fuel wood, construction materials, medicinal values, for domestic uses, fishing equipment, food or drink and others that are included decoration and handicraft. The highest category of MFPs that was used by communities was marine products (fishes, crab, bivalve and seashells).

The information collected can be used as baseline information for future references. This research could also help government or policy makers to form strategy to help to preserve the mangrove forest and at the same time able to upgrade the standard of living of the local communities of Kudat and Banggi Island. It is recommended that further studies are required to learn more on the adaptation of the community towards the importance of mangrove forest and their livelihood.

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