

Importance, Value Addition and Marketing Chain of Mangrove Wood in Fako Division, South West Region, Cameroon

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Mangroves are highly productive ecosystems which are adapted to survive in harsh brackish water and at the interface between land and sea. This study examines the socio-economic and ecological importance of mangroves, value addition and marketing chain of mangrove wood in Fako. This study employed the cross-sectional research design. Data were obtained using primary and secondary sources. Primary data were obtained through field observations, structured interviews, focused group discussions and the administration of questionnaires. Secondary data were obtained from published and unpublished materials and reports. Data were entered using EpiData Version 3.1 and analyzed with the aid of the Statistical Package for Social Sciences (SPSS). Data were presented using prose, frequency tables and illustrations. The study found out that mangroves serve socio-economic and ecological, functions to the population. Also, mangrove wood is harvested from major areas such as Tiko and Mudeka, and sold throughout the coastal settlements of Mutengene, Buea and Limbe. This is achieved through value addition and commercialisation of mangrove wood. The study recommended the implementation of legal and institutional framework, community participation and integrated management of shared resources and strict enforcement of other international legal instruments ratified by member countries such as the Ramsar Convention and Convention on Biological Diversity (CBD) so as to better conserve mangrove forests.

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1. INTRODUCTION

Mangroves are widely recognized as an important and productive coastal ecosystem in the tropical milieus. Mangroves are highly productive biodiversity ecosystems which are adapted to survive in harsh brackish water and at the interface between the land and the sea. The net primary productivity of mangroves supports numerous forms of wildlife and avifauna as well as estuarine and near-shore fisheries. Mangrove habitats are significant natural resources traversing the interface between terrestrial and marine environments. Mangroves constitute a productive ecosystem in an abiotically challenging and often highly unproductive environment [1]. Mangroves are important resources providing raw materials and land for urban development, farming and aquacultural ventures [2]. They provide a wide range of resources and ecosystem services for human livelihoods, including: fisheries production; timber production; coastal protection; pollution abatement; and carbon sequestration [3]. Mangroves play an important role in sustaining the livelihoods and cultures of many people. Mangroves are beneficial in areas of tidal influence, protecting the coastline from natural erosion stressors [4,5]. Mangroves support a range of wildlife and fishery resources, supply a range of commercial products and provide a number of ecological services [6]. These include timber and honey production, fisheries nursery, sewage wastewater treatment, and coastal protection [7].

In the African continent, mangrove forests cover over 3.2 million hectares which make up about 19% of the total land surface; and are found in the low-lying swampy areas of the Niger Delta (Nigeria), the Congo Basin marshes and the Wouri, Mungo and Sanaga estuaries in Cameroon [8]. The largest mangroves in Africa are found in the Niger delta region of Nigeria with up to 0.8 million hectares of mangrove stands in this area [9].

The coastline of Cameroon covers about 590 km of the Gulf of Guinea from the Bakassi peninsula bordering Nigeria to the River Ntem estuary

bordering Equatorial Guinea. The estimated mangrove area in Cameroon has decreased from 250,000 ha to 134,000 ha [10]. However, some of Cameroon's mangrove forests are still relatively intact, the most notable of which can be found in the Rio del Rey estuary, the Cameroon estuary of Douala and the smaller estuaries at the mouths of the rivers Sanaga, Loukoundje and Ntem [11].

The abundance of mangrove stands along the coast of Fako Division has made mangrove wood exploitation an important economic activity. The exploitation, commercialization, distribution and utilization of mangrove wood extend far beyond the areas where it is harvested. This study therefore focuses on the social, economic and ecological importance, value addition, and the marketing chain of mangrove wood in Fako Division.

2. THE STUDY AREA AND METHODS

2.1 The Study Area

Fako Division is located between latitudes 3o50' to 4o25' North of the equator and from longitudes 8o 55' to 9o35' East of the Greenwich (Fig. 1).

It covers a surface area of 2,093km² and has a total population of 534,854 [12,13]. It spans from Idenau in the south western flank of the Mungo River in the south east to Tiko. It borders the Atlantic Ocean to the south, Ndiang to the west, Mungo to the east and Muyuka to the north. The study area encompasses the entire coastline of Fako Division including Idenau, Limbe I, II, and III and Tiko sub-divisions. In Tiko, the study sites cover the Apolos Beach and Douala-Koto Beach while in Limbe some settlements were selected along the Atlantic Ocean which will include: Mudeka, Tiko, Mabeta Fishing Port, Bimbria, Mondoli, Mbonjo, Batoke and Idenau. Furthermore, extending towards the Limbe, selected areas include: Mabeta Fishing Port, Bimbria, Mondoli, Mbonjo and Batoke. The occupations of the people in these localities are a mixture of agriculture, petty trading, and white collar jobs.

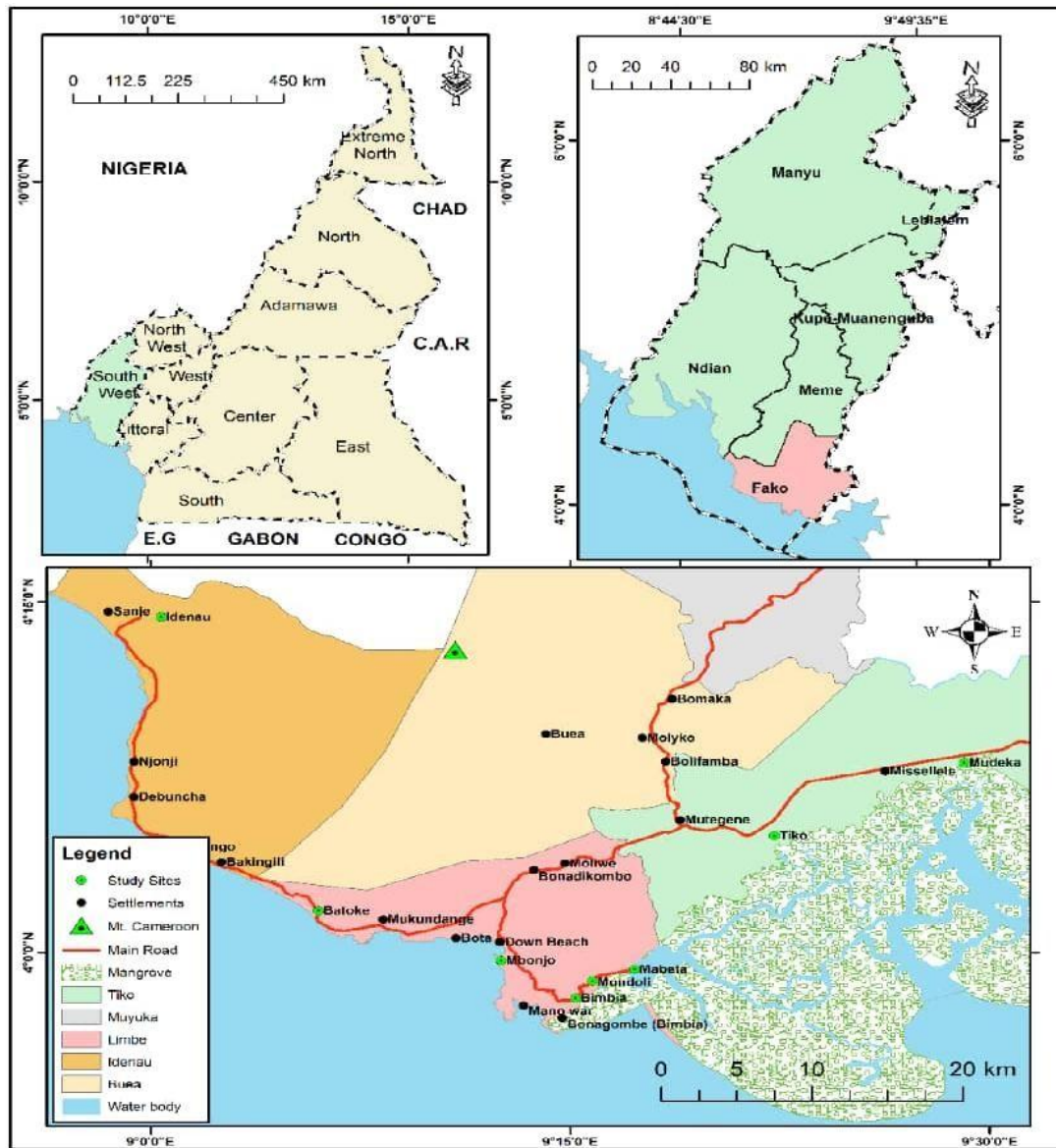


Fig. 1. Location of the Study Area
 Source: Administrative map of Cameroon (2020)

2.2 Research Methods

The target population of the study comprised the population of the selected localities in Fako Division which include Mudeka, Tiko, Mabeta Fishing Port, Bimbia, Mondoli, Mbonjo, Batoke and Idenau who directly or indirectly benefit from mangrove exploitation. These included wood harvesters, firewood sellers, fishermen, and boat transporters who obtain direct benefits from the mangrove ecosystem.

Primary data included semi-structured interviews and questionnaires. The major study sites were selected through a reconnaissance survey

involving field visits. Questionnaires constituted the main tool for primary data extraction for this study. The questions were semi-structured to include both opened and closed-ended questions. This facilitated the analyses and interpretation of the responses. The questions were designed based on the major themes of the study. Field observations were also done where socio-economic activities were observed.

Secondary data were obtained from libraries. Secondary data also included recorded materials from textbooks, journals, periodicals, magazines, newspapers and from students' thesis or dissertations.

The multi-stage stratified random sampling technique was employed in this study. The population was first categorized according to location. In each category, the sampling technique was applied to select the respondents of the questionnaire and this was aided by snow-balling.

Data on the marketing chain of mangrove wood was obtained from interviews, questionnaires, focus group discussions and field survey. To this effect, a total of 10 interviews were conducted, focused group discussions (FGD) were held comprising 6-10 participants involved in various aspects of mangrove exploitation, utilization and marketing in Mudeka, Tiko and Mabeta Fishing

Port. Stratified random sampling was used to select participants of the FGD across the study sites, 154 questionnaires were administered containing both closed and open ended questions (Table 1).

Data were analysed using descriptive and inferential statistical techniques. Descriptive techniques comprised on frequencies and percentages, while inferential techniques were used to establish the relationship between the socio-economic and ecological importance of mangroves, value addition and marketing chain of mangrove wood in various coastal localities. Qualitative analysis was aided with the use of content-thematic analysis.

Table 1. Distribution of questionnaires across the sample areas

Sub-division		Localities		Sample sites	
Name	Number	Name	Number	Name	Number
Tiko	60	Tiko	40	Douala Koto Beach	21
				Apolos Beach	19
				Court Beach	13
				Market Beach	7
				Big Kombo	9
				Small Kombo	10
				Santa Beach	10
				Creeks	5
Limbe	79	Mbondjo	15	Mondoli	14
		Batoke	15	Down Beach	8
				Dockyard	7
				Batoke	16
				Sanje	15
Idenau	15	Idenau	15		
Total	154	8		13	154

Source: Field work (2020)

3. FINDINGS AND DISCUSSION

Table 2 presents the main economic activities of the population along the coast of Fako Division.

Table 2. Main economic activities of selected study localities

Sub-divisions	Localities	Sample sites	Main economic activities
Tiko	Tiko	Douala Koto Beach	- Fishing, - Fish smoking, - Firewood selling
		Apolo Beach	- Firewood splitting, - Agriculture, - Boat construction/ repairs, - Hunting
		Court Beach	
Mudeka	Mudeka	Market Beach	- Fishing, - Fish smoking, - Firewood selling, -Firewood splitting, - Agriculture, - Boat construction/ repairs, - Hunting, - Food vending
Mabeta Fishing Port	Bimbia	Big Kombo	
		Small Kombo	
		Creeks	
		Santa Beach	
Mondoli	Mondoli	Mondoli	
		Down Beach	

Sub-divisions	Localities	Sample sites	Main economic activities
Limbe	Mbonjo Batoke	Dockyard Batoke	
Idenau	Idenau	Sanje	- Fishing, - Fish smoking, - Firewood selling, - Firewood splitting, - Agriculture

Source: Field Work (2020)

3.1 Importance of Mangroves

Coastal areas are known to be attractive areas for human residence. This is as a result of the benefits humans obtain from the natural resources such as mangroves. This study found out that mangroves are of socio-economic as well as ecological importance to the mangrove-dependent communities.

3.1.1 Socio-economic importance of mangroves

Throughout the different study sites it was revealed that mangroves provide some socio-economic benefits to population. Fig. 2 presents the scoring of socio-economic importance of mangroves by the population.

Provision of employment

Mangroves have great socio-economic value to the mangrove-dependent communities. They

provide employment to people through a variety of means. Ninety per cent of the population indicated that they have been employed in one or more mangrove wood exploitation activities such as engine saw operators, porters, boat drivers, firewood splitters and truck drivers. The engine saw operators are those that are involved in the felling of the trees from the forest. When the wood is cut, porters are hired to evacuate it to where they will be loaded unto boats. This means, people are employed to man the boats that transport the logs to areas of destination. At the point of destination, mostly male youths are employed to split the logs of wood into pieces of wood ready for utilization (Fig. 3a). The participants of a focused group discussion at Mabeta Fishing Port were mostly made up of firewood splitters who said they earn an average of 5,000 frs a day depending on their physical strength and the number of customers served (Fig. 3b). The same opinion was also expressed by a firewood splitter at Tiko.

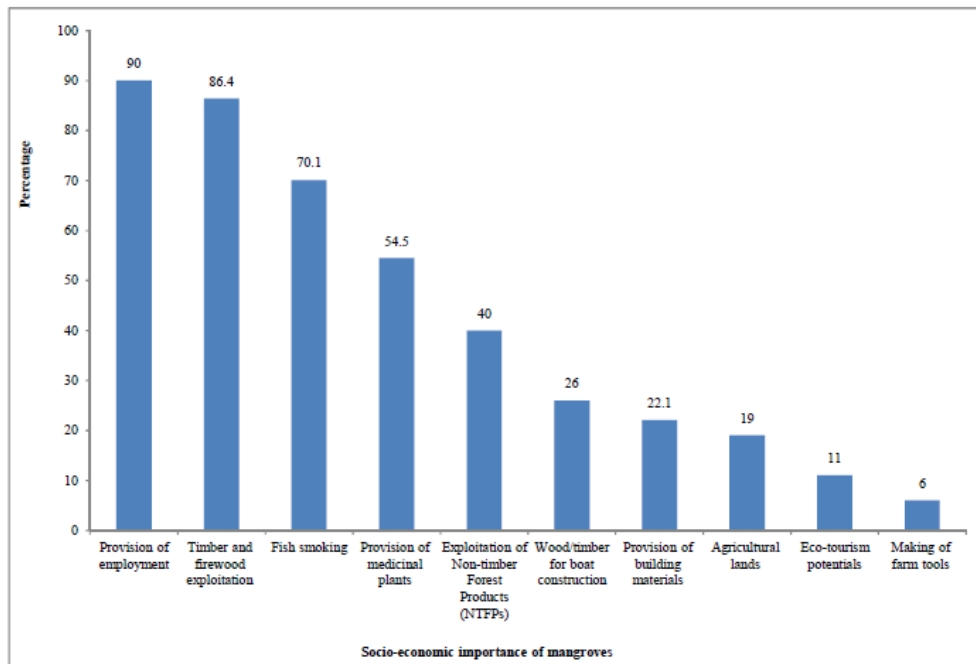
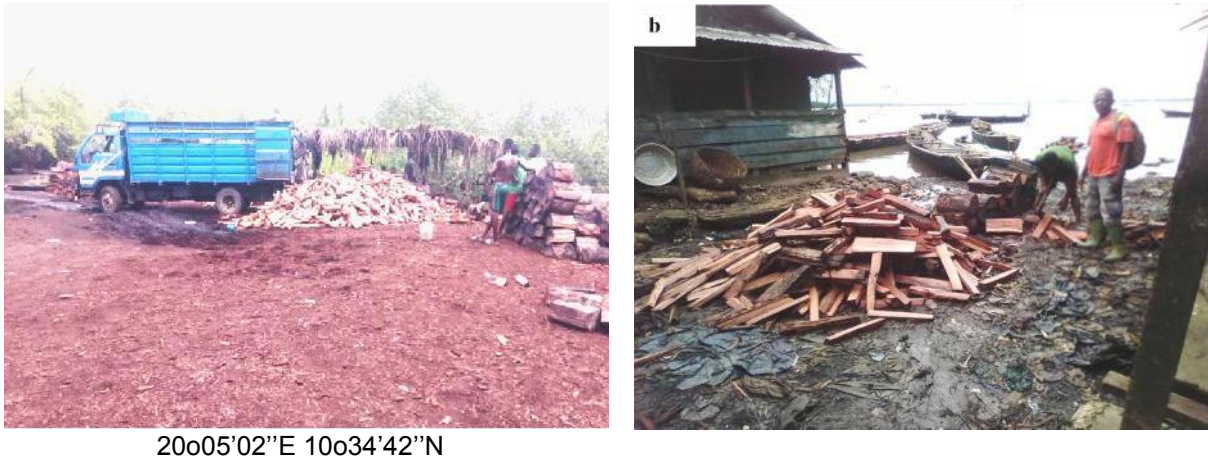


Fig. 2. Scoring of socio-economic importance of mangroves

Source: Field work (2020)



20o05'02''E 10o34'42''N

Fig. 3. (a) Loading of a truck-vehicle at Douala Koto beach Tiko (b) Firewood splitting at Big Kombo Mabeta Fishing Port

Source: Field work (2020)

Fish smoking

The main economic activities of the population in the study sites were fishing for men and fish smoking for women. The study found out that 22.7% of the females were fish smokers who said they had been involved in fish smoking using mangrove wood from childhood helping their parents who were also involved in the same activities (Fig. 4a). Rapid population growth in the coastal settlements has led to increasing demand for fish. As such, fish smoking is an important economic activity of the coastal people and the demand for fish continues to grow. Some fish smokers attested that they use mangrove

wood which enables them to easily regulate the temperature and gives the smoked fish attractive colouration (Fig. 4b). Throughout the study sites, it was remarked that wood availability in the right quantities was of prime importance in fish smoking. Several wood species were used for fish smoking such as mangrove, iron wood and rubber depending on their availability. Mangrove wood was ranked as first choice by many fish smokers. The reasons they advanced for it were that it is easily available, durable and retains heat energy. A fish smoker at Down Beach, Limbe in an interview explained that she uses a truck-vehicle of mangrove wood every week to smoke fish.



Fig. 4. Fish smoking using mangrove wood in (a) Dockyard and (b) attractive colour of smoked fish using mangrove wood

Source: Field work (2020)

Provision of medicinal plants

Plants have valuable and indispensable natural products for the health of humans. Mangrove plants are a rich source of steroids, alkaloids, flavonoids as well as fatty acids. Extracts from different mangrove plants are reported to possess diverse medicinal properties such as antiviral, antifungal and antibacterial properties. They are widely used by mangrove communities for medicinal purposes. Some mangrove communities use the roots, leaves and barks of mangrove plants because of their medicinal value through infusion, decoction and concoctions. About 54.5% of the population attested that they have used mangrove plants to treat headaches, skin diseases, ulcers, sores and boils. Their knowledge of the medicinal value of mangroves was transferred to them from their parents who used it to treat certain sicknesses.

Exploitation of Non-timber Forest Products (NTFPs)

The study identified Non-timber Forest Products (NTFPs) which are harvested from mangroves. These include honey, leaves, barks as well as the roots of mangrove trees for medicinal purposes as they use it in treating some illnesses. A farmer in Tiko reported that he uses mangrove leaves to feed pigs and fish. This is an important benefit that is derived from mangroves by mangrove dependent communities. In this study, 40% of the population explained that they derive such benefits from mangroves. Honey production was equally identified as a socio-economic importance of mangroves. Honey is

produced by bee keeping which is carried out in mangrove forests as bees gather nectar from mangrove species. Bees are not only a source of income that helps support local livelihood; they are also an important factor in community-based mangrove conservation.

Some individuals in Mabeta Fishing Port and Mudeka confirmed that they are involved in the extraction of periwinkle (small edible marine snail) which is a staple source of protein food and a source of income in these communities (Fig. 5a). It was pointed out that in Mudeka periwinkle is processed and used as raw materials in the ceramic industry to produce tiles and in the construction industry to decorate buildings (Fig. 5b). This also constituted an important source of employment and income to those involved in the activity.

Wood/timber for boat construction

This study found out that mangrove wood is the most preferred for boat construction/repair as a result of its durability and hardness. It was an important aspect of the culture of some coastal communities to use mangrove wood for boat construction/repair. This is one of the reasons for the rapid deterioration of mangroves in the study sites as fishing constitutes an important economic activity for coastal people. Twenty-six per cent (26%) of the population who were fishermen said they have used mangrove wood for boat construction for a long time until they became depleted such that they only use it for boat repairs.



Fig. 5. (a) Exploitation of periwinkle in Big Kombo, Mabeta Fishing Port and (b) processing of periwinkle at Court beach, Mudeka

Source: Field work (2020)

Provision of building materials

Different mangrove species have different wood properties, making some more suitable than others for specific uses. For example, trees from the *Rhizophoraceae* family (*Rhizophora*, *Ceriops* and *Bruguiera*) are characterized by hard, dense wood and as such, are widely valued for construction and as firewood. An important benefit of mangroves is the provision of building materials. A wide range of building materials are provided by mangrove ecosystems such as wood and sand. This is substantiated by the fact that 22.1% of the population attested that they obtain building materials such as wood for building and roofing of houses.

Field evidence showed that the residents of some mangrove communities use mangrove wood to construct their houses while some use it just for the roofing of houses (Fig. 6a). It was observed that some bridges at Mabeta Fishing Port were constructed with mangrove wood. Mangrove wood is widely used in coastal communities for residential construction (posts, beams, roofing and fencing of houses) and to make fish traps. Fronds from the mangrove palm (*Nypa fruticans*) are particularly valued in Fako Division for use in roofing and as thatch in walls and floor mats. Through field observations, houses at Sanje are constructed using mangrove wood. The growing demands for such woods have accelerated exploitation in some areas such that the vegetation cannot attain its climax. Fig. 6b shows the situation in Tiko where a farmer uses mangrove wood to construct his poultry farm. He said it is cheaper and economical for him to harvest mangrove wood and use at no cost since he needs just to get into the mangrove forest and harvest wood than for him to buy wood which is expensive.

Agricultural lands

Agriculture is an important economic activity to mankind. The close proximity of mangroves to the ocean makes them ideal locations for shrimp farming and aquaculture. They are areas rich in nutrients and part of larger wetland systems, making them attractive as agricultural areas. Nineteen per cent (90%) of the study population derived agricultural lands from mangroves they carry out aquaculture and shrimp farming in mangroves. Field observation revealed a fish pond, piggery and poultry that have been constructed in mangrove in Tiko. This farmer explained that mangrove leaves are used to feed

pigs and fish, while ducks feed on crabs from the mangroves. This was also confirmed by satellite images which showed that the surface areas of farmlands in Fako Division have increased.

Eco-tourism potentials

The coastline of Fako Division is blessed with a variety and abundance of coastal resources, which include; a variety of habitats; sandy beaches, wetlands, streams, rivers and other bodies of water which support a diversity of biotic communities including numerous rare and endangered species. There are the presence of beautiful beaches, hotels and leisure sites which serve as attraction to tourists. Tourism is an important socio-economic activity in many coastal resort towns. Tourists visit mangrove areas to enjoy panoramic view and beautiful scenery. Cameroon's coastal forest (mangrove) is home to a large number of rare and endemic plants and animals. This serves as touristic attraction to tourists mostly from developed countries of Europe and North America who visit the mangroves to have a panoramic view and to commune with nature. This opinion was shared by 11% of the respondents.

However, mangroves have come under attack due to unsustainable tourism activities. In Batoke for example, mangroves have been vandalized and replaced by hotels to accommodate tourists. This town has four hotels some of which include Sea Belview Hotel, Madison Beach Hotel and Etisah Beach Hotel and are constructed in an area that was formerly occupied by mangroves. Field evidence showed that there are about 18 hotels between Limbe Municipality and Idenau Municipality and almost all of them are constructed on reclaimed mangrove areas. This is the process of personification of a common property resource.

Making of farm tools

The study found out that 6% of the population used mangrove wood to produce farm tools such as hoes, dig axes and the handles of machetes. Long-lasting handles of hoes, cutlasses, spears and dig axes were remarked to be those that were made out of mangrove wood. In Idenau, a farmer confirmed that they used mangrove wood to produce their loading equipment. A trader was interviewed at Down Beach who produces farm tools from mangrove wood who explained that he has used other woods but mangroves is the most preferred and profitable.



Fig. 6. Building materials (a) Mondoli and (b) Douala Koto beach

Source: Field work (2020)

It should be noted that the revenue from the sales of mangrove products is used by the community in a variety of ways. The socio-economic and demographic characteristics of the population showed that more than half of them are married with average family sizes of about 8 persons. This means that the population are responsible and have family issues to handle with regards to finances. The money is spent judiciously as the population educate their children as well as feed their families in order to live a healthy life. Health care is also on the list of what the population spend money on, that is, when their families are sick, they are being catered for. They also spend money on socialization especially during events and festive periods as they merry together in their communities.

3.1.2 Ecological importance of mangrove

Mangroves along the coastline of Fako Division serve a number of ecosystem functions. Mangroves are known to provide services termed Cultural Ecosystem Services (CES) which are the non-material benefits obtained from nature by the population. These include recreation, aesthetic enjoyment, physical and mental health benefits and spiritual experiences. These contribute to a sense of place, foster social cohesion and are essential for human health and well-being. Fig. 7 presents the tangible and intangible ecological uses of mangroves as postulated by the population.

Forests are one of the most productive and biologically complex ecosystems on the

biosphere. Mangrove ecosystems provide vital habitat for endangered species of animals. Besides sheltering animals and birds, mangroves also provide protected areas for crabs, shrimps and other aquatic organisms. These species are attracted to the mangrove ecosystems for the high availability of food, cooler water with high oxygen content and refuge. They contribute to mangrove food web and provide a rich environment for many marine species. The study population indicated that mangroves have proven ecological value as 86.4% of them shared this view. Mangroves serve as wildlife habitats to a number of animal species such as crocodiles, birds, snakes and monkeys sheltered in the roots and branches of the plants.

Nurseries for fish/fish resources

This study identified mangroves as important spawning grounds and nurseries for fish. Aquatic organisms find enough quantity of fish food in mangroves which provide breeding places for shrimp and fish. Some fish species and aquatic mammals carry their propagation in mangrove areas as mangroves protect them from predators. This is confirmed by the fact that 79.9% of the population identified nurseries for fish as an ecological importance of mangroves. One respondent specified in an interview in Tiko that mangroves provided him nurseries for his fish pond and shrimp farm as he did not need to construct one. He said the mangroves were particularly useful as nursery grounds for fish larvae especially during the breeding and juvenile stages.

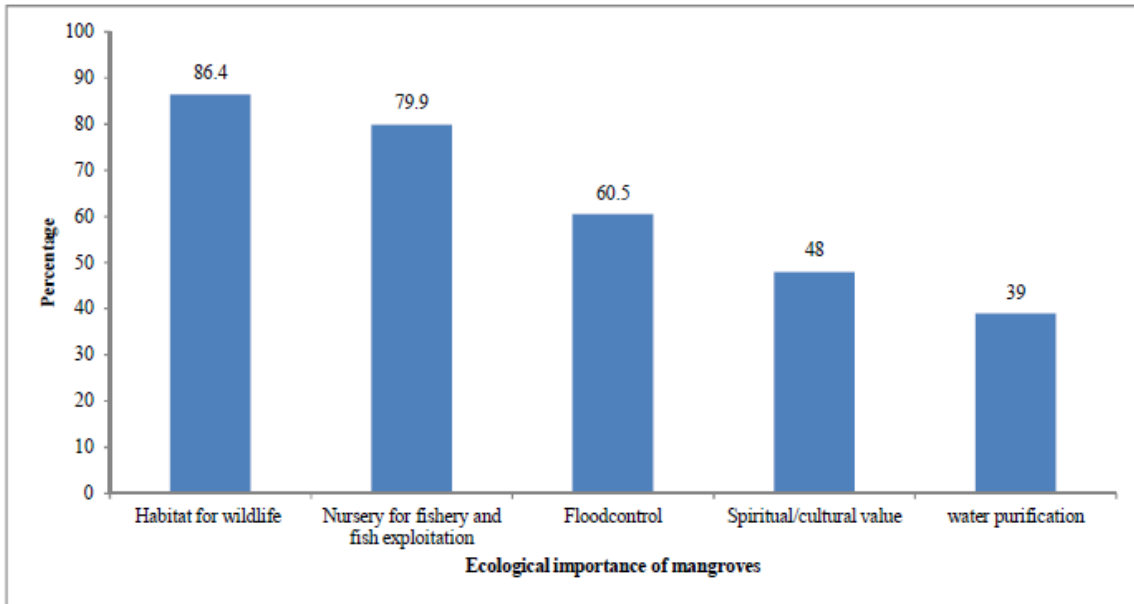


Fig. 7. Ecological importance of mangrove

Source: Field work (2020)



Fig. 8. Role of mangroves in flood control/mitigation at Mabetta Fishing Port

Source: Field work (2020)

Flood control/mitigation

It was observed that mangroves play important roles in flood control / mitigation. The aerial roots of mangroves retain sediments and prevent erosion while the roots, trunk and canopy reduce the force of oncoming waves and storms thus reduce flooding. About 60.5% of the respondents stated that mangroves are important in the environment as they play an important role in flood control. At Big Kombo, Mabetta Fishing Port, participants of the focused group discussion showed a cluster of mangrove trees which have been left isolated by the seashore that the trees play a major role in breaking waves that hit the

coastline. They remarked that mangroves provide incredible natural defences which reduces flood. Their argument was substantiated by field surveys which revealed portions of this settlement whose mangroves have been completely wiped out are those that are the most affected by the damaging effect of waves and storms as the mangrove vegetation acts as natural breaks (Fig. 8).

Spiritual/cultural value

Among the perceived cultural values of mangroves, some of the participants stated that their traditional rulers visit the mangroves from time to time to pour libations and make

incantations in the mangroves as a means of cleansing and purifying the sea. About 40% of the participants said they have special affiliations to live in mangroves areas given that they were born in the mangrove communities; they have that special attachment to live in mangrove areas. Some participants at Down Beach said that the coastal culture is linked to water which is part of mangroves. They noted that it was part of their culture to make certain tools with mangrove wood.

Coastal protection

Mangroves may significantly reduce wave attack on a coastal dyke. Mangroves protect shorelines from erosion. Mangroves protect shorelines from damaging storm and hurricane winds, waves and floods. Mangroves also help prevent erosion by stabilizing sediments with their tangled root systems. They also help prevent erosion by stabilizing sediments with their tangled root systems. Mangroves aid soil formation by trapping debris. Prop roots and pneumatophores accumulate sediments in protected sites and form mangrove peats. The filamentous algae also help to stabilize the fine sediments trapped by mangroves. Field observation showed that mangroves provide protection for the Fako coastline against storms and surges. Results from questionnaires indicated 48% of the population perceived coastal protection as ecological function of mangroves.

Water purification

Mangroves filter sodium ions (Na⁺) effectively by using the outermost root layer. Thus, the internal structures of mangroves can absorb relatively pure water by filtering the sodium ions of seawater on the roots. Like desert plants, mangroves store fresh water in thick succulent leaves. A waxy coating on the leaves of some mangrove species seals in water and minimizes evaporation. *Mangroves* also filter pollutants, absorb excess nutrients from runoff, and trap sediments, helping to increase the clarity and quality of waters. Hence mangroves purify water for aquatic organisms. Thirty-nine per cent (39%) of the population opined that mangroves purify water making it fit for marine organisms.

3.2 Mangrove Wood and Its Marketing Chain

3.2.1 Distribution and sale of mangrove wood

One of the greatest human activities carried out in mangrove areas is timber and firewood

exploitation. Rapid population growth has led to increasing demand for mangrove wood for commercial and domestic activities (Fig. 9). Mangrove wood is sawn off the coast of Tiko. The wood is transported by boat to the Tiko (Douala Koto and Apolo Beaches). At these beaches, the wood is split into smaller pieces ready for consumption. This is done by specialised youths whose duty is to split the wood as their source of livelihood. The wood is transported to areas of high demand such as Mutengene, Buea and Limbe. In these urban centres, the wood is used for cooking in homes and restaurants and other public eateries. For example, a firewood seller in Limbe said she pays 32,000 frs to transport a truck-vehicle of firewood from Tiko to Limbe. Firewood splitting is an important economic activity that has employed many youths in mangrove areas as it is the main source of income for some of them.

Furthermore, a firewood vendor who was interviewed at Tiko said he buys a truck-vehicle of firewood every week as the firewood has a high demand from households, restaurant operators and soya vendors (meat roasting or grilling). Another firewood seller at Tiko said she buys just once a week such that by the time she is buying the next consignment, the previous one should be almost finished and there are about seven of them involved in the activity at Tiko. In an interview with a respondent at Mudeka she said she prefers mangrove firewood for cooking to any other firewood because mangrove firewood is durable, produces a lot of heat and also generates charcoal as its output which is equally used for cooking.

In Buea, the main source of supply of mangrove wood is from the Tiko firewood beaches, from where the wood is either supplied in logs or pieces ready for utilization. The trade in mangrove wood takes a variety of forms. On the one hand, some truck-vehicle drivers buy mangrove wood in logs and supply to those involved in retail of the wood. The retailers in turn split the logs of wood into smaller pieces ready for use by households and other users.

This mangrove wood vendor explained in an interview that he makes more profits when he buys the wood in logs than when he buys in pieces that have already been split. He also explained that in order to maximise profits, he splits the wood himself as his cost is reduced. Some mangrove wood vendors however found it economical to buy already split wood so that they

can make it available for the customers and consumers rapidly. In the Molyko neighbourhood in Buea, a firewood vendor disclosed that she buys a truck-vehicle of firewood twice a month. She noted that this was as a result of the high demand for mangrove wood from her customers. She also noted that he supplies homes and restaurants around Mile 16, Mile 17, Muea, Molyko and Check Point areas.

It was observed at Mabeta Fishing Port that mangrove wood is the main source of fuel for fish smoking. The fish smokers showed a lot of preference for mangrove wood in favour of other wood types. Mangrove wood comes from within the Mabeta Fishing Port neighbourhood but due to the high rate of exploitation, they are almost completely exhausted until they have extended their exploitation to Manoka in the Littoral Region. Several houses constructed in mangrove areas are done with the use of mangrove wood in this locality.

Some of the wood sawn in the Mudeka community is consumed locally. The wood is

sawn and consumed within the area. Here, it is highly used by fish smokers and locally in homes in this locality as its demand is also high there. Wood also leaves from Mudeka to Bonako and Yato where it is used for cooking and fish smoking.

In an interview with a soya vendor at Idenau, he explained that he uses firewood for 1000 frs every day x 6 days a week x 4 weeks = 24,000 frs a month. Mangrove wood here comes mainly from Njonji, Isobe and Sanje. Field survey showed that mangrove wood used to be supplied from Mobange (around Debundscha) but as a result of over exploitation in this area, the mangroves here had long been extinct. Njonji, Isobe and Sanje are now the main points of supply of mangrove wood in Idenau municipality. The mangrove wood exploiters remarked that use mostly machetes to fell the wood since most of them are young and immature trees (Fig. 10). A truck load of this which consists of five bundles is sold at 7000 frs.



Fig. 9. Mangrove wood exploitation in (a) Court Beach, Mudeka and (b) Douala Koto beach, Tiko
Source: Field work (2020)



Fig. 10. Harvested immature mangrove wood in Sanje (a) and Small Kombo (b)
Source: Field work (2020)

Another soya vendor in Down Beach said he uses firewood for 2500 frs every day, that is, 5 bundles. This means that 2500 frs every day x 6 days a week x 4 weeks = 60,000 frs a month. Considering that there were an estimated 10 soya vendors around Down Beach, it implies that at least mangrove firewood worth 600,000 frs is used by 10 soya vendors (based on the 1000 frs per day estimation) is used in Down Beach. This is a huge economic contribution to the local economy. Furthermore at Down Beach mangrove wood was ranked as first choice by many fish smokers. The reasons they advanced for it were that it is easily available, durable and retains heat energy. A fish smoker at Down Beach, Limbe in an interview explained that she uses a truck-vehicle of mangrove wood every week to smoke fish. The main point of supply is Tiko; hence mangrove wood used throughout Limbe comes from Tiko. Timber exploitation involves the extraction of logs of wood from the forest which are used for a variety of purposes such as furniture production and building construction. A carpenter interviewed was of the opinion that mangrove wood is very durable as it is less susceptible to pest and disease attack and it is hard wood and hence good for making of furniture.

3.2.2 Estimated monthly income from mangrove activities

The study found out that the respondents make huge monthly incomes from mangrove activities. Table 3 shows that the participants that obtain

the highest monthly income from mangrove activities are firewood sellers. This is because over 56.3% of the participants sampled make above 400,000, while 43.7% of them earn between 100,000 to 400,000 frs from the sale of mangrove wood a month. The carpenters were those who made very little from mangrove activities as all the carpenters sampled earned below 400,000 frs from mangrove activities.

3.2.3 Cost analysis of firewood exploited from the mangroves

Interviews further revealed that most of them purchase at least a trip which is made up of 250 logs at the cost of 160,000 frs. After splitting the logs, it will give them an average of 5000 pieces. A bundle of firewood containing 10 pieces will give 500 bundles, that is, 5000 pieces/10. Therefore, the 500 bundles will be sold at 500 frs each, then it will be 500 bundles x 500 frs = 250,000 frs. After subtracting his expenses on buying of ropes, loading unto a truck-vehicle, payment at police checkpoint, custom and council and transportation by truck-vehicle to Limbe, he still makes a net profit of 196,500 frs/month (Table 4).

From this cost analysis, if seven firewood sellers in Limbe buy 250 logs a week, it shows that there is a high rate of exploitation of mangrove ecosystems if we have to make a comparison with all the other study sites. This indicates that mangroves are under great threat from anthropogenic activities.

Table 3: Estimated monthly income from mangrove activities by the population

Activities	Estimated monthly income from mangrove activities (FCFA)				Total
	<100,000	100,000-400,000	400,001-700,000	700,001-1,000,000	
Fishing	9 (34.6)	11 (42.3%)	5 (19.2)	1 (3.8%)	26
Farming	2 (22.2%)	4 (44.4%)	3 (33.3%)	0 (0.0%)	9
Hunting	4 (80.0%)	1 (20.0%)	0 (0.0%)	0 (0.0%)	5
Engine saw operator	7 (35.0%)	12 (60.0%)	1 (5.0%)	0 (0.0%)	20
Boat driving/repairs	4 (28.6%)	4 (28.6%)	3 (21.4%)	3 (21.4%)	14
Firewood selling	1 (3.1%)	13 (40.6%)	14 (43.8%)	4 (12.5%)	32
Trading	5 (38.5%)	3 (23.1%)	4 (30.8%)	1 (7.7%)	13
Civil servants	2 (40.0%)	1 (20.0%)	1 (20.0%)	1 (20.0%)	5
Firewood splitters	16 (88.9%)	2 (11.1%)	0 (0.0%)	0 (0.0%)	18

Source: Field work (2020)

Table 4. Estimated cost analysis of firewood exploited from the mangroves

SN	Quantity of wood purchased	Frequency	Cost	Profits
1	120 pieces per truck	Once a week	3,000 frs per truck	500 frs for a bundle of 10 pieces (120/10 = 12 bundles) total = 500 500 * 12 = 6000 frs
2	7 Trucks of 120 pieces each	Once a week	21,000 frs	7 Trucks (120 pieces*7= 840 pieces) 840 pieces/10 = 84 bundles * 500 84 bundles * 500 = 42,000 frs
3	1 truck vehicle (250 logs)	Once a month	160,000 frs	250 logs*20= 5000 pieces 5000 pieces / 10 = 500 bundles 500 bundles*500 = 250,000 frs 250,000 frs - 53,500 frs = Net profit=196,500 frs

Source: Field work (2020)

4. CONCLUSION AND RECOMMENDATIONS

This study was conducted in ten communities, all located in Fako Division in the South West Region of Cameroon. It has shown that wood plays a major role in the energy supply of the rural population. Mangrove wood is generally the preferred fuel for most low and middle income people since it is easily available, and can usually be obtained without major costs. The socio-economic importance of mangroves include: firewood exploitation/charcoal production, nursery for fish/fish exploitation, fish smoking, exploitation of non-timber forest products, provision of building materials, wood/timber for boat construction/repair and eco-tourism potentials are some of the socio-economic importance of mangroves.

Mangroves have a myriad of benefits to humans and the environment. The demand for the wood is high and extensive along the coastal settlements of Fako Division as the wood is made readily available in the areas of demand as its supply is high available. The overwhelming importance has resulted in over exploitation and degradation of mangrove forest as the wood is traded and used in most coastal settlements of Fako Division. This has raised urgent conservation concerns for this fragile ecosystem.

This study recommended the following for mangrove wood conservation. The Ramsar Convention (1971) stipulated the installation of a legal and institutional framework, strict enforcement of other international legal instruments ratified by member countries such as the Ramsar Convention and Convention on

Biological Diversity (CBD). Cameroon being a party to the above international protocol is recommended to execute their verdicts fully to ensure the sustainable management of mangroves therefore, state legislations should be used to support mangrove management.

The 1994 forestry law and the 1996 environmental law of Cameroon are the guiding policy and legal framework for biodiversity and need to incorporate mangrove reforestation as a sustainable way of managing mangrove ecosystems because these laws do not protect the mangrove ecosystems of the country. This study therefore recommends that the environmental and forestry laws should be enforced while the protection of mangrove ecosystems should be incorporated into these laws.

Zoning plans for mangrove ecosystems should be established, community forests, establishment of national mangrove sanctuaries or protected area status should be granted to mangroves such that exploitation of all forms and expansion of settlements into mangroves is prohibited to arrest mangrove degradation.

Mangrove reforestation projects should be carried out along the coastline of Fako Division to restore degraded areas. Resettlement schemes should be carried out to resettle people who are living in mangrove areas such that mangroves should be planted again in the areas where mangroves first existed.

DISCLAIMER

Mangroves are commonly and predominantly used products in our area of research and

country. There is absolutely no conflict of interest between the authors and exploiters of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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