INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 10, No. 1, p. 225-239, 2017
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Ethnobotanical study of plant non timber forest products in the coastal area of Cameroon: Cases of Yabassi and Mouanko

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Article published on January 31, 2017

Key words: Ethnobotany, Coastal area, Sustainable use, NTFP, Cameroon

Abstract

In order to preserve and value plant Non Timber Forest Products (NTFPs) in the coastal area, a study was conducted in three villages of Yabassi and Mouankoalso in Cameroon. Ethnobotanical surveys, interviews, and direct observations were carried out with 132 households notably (74 and 58 respectively). Results showed that social class whose age was between 15 and 60 years was the main workforce in the collection of NTFPs of both localities. Females and children were most involved in the collection of these NTFPs. Agriculture, fishing and hunting were the main activities identified in both study areas. It was observed that 67 and 71 species, respectively inYabassi and Mouanko,were the most used. The types of uses were food, traditional medicine, traditional rites and timber. The commercialized forest species were: *Baillonella toxisperma*, *Garcinia kola*, *Irvingia gabonensis* and *Scorodophleus zenkeri*. Four main collection toolswere perch, machete, ax and saw.Picking and collection were the most used processes.For local uses of forest resources, the results indicated that the sustainability of timber resources use was not compromised, because their useswere marginal. However, the sustainability of local uses of NTFPs is uncertain. Economic or food dependency of local people on these resources, their representation in the forest and the importance of the forest for these peoplealso compromised the sustainability of local uses of these resources. Sustainable farming and efficient conservation need to be envisaged for promote and perpetuate exploitation of NTFPs in both localities.

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Introduction

In Cameroon, non-timber forest products (NTFPs) are experiencing renewed interest both in terms of its contribution to the wellness of local and intermediate urban operators of these resources and in terms of its commercial potential in the development of new medical, cosmetic and food products (Betti, 2002a, b). Approximately 80% of the population uses them for health care and food. However, despite its vast forest area, some areas such as coastal areas are significantly degraded by slash-and-burn agriculture and related activities such as harvesting, hunting and logging, but also by the presence of maritime ports, to hence their vulnerability (Anonyme, 2005). Sustainable uses of NTFPs could contribute not only to the preservation of a significant part of the biological diversity of the Yabassi and Mouanko's ecosystems, but also to the improvement of many local communities through income generation and to the equitable distribution of wealth from the exploitation of natural resources.

Traditional knowledge of plants and their uses is the result of thousands of years of experience. The relevance of this knowledge as far as increasing the daily living standards of rural populations is concerned, as well as in taking decisions regarding the sustainable use of plant resources, has frequently been noted (Benz *et al*., 2000; Shackleton *et al*., 2002). Many authors have noted the different uses as well as the methods of sampling in the southern part of Cameroon. These include authors such as Mbita (1999), Dibong *et al*. (2011, 2015), Mpondo *et al*. (2012), Betti *et al*. (2013) who conducted studies on plants used by local residents and also used in traditional medicine.

Considering the importance of the participatory approach that places consumers at the center of decisions in the conservation and promotion of plant resources, it is necessary to assess the needs of the populations and to identify their preferred species. The aim of this study is to record local knowledge regarding plants and their traditional uses and to assess how this knowledge is distributed within communities of Yabassi and Mouanko (Cameroon).

The objectives of this study are to establish an inventory of NTFPs exploited in the study areas; determine the part of the species used and how it is harvested and assess the sustainability of farming practices.

Material and methods

Study Areas description

Yabassi (latitude, 04°-04°45'N ; longitude, 09°40'-10°30' E ; altitude, 10m) has a climate that belongs to the tropical type characterized by two seasons with a long rainy season (at least 9 months), abundant rainfall (about 3000 mm per year), high temperatures (23-29°C) and a population about 14 685 inhabitants.

Mouanko (latitude, 03°15'-03°45' N; longitude, 09°35'-10°5'E; altitude, 14 m) has a tropical climate with two rainy seasons and two dry seasons by year; a major part of the year is marked by heavy rainfall. The average annual rainfall is 2952 mm. The average temperature is 27.2°C with a population of about 10,000 inhabitants.

Methodology

Surveys, interviews, as well as direct observations were conducted in the study areas from the 08 June to the 14 November 2015. In each study area, three sites were chosen; it was Ndogbele, Banya and Ndockama for Yabassi, and Nkaganzok, Bakaka and Yavi for Mouanko. The participatory rural appraisal method (Shillington, 2002) and participatory diagnostic method (Souare *et al*., 2014) were adopted to facilitate assessment of the importance of use of NTFPs. An exploratory study is made on the basis of an interview guide with actors aged at least of 15 years and involved in the chain of NTFPs. 132 people were interviewed, 74 in Yabassi and 58 in Mouanko. From the actors, we had collected the following data: the parts of the collected plants, their uses, product preservation techniques or resource species, the availability period, the ecological environment in which the products were collected as well as the relationships they presented with the forest.

Samples of plants were harvested and their identification validated at the National Herbarium in Yaoundé. Data of the field study were recorded on a spreadsheet and analyzed using the R 3.0.1 software.

Results and discussion

Socioeconomic characteristics

The age proportions of people surveyed in 74 people in Yabassi, distributed as 39 male (52.7%) and 35 female (47.29%) and 58 people in Mouanko including 30 males (51.72%) and 28 females (48.27%) were surveyed. In the locality of Yabassi, the most represented group was between 30 and 44 years (52.7%), followed by the age group between 45 and 59 years (25.67%). The least represented persons were those respondents whose age was between 15 and 29 years (10.16%) and also 60 more than (9.45%). Age proportions in Mouanko ranged between 15 and 29 years and between 30 and 44 years (31.03% each) were the most represented, followed by the age group between 45 and 59 years old (24.13%). People with more than 60 years old were least represented (13.79%). Therefore, the social class whose age was between 15 and 60 years was the main workforce in the NTFPs collection of the two localities (90% and 86%, respectively for Yabassi and Mouanko). The age group beyond 60 years was rarely involved in this activity (Fig.1).

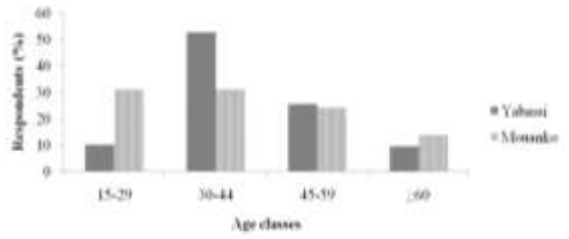

Fig. 1. Age groups of respondents.

In this study, the fact finding is that female and children are most involved in the collection of NTFPs (30 female and 34 children in Yabassi, and 21 female and 30 children in Mouanko). This finding could be explained by the fact that this sector was informal and generally, it was female and children who went to the fields and harvest the products that will be consumed or sold. The age group that predominates is the one situated between 15 and 60 years. Generally, the portion beyond 60 years is rarely involved in this activity because it requires a lot of physical effort and agility.

This same finding was revealed by Tejaswi (2008; cit. Souare, 2015) who got 97% of respondents in this predominant class being the main workforce in the exploitation of NTFPs in Karnataka in India. The locality of Yabassi consists of three ethnic groups: Bandem (77.02%), Bakoko (6.75%) and Bassa (16.21%). Mouanko meanwhile, was composed of Yakalak (32.75%), Bakoko (25.86%), Toupouri (17.21%), Malimba (13.79 %) and Bamiléké (13.79%). Among these tribes, in Yabassi, 33.78% of respondents are single, 54.05% are married and 12.16% are divorced, against 36.20% single; 46.55% 17.24% married and divorced at Mouanko. Married and divorced persons of both communities are fully involved in this sector. As regards the level of education, respondents from the studied localities were educated (93.2% divided in 29.7% for primary level, 52.7% for secondary level and 10.8% for higher education in Yabassi, and 86.2% divided in 25.8% for primary level, 37.9 % for secondary level and 22.4% for higher education in Mouanko). This education would help to raise the awareness on the importance of sustainable land management.

Main activities realized by the respondents are presented in different proportions. It appears that agriculture (81.08% in Yabassi and 34.4% in Mouanko), fishing (10.8% to Yabassi and 48.2% in Mouanko) and hunting (8.1% in Yabassi and 17.4% in Mouanko) are the main activities practiced in the study areas.

The size of households in Yabassi and Mouanko varied respectively from 18 to 32 and 15 to 23 people. The families of more than 7 dependant persons were most numerous and from 4 to 6 people in the locality of Yabassi, 0 to 3 people were most numerous in Mouanko. All ethnic groups living in different areas of study are involved in the collection of NTFP. These actors were evolved in agriculture (81.08% to Yabassi and 34.4% to Mouanko), fishing (10.8% to Yabassi and 48.2% to Mouanko) and hunting (8.1% to Yabassi and 17.4% to Mouanko).

However, all households do not depend exclusively on the extraction of forest products, but the operation is still an important activity in the occupation of rural communities.

The number of plant species identified in the localities of Yabassi and Mouanko were 67 and 71 respectively. These species were divided into four categories of uses that are: food, traditional medicine, traditional rites and timber (Table 1 and Table 2). These results have differences with some previous work done by Souare (2006) in the locality of Mbam and Djerem who found 17 categories of uses; Biloso and Lejoly (2006) in Kinshasa found 12 categories.

Table 1. Plant species and different uses in Yabassi.

Scientific names	Family	Harvested parts	Uses
Abelmonchus esculenta Linn.	Malvaceae	Fruits, leaves	Food, drug
Afzelia bipindensis Harms	Caesalpiniaceae	Wood	Lumber
Ageratum conyzoides Linn.	Asteraceae	Leaves	Drug
Aloe vera Linn.	Liliaceae	Leaves	Drug
Alstonia boonei De Wild	Apocynaceae	Bark	Drug
Annickia chlorantha (Oliv.) Setten & P. J. Maas	Annonaceae	Bark	Drug
Annona muricata Linn.	Annonaceae	Fruits	Food
Anthocleista vogelii Planch.	Loganiaceae	Bark, stem	Drug, wood
Arachis hypogaea Linn	Fabaceae	Seeds	Food
Baillonella toxisperma Pierre	Sapotaceae	Fruits, barks	Food, drug
Capsicum frutescens Linn.	Solanaceae	Fruits	Food
Carica papaya Linn.	Caricaceae	leaves	Food, drugs
Ceiba pentandra (Linn.) Gaerth.	Bombacaceae	Barks	Sexual weakness
Citrus lemon Linn.	Rutaceae	Fruits, leaves	Food, drugs
Citrus sinensis Linn.	Rutaceae	Fruits	Food
Citrus sp.	Rutaceae	Fruits	Food
Cocos nucifera Linn.	Arecaceae	Fruits	Food
Cola sp.	Sterculiaceae	Fruits	Aphrodisiac
Coula edulis Baill.	Olacaceae	Fruits	Food
Cucurbita sp.	Cucurbitaceae	Seeds	Food
Cymbopogon citratus Stapf	Poaceae	Leaves	Drugs
Dacryodes edulis (G. Don.) H. J. Lam	Burseraceae	Fruits, barks	Food, drugs
Dioscorea sp.	Dioscoreaceae	Rhizomes	Food
Elaeis guineensis Jacq.	Arecaceae	Fruits	Food
Entandrophragma utile (Dawe & Sprague) Sprague	Meliaceae	Stem	Lumber
Eucalyptus sailgna Smith.	Myrtaceae	Leaves	Drugs
Fagara heitzii (Aubr. et Pel.)	Rutaceae	Stem	Aphrodisiac
Garcinia kola Heck.	Clusiaceae	Fruits	Aphrodisiac, adjuvant drinks
Gnetum africanum Linn.	Gnetaceae	Leaves	Food, drugs
Guibourtia tessmannii(Harms) J.Léonard	Fabaceae	Stem	Lumber

Hevea brasiliensis (Willd. ex A.Juss.) Müll. Arg.	Euphorbiaceae	Sap, fruits	Food
Irvingia gabonensis (Aubey-Lec ex O'Rorke) Mill.	Irvingiaceae	Fruits, bark	Food, drugs
Lantana camara Linn.	Verbenaceae	Leaves	Drugs
Lophira alata Banks. ex Gaerth. f.	Ochnaceae	Bark, stem	Drugs, lumber
Macaranga sp.	Euphorbiaceae	Stem	Lumber
Mangifera indica Linn.	Anacardiaceae	Bark	Food, drugs
Manihot esculenta Crantz	Euphorbiaceae	Tuber and leaves	Food, drugs
Marantochloa sp.	Marantaceae	Leaves	Packing
Microberlinia bisulcata A. Chev.	Caesalpiniaceae	Stem	Lumber
Milicia excelsia (Welw.) Berg	Moraceae	Stem	Lumber
Mimosa pudica L.	Mimosaceae	Leaves	Drugs
Monodora myristica(Gaertn.) Dunal	Annonaceae	Fruits	Food, drugs
Musa paradisiaca Linn.	Musaceae	Fruits	Food
Musa sapientum Linn.	Musaceae	Fruits	Food
Ocimum basilicum Linn.	Lamiaceae	Leaves	Food, drugs
Ocimum sp.	Lamiaceae	Leaves	Food, drugs
Persea americana Mill.	Lauraceae	Fruits, bark	Food, drugs
Piptadeniastrum africanum (Hook. f.) Brenan	Mimosaceae	Wood	Lumber
Psidium guajava Linn.	Myrtaceae	Leaves and root	Food, drugs
Pterocarpus osun (Craib)	Fabaceae	Stem	Lumber
Pycnanthus angolensis (Welw.) Warb.	Myristicaceae	Stem	Lumber
Ricinodendron heudelotii (Baill.) Pierre ex Pax	Euphorbiaceae	Seed	Food
Sacoglottis gabonensis (Baill.) Urban	Euphorbiaceae	Bark, wood	Lumber
Scorodophleus zenkeri Harms.	Caesalpiniaceae	Bark, fruits	Food
Senna alata Linn.	Caesalpiniaceae	Leaves	Drugs
Staudtia kamerunensis Warb.	Myristicaceae	Stem, sap	Lumber, drugs
Terminalia superba Engl. & Diels	Combretaceae	Fruits	Food
Tetracera masuiana De Wild. & T. Durand	Dilleniaceae	Liana	Food
Tetrapleura tetraptera (Schum. & Thonn.) Taub.	Mimosaceae	Fruits	Food
Uapaca guineensis Mûll. Arg.	Phyllanthaceae	Stem	Lumber
Xanthosoma colocasia L. Schott	Araceae	Rhizomes	Food
Xanthosoma sagittifolia L. Schott	Araceae	Rhizomes	Food
Zea mays Linn.	Poaceae	Seeds	Food, drugs
Zingiber officinale Rosc.	Zingiberaceae	Rhizomes	Food, drugs
Fungi		All plant	Food
Titimut		Bark, seed	Food, drugs

Table 2. Plant species and different uses in Mouanko.

Scientific names	Family	Harvested parts	Uses
Abelmonchus esculenta Linn.	Malvaceae	Fruits	Food, drugs
Afzelia bipindensis Harms	Caesalpiniaceae	Wood	Lumber
Ageratum conyzoïdes Linn.	Asteraceae	All plant	Food, drugs
Allium sativum L.	Liliaceae	Cloves	Food, drugs
Aloe vera Linn.	Liliaceae	Leaves	Drug
Alstonia boonei De Wild	Apocynaceae	Bark	Drug
Amaranthus hybridus L.	Amaranthaceae	Leaves	Food
Anthocleista vogelii Planch.	Loganiaceae	Bark	Drug
Arachis hypogaea Linn.	Fabaceae	Seed	Food
Baillonella toxisperma Pierre	Sapotaceae	Fruits, bark	Food, drug
Bambusa sp.	Poaceae	Stem	Lumber
Capsicum frutescens Linn.	Solanaceae	Fruits	Food, drug
Carica papaya Linn.	Caricaceae	Leaves, fruits	Food, drug
Ceiba pentandra(Linn.) Gaerth.	Bombacaceae	Bark	Drug
Citrus aurentifolia Linn.	Rutaceae	Fruits	Food
Citrus lemon Linn.	Rutaceae	Fruits	Drug
Citrus sinensis Linn.	Rutaceae	Fruits	Food
Cocos nucifera Linn.	Arecaceae	Fruits	Food
Cola acuminata (P. Beauv.) Schott & Endl.	Sterculiaceae	Fruits	Aphrodisiac, rites
Cola sp.	Sterculiaceae	Fruits	Drug, rites
Costus afer Ker-Gawl.	Costaceae	Stem	Drug
Coula edulis Baill.	Olacaceae	Fruits	Food
Cucurbita sp.	Cucurbitaceae	Seed	Food
Dacryodes edulis(G. Don.) H.J. Lam	Burseraceae	Fruits, bark	Food, drug
Dacryodes klaineana (Pierre) Lam.	Burseraceae	Fruits	Food
Dioscorea sp.	Dioscoreaceae	Rhizomes	Food
Diospyros sp.	Ebenaceae	Wood	Lumber
Elaeis guineensis Jacq.	Arecaceae	Fruits, Sap	Food
Fagara heitzii (Aubr. et Pel.)	Rutaceae	Bark	Aphrodisiac
Garcinia kola Hechel	Clusiaceae	Fruits	Aphrodisiac, rites
Gnetum africanum Welw.	Gnetaceae	Leaves	Food, drug
Guibourtia tessmannii (Harms) J.Léonard	Fabaceae	Stem, bark	Lumber, drug
Hevea brasiliensis(Willd. ex A.Juss.) Müll.Arg.	Euphorbiaceae	Sap	Used to make plastics
Ipomoea batatas Lam	Convolvulaceae	Tuber	Food, drug
Irvingia gabonensis (Aubey-Lec ex O'Rorke) Mill.	Irvingiaceae	Fruits, bark	Food, drug
Lophira alata Banks. ex Gaerth. f.	Ochnaceae	Stem, wood	Lumber
Lovoa trichilioides Harns	Meliaceae	Stem	Lumber
Macaranga sp.	Euphorbiaceae	Wood	Lumber
Mangifera indica Linn.	Anacardiaceae	Fruits, bark, stem	Food, drug, lumber
Manihot esculenta Crantz	Euphorbiaceae	Tuber and leaves	Food, drug
Marantochloa sp.	Marantaceae	Leaves	Packing

Milicia excelsia (Welw.) Berg	Moraceae	Wood	Lumber
Mimosa pudica L.	Mimosaceae	Leaves	Soigne les Drug
Monodora myristica (Gaertn.) Dunal	Annonaceae	Seed	Food, drug
Musa paradisiaca Linn.	Musaceae	Fruits	Food
Musa sapientum Linn.	Musaceae	Fruits	Food
Ocimum sp.	Lamiaceae	Leaves	Food, Drug
Panda oleosa Pierre	Pandaceae	Stem	Lumber
Piptadeniastrum africanum (Hook. f.) Brenan	Mimosaceae	Fruits, stem	Food, lumber
Pycnanthus angolensis(Welw.) Warb.	Myristicaceae	Stem	Lumber
*Raphia hookeri*G.Mann & H.Wendl.	Arecaceae	Fruits, sap	Food, drug
Ricinodendron heudelotii (Baill.) Pierre ex Pax	Euphorbiaceae	Seed	Food
Sacoglottis gabonensis (Baill.) Urban	Humiriaceae	Bark, wood	Drug, lumber
Scorodophleus zenkeri Harms.	Ceasalpiniaceae	Seed, bark	Food
Solanum licopersicum L.	Solanaceae	Fruits	Food, drug
Solanum melongena Linn.	Solanaceae	Fruits	Food
Solanum sp.	Solanaceae	Rhizomes, leaves	Food, drug
Staudtia kamerunensis Warb.	Myristicaceae	Stem, sap	Lumber, drug
Terminalia superba Engl. & Diels	Combretaceae	Fruits	Food
Theobroma cacao L.	Rubiaceae	Fruits	Food, drug
Uapaca guineensis Mûll. Arg.	Phyllanthaceae	Bois	Lumber, packing
Vernonia amygdalina Delile	Asteraceae	Leaves	Food, drug
Xanthosoma colocasia L. Schott	Araceae	Rhizomes	Food, drug
Xanthosoma sagittifolia L. Schott	Araceae	Rhizomes	Food
Zea mays Linn.	Poaceae	Tuft	Food, drug
Zingiber officinale Rosc.	Zingiberaceae	Rhizomes	Food, drug
Nsing		Leaves	Drug
Titimut		Bark	Drug
Touwè		Seed	Food

The most important uses NTFPs were food (57.57% in Yabassi and 61.42% in Mouanko), drugs (51.51% in Yabassi and 54.28% in Mouanko), followed by timber service (22.72% in Yabassi and 22.85% in Mouanko) and traditional rites (3.03% in Yabassi and 5.71% in Mouanko). This result was not corrobore with the work of Souare (2006) who found that food and medicines were the most used by local residents.

Food Non Timber Forest Products

Generally, rural and urban populations supplement their diet with plant NTFPs. These plants played an important role in food diversification, with respect to variety of mushrooms, fruits, vegetables and condiments they provided to people.

Edible fungi

Fungi sometimes constituted the main source of proteins for populations of the two study areas. They supplemented the meal, were sold and therefore prooded additional financial resources. Their diversity was greater in forests, but they were difficult to identify.

Fruits, seeds and vegetables

In the locality of Yabassi, 19 fruit species were of highly valued by local people. It was namely: *Abelmonchus esculenta*, *Baillonella toxisperma*, *Capsicum frutescens*, *Citrus lemon*, *Citrus sinensis*, *Cocos nucifera*, *Cola* sp., *Coula edulis*, *Dacryodes edulis*, *Annona muricata*, *Elaeis guineensis*,

Garcinia kola, *Irvingia gabonensis*, *Monodora myristica*, *Musa paradisiaca*, *Musa sapientum*, *Citrus* sp., *Persea americana*, *Scorodophleus zenkeri*, *Terminalia superba* and *Tetrapleura tetraptera*. In Mouanko 31 fruit species were observed, such as *Abelmonchus esculenta*, *Allium sativum*, *Arachis hypogaea*, *Baillonella toxisperma*, *Capsicum frutescens*, *Carica papaya*, *Citrus aurentifolia*, *Citrus lemon*, *Citrus sinensis*, *Cocos nucifera*, *Cola acuminata*, *Cola* sp., *Coula edulis*, *Dacryodes edulis*, *Dacryodes klaineana*, *Elaeis guineensis*, *Garcinia kola*, *Irvingia gabonensis*, *Mangifera indica*, *Monodora myristica*, *Musa paradisiaca*, *Musa sapientum*, *Piptadeniastrum africanum*, *Raphia hookeri*, *Ricinodendron heudelotii*, *Scorodophleus zenkeri*, *Solanum licopersicum*, *Solanum melongena*, *Terminalia superba*, *Theobroma cacao* and *Zea mays*.

Some fruits were usually consumed as appetite suppressant, the others, in addition to their contribution, are sought for their particular quality, for their flavor as *Monodora myristica* and *Scorodophleus zenkeri* either for therapeutic or aphrodisiac quality as *Garcinia kola*, *Cola* sp. and *Cola acuminate*. Almonds of *B. toxisperma* and *R. heudelotii* were used as thickeners for sauces. Almonds of *I. gabonensis* were used in sauces, but also in the treatment of backache. Leaves of *Gnetum africanum* were eaten as vegetable and in the treatment of various diseases.

Tubers

Tubers are represented by species such as *Manihot esculenta*, *Dioscorea* sp. and *Xanthosoma* sp. which were used as main dishes in households.

Processed Non Timber Forest Products

Some products were processed before consumption for better preservation. This was among other oils extracted from *Baillonella toxisperma* or *Theobroma cacao*. The saps of other products were used to prepare beverages such as *Elaeis guineensis* and *Raphia hookeri*. These beverages were fermented by the bark of some species such as *Garcinia kola*.

Medecine and traditional rites

Traditional medicine was used in the foreground by poor households. Several products were used in traditional pharmacopoeia. This was namely: *Abelmonchus esculenta*, *Ageratum conyzoïdes*, *Allium sativum*, *Aloe vera*, *Anthocleista vogelii*, *B. toxisperma*, *Carica papaya*, *Ceiba pentandra*, *Citrus* sp., *Garcinia kola*, *Guibourtia tessmannii*, *Irvingia gabonensis*, *Mangifera indica*, *Monodora myristica*, *Sacoglottis gabonensis*, *Staudtia kamerunensis* and *Zingiber officinale*. Also, some plants were used in ritual ceremonies such as*Irvingia gabonensis*, *G. kola*, *G. tessmannii* and *Cola* sp.

Habitat and equipment

In the study areas, some houses were bult with plant materials at varying proportions. This was among others chineese bamboo which was used to support the walls. The frame was constructed with reliable woods such as *B. toxisperma*, *Lophira alata*, *G. tessmanii*, *Milicia excelsia* and *Piptadeniastrum africanum*. These woods could resist for a long time to adverse conditions.

Local people also used the forest to provide a wide range of furniture and agricultural tools. These people used bamboo and rattan to make furniture such as beds, wardrobes, mats, chairs, tables and interiors of houses. Other species were used for the production of agricultural tools such as hoes sleeves and axes. It was namely*M. excelsia* and *Terminalia* sp.

Craft

The species used in craftalso included those employed at the same time as wood for carpentry, but also for the manufacture of masks, statues, arches. It included *M. excelsia, Uapaca guineensis*, *P. africanum*, *S. gabonensis*. It was also found species used to build canoes, mortars and drums. It was namely *Lophira alata*, *M. excelsia*, *P. africanum*.

Wood energy

Local residents used several plant species as energy source. Species which produced excellent firewood and charcoal, and which were popular were:*Lophira alata*, *Macaranga* sp.,

Uapaca guineensis, *Terminalia* sp., *Afzelia bipindensis*, *Guibourtia tessmannii*, *Piptadeniastrum africanum* and *Pycnanthus angolensis*.

Packaging leaves

Local people used plant to package food and other objects. The most used like food packaging were among other species *Marantochloa* sp. and U. *guineensis*.

The coastal area abounds in many plant species. Investigations have emerged in low-value products, used for subsistence purposes, and products of high value offering good revenue generating potential. NTFPs in terms of uses were drugs, the service timber (construction materials) and traditional rites. These results show once again that NTFPs provided a food safety net in case of need for households. These NTFPs were also used for the health care of residents who still uses traditional medicine. This can be explained by the purchasing power is very low, the cost of pharmaceutical products that are not within the reach of all. Forests thus played plural role for local residents. This was demonstrated by Falconer (1992) on the outskirts of the reserve Tano Offin in Ghana and also by Souare (2014) in the National Park in Cameroon Mbam and Djerem.

It was noted that in the various study areas, NTFPs were very poorly valued commercially. Those used as local drinks were often sold in local markets because they were directly transported to the local shops where they are sold. This was the case even for NTFPs that enter the traditional pharmacopoeia. This low valuation can be explained by the fact that the sector is not lucrative enough, people underestimate the market value of these products on the market or it has other profitable activities, and finally knowledge of use of certain natural resources are lost more and more. All these claims are in line with studies by Sunderland (1998), which explains the loss of knowledge by the fact that there are restriction laws on the use of forest resources. During the study, we found that every 15 to 35 years were difficulties on the knowledge of many products uses. It may be justified by the fact that young people are moving away more and more of the ancestral customs.

Commercial species in the study areas

The population of Yabassi and Mouanko sell certain products which play an important role in the local and national economy. In fact, investigations have shown that these were the crops from fields and forest species that are most traded. Thesewere *Manihot esculenta*, *Xanthosoma* sp., *Arachis hypogaea*, *Cucurbita* spp., *Citrus* spp., etc. Regarding forest species, some were sold in small quantities and after having been transformed. It is namely *Baillonella toxisperma*. Thus, *Garcinia kola*, *Irvingia gabonensis* and *Scorodophleus zenkeri*were operated in large quantities and were subject to local and national trade. Indeed, these species are found not only in the local markets, but also in the markets of Douala and Edea.It appears that most products come from cultures and the rest either fallow or forest.

Plant species collection methods and processes

In both study areas, tools and processes were identical. In fact the survey identified four tools used by local residents, namely the pole (20 in Yabassi and 0 in Mouanko) machete (40 in Yabassi and 23 in Mouanko), ax (5 in Yabassi and 12 in Mouanko), the saw (3 in Yabassi and 7 in Mouanko) and other (6 in Yabassi and 6 in Mouanko). Thus, the machete was the most uses tool in the two forests, followed by perch and ax.

These residents proceed to cutting down (5 people in Yabassi and 9 in Mouanko), the collection (27 persons in Yabassi and 18 in Mouanko), gathering (38 people in Yabassi and 20 in Mouanko) and others (4 people in Yabassi and 11 in Mouanko) (Fig.2).

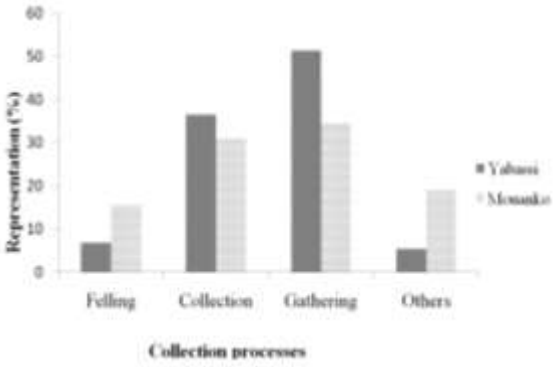

Fig. 2. Different harvesting methods of NTFPs in the study areas.

Thus, picking and collection are the most used methods for the harvest of NTFP in both forests. These methods ensure the availability of the species and are compatible with sustainable forest management. In a study conducted by Piba *et al.* (2015) therefore, the results showed that it is felling and debarking which are the main NTFPs collection methods in the classified forest of Yapo Abbé in Côte d'Ivoire.

Supply frequency

At the end of the investigation in both study areas, most residents are supplied twice a week. In fact, in Yabassi and Mouanko respectively, 17 and 23 people do it once a week. For residents who buy twice a week, 47 people in Yabassi and 22 in Mouanko; those who buy once a month are 10 in Yabassi and 13 in Mouanko) (Fig. 3).

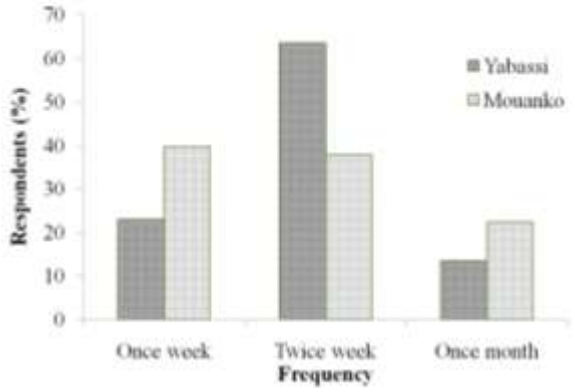

Fig. 3. Supply frequency NTFPs in the study areas.

Determinants of the sustainability of local uses of the forest area

The relationship between local people of Yabassi and Mouanko and forest suggests the existence of possible dependency between the different variables of local forest uses. To explore these dependencies, the χ2 tests were performed. The variables involved in these analyzes include the representation of the forest of local people, local uses of forest resources, local uses of forest areas, the means of local ownership of forest resources and socio-demographic variables (gender, ethnicity, education) (Table 3 and Table 4).

The test results indicatedthat it is no dependency between the practice of fishing and education (P = 0.801), but also the hunting and education (P = 0.343). So, there is no big difference between education and non-actors and the practice of fishing and hunting. Nevertheless, these results show a dependency between the practice of agriculture and education (P = 9.56e-10). In fact, over 80% of the lower level in practice, against only 37.5% of the higher level of study.

Table 3. Education hunting actors and practice fishing and agriculture in Yabassi.

	Agriculture (%)	Fishing (%)	Hunt (%)
Illiterate	80	20	0
Primary level	81.81	13.63	4.54
Secondary level	89.74	5.13	5.13
Higher level	37.5	25	37.5
Meaning of the chi-square test (χ^2)	Significant P=9.56e-10	No significant P=0.801	No significant P=0.343

Table 4. Education hunting actors and practice fishing and agriculture in Mouanko.

	Agriculture (%)	Fishing (%)	Hunt (%)
Illiterate	62.5	25	12.5
Primary level	40	40	20
Secondary level	31.82	54.55	13.64
Higher level	15.38	61.54	23.08
Meaning of the chi-square test (χ^2)	No significant P=0.059	No significant P=0.059	No significant P=0.753

In Mouanko, these results indicate therefore, there is no dependency between the practice of agriculture and education (P = 0.059), the practice of fishing and education (P = 0.059) and hunting and education (P = 0.753). Thus, there is no high difference between education and non-actors and the practice of their various activities.

In terms of the utilitarian dimension of the forest, the multi-functional representation of it (agriculture, hunting, fishing, rituals, pharmacopoeia, collecting NTFPs) confers varying magnitudes as actors.

The test results indicate that in Yabassi there is a dependency between the ethnic actors and the practice of farming, fishing and hunting. Indeed, over 80% of Bakoko and Bassa practise agriculture in the forest against 78% of Bandem.

Fishing is also practiced by 20% of Bakoko against 8% of Bassa. Regarding hunting, 10% of the Bandem practice against 0% of Bakoko and Bassa (Table 5). In Mouanko, these results also show a dependency between the practice of agriculture and ethnicity (P = 0.049). Indeed, nearly 50% of Yakalak, Bakoko Toupouri and in practice, against 0% in Malimba. There were no dependency between the practice of fishing and hunting and ethnicity (P = 0.801 and 0.557 respectively). Thus, there is no big difference between the ethnic actors and the practice of these two activities (Table 6).

These results point in the same direction that the work of Mbairamadji (2006) which showed that ethnicity and education of populations influence the emphasis on the forest.

Table 5. Ethnic hunting actors and practice fishing and agriculture in Yabassi.

	Agriculture (%)	Fishing (%)	Hunt (%)
Bandem	78.95	10.53	10.53
Bakoko	80	20	0
Bassa	91.67	8.33	0
Meaning of the chi-square test (χ^2)	SignificantP=6.508e-12	SignificantP=0.04394	SignificantP=0.002479

Table 6. Ethnic hunting actors and practice fishing and agriculture in Mouanko.

	Agriculture (%)	Fishing (%)	Hunt (%)
Yakalak	42.11	36.84	21.05
Bakoko	38.46	46.15	15.38
Toupouri	50	40	10
Malimba	0	87.5	12.5
Bamiléké	25	25	25
Meaning of the chi-square test (χ^2)	Significant P=0.049	No Significant P=0.801	No Significant P=0.557

Representation and emphasis on forest

The results of χ2 tests show dependencies between socio-demographic variables (gender, ethnicity, education) and the importance that local players agree to the forest. Test results from the area of Yabassi show a dependency between the representation of the forest of local actors and sex. However, the difference can be observed is in the importance given to the forest to the function of the forest as a source of food with 57.14% of women who give this importance against 25.64% men.

By cons in Mouanko, the tests show that there is no dependency between the representation of the forest of local actors and sex.

Tests show a dependency between the representation of the local forest actors Yabassi and ethnicity. In fact while the representation of the forest in Bandem is heavily dominated by the function of the forest as a source of drugs (49.12%), among Bakoko and Bassa, it is represented by the function of the forest as source of food (40% and 41% respectively) (Table 7).

The representation of the forest of local actors in Mouanko does not depend on ethnicity met there. Thus, there is no big difference between the representation of the forest among different actors and function of the forest (Table 8).

Table 7. Representation of the forest area along ethnic actors in Yabassi.

	Food source (%)	Drug source (%)	Source of wealth (%)
Bandem	28.07	49.12	22.81
Bakoko	40	40	20
Bassa	41.67	33.33	25
Meaning of the chi-square test (χ^2)	Significant P=0.0008	Significant P=9.513e-09	Significant P=0.00068

Table 8. Representation of the forest area along ethnic actors in Mouanko.

	Food source (%)	Drug source (%)	Source of wealth (%)
Yakalak	63.16	26.32	10.53
Bakoko	61.54	23.08	15.38
Toupouri	70	30	0
Malimba	50	25	25
Bamiléké	37.5	12.5	50
Meaning of the chi-square test (χ^2)	No significant P=0.113	No significant P=0.5342	No significant P=0.406

The Yabassi's tests indicate a dependency between the representation that local people have of the forest and education. In fact, while 60% are illiterate represent the forest as a source of food, only 37.5% of the senior players and represent. For them, their representation of the forest is dominated by forest functions as a source of wealth. There is no big difference between the representation of the forest of lower level.

Mouanko's tests showing that there is no dependency between the representation of the forest of local actors and education. Thus, there is no big difference between the representation of the forest among different actors and functions of the forest. Overall, in terms of the performance, the results show that the representation of the forest varies according to gender, ethnicity and education of local people. The different types of forest representation induce different uses of the forest and therefore involve different potential impacts on the sustainability of forests and forest resources. These findings add new elements to the work of Jonkers and Foahom (2003) that showed how the forest is perceived by the local population is linked to the values they attribute to him, especially as a space of agricultural practice, product source diverse forest and other intangible benefits. In terms of the utilitarian dimension of the forest, the multi-functional representation of it (agriculture, hunting, fishing, rituals, pharmacopoeia, collecting NTFPs) confers varying magnitudes as actors. The results showed that the focus on the forest is influenced by socio-demographic variables. This goes in the same direction as the work of Mbairamadji (2006) which showed that ethnicity and education of populations influence the emphasis on the forest.

Emphasis on forest

The test results of different study areas show no dependence between the importance that actors give to forest functions and sex (Table 9 and Table 10). There is no dependency between the importance that actors give to forest functions and ethnicity. Nevertheless, agriculture, hunting and fishing are more used by these tribes pharmacopoeia (Table 11 and Table 12).

Table 9. Importance accorded to main functions of the forest by gender actors in Yabassi.

	Emphasis on forest	
	Agriculture, hunt, fishing (%)	Pharmacopoeia (%)
Female	65.71	34.29
Male	69.23	30.77
Meaning of the chi-square test (χ^2)	No significant P=0.941	

Table 10. Importance accorded to main functions of the forest by gender actors in Mouanko.

	Emphasis on forest	
	Agriculture, hunt, fishing (%)	Pharmacopoeia (%)
Female	64.29	35.71
Male	66.67	33.33
Meaning of the chi-square test (χ^2)	No significant P=1	

Table 11. Importance accorded to main functions of the forest along ethnic actors in Yabassi.

	Emphasis on forest	
	Agriculture, hunt, fishing (%)	Pharmacopoeia (%)
Bandem	73.68	26.32
Bakoko	60	40
Bassa	66.67	33.33
Meaning of the chi-square test (χ^2)	No significant P=0.742	

Table 12. Importance accorded to main functions of the forest along ethnic actors in Mouanko.

	Emphasis on forest	
	Agriculture, hunt, fishing (%)	Pharmacopoeia (%)
Yakalak	57.89	42.11
Bakoko	69.23	30.77
Toupouri	70	30
Malimba	62.5	37.5
Bamiléké	62.5	37.5
Meaning of the chi-square test (χ^2)	No significant P=0.959	

Education does not depend on the importance attached to the main functions of the forest. Nevertheless, the most used function is agriculture, hunting and fishing. Finally, the focus on main functions does not depend on the socio-demographic variables. This is in contrast to the work of Mbairamadji (2006) which states that the emphasis on the forest is influenced by the socio-demographic variables. Thus, according to the importance given to the forest, the uses made of the forest resources are not the same and the potential impacts on the sustainability of either forest.

Evolution of the number of trees

The dependence of changes in the number of trees and encountered supply frequency Yabassi shows that more local people collect NTFPs, plus they tend to be scarce, even disappear. In Mouanko, changes in the number of trees and the supply frequency are not dependent In Yabassi, the results show that there is a dependency between the evolution of the number of trees and harvesting tools (Table 13) contrary to Mouanko (Table 14). Thus, the number of trees decreases depending on the type of tool used.

Table 13. Evolution of the number of trees based on harvesting tools in Yabassi.

	Increases (%)	Decreases (%)	Static (%)
Perch	75	5	20
Machete	25	12.5	62.5
Ax	20	20	40
Chain saw	0	66.67	33.33
Others	16.67	16.67	66.67
Meaning of the chi-square test (χ^2)	Significant P=0.0007732		

Table 14. Evolution of the number of trees based on harvesting tools in Mouanko.

	Increases (%)	Decreases (%)	Static (%)
Perch	0	0	0
Machete	30.43	13.04	56.52
Ax	16.67	25	58.33
Chain saw	0	71.43	28.57
Others	16.67	33.33	50
Meaning of the chi-square test (χ^2)		No significant P=0.1083	

The ownership of forest resources system includes the means for the appropriation of these resources, frequency of collection or use and the number of players involved. The most used means by the local populations of the two study areas in the appropriation of timber resources are mainly machetes, perch and ax. The chain saw is also used, but with a limited number of local players. These means certainly have limited individual impacts, but the number of people involved in the collection and sampling, frequency of use of these means, and the frequency of supply, could increase the impact on the sustainability of local customs these resources.

Conclusion

The analysis and description of NTFPs in the localities of Yabassi and Mouanko was very informative. Products include a wide range of species that come from forests, fields, plantations. These results reveal important NTFPs harvesting to consumption. As everywhere in Cameroon, operation/marketing of NTFPs in the area remain informal. Women and children are the most involved in the collection of NTFPs. Among the different activities, it is agriculture that prevails. The different categories are: food, traditional medicine, traditional rites and timber. This study also allowed characterizing the determinants of the sustainability of such uses. The results invite to question the sustainability of local uses that are made. In terms of determining the sustainability of local uses of forest resources, the results reveal three determinants which were economic or food dependency of local people on forest resources, their representation of the forest and the importance they attach so there that the local ownership of existing forest resources system.

Links between these three drivers and certain socio-economic variables are asked and deserve further investigation to assess the real impact on the sustainability of local uses of forest resources. To contribute to the conservation of NTFPs in the region, it is urgent to raise awareness on the need to use management practices that take into account the renewal of the resource for the benefit of present and future generations.

References

Anonyme. 2005. Etude socio-économique dans le secteur nord du parc national du Mbam et Djerem. Wildlife Conservation Society, Cameroun p.17.

Benz BF, Cevallos J, Santana F, Rosales J, Graff M. 2000. Losing knowledge about plant use in the Sierra de Manantian Biosphere Reserve, Mexico. Economic Botany **54,** 183-191.

Betti JL, Caspa R, Ambara J, Kourogue R L. 2013. Ethno-botanical study of plants used for treating malaria in a forest: savanna margin area, east region Cameroon. Global Journal of Research on Medicinal Plants & Indigenous Medicine **2,** 692-708.

Betti JL. 2002a. Usages traditionnels des plantes médicinales et traitement des maux de dos dans la réserve de biosphère du Dja/Cameroun. In History of Health and Diseases: Living and Curing Old Age in The World, Gueri A, Consiglière S (Eds). Genoa/Italy 117-154.

Betti JL. 2002b. Medicinal plants sold in Yaounde markets, Cameroon. African Study Monographs **(23)3,** 47-64.

Biloso A and Lejoly J. 2006. Etude de l'exploitation et du marché des Produits Forestiers Non Ligneux à Kinshasa. Tropicultura **(24)3,** 183-188.

Dibong SD, Mpondo Mpondo E, Ngoye A, Kwin MF, Betti JL. 2011. Ethnobotanique et phytomédecine des plantes médicinales de Douala, Cameroun. Journal of Applied Biosciences **37,** 2496-2507.

Dibong SD, Mvogo Ottou PB, Vandi D, Ndjib RC, Tchamaha F, Mpondo E. 2015. Ethnobotanique des plantes médicinales anti hémorroïdaires des marchés et villages du Centre et du Littoral Cameroun. Journal of Applied Biosciences **96,** 9072-9093.

Falconer J. 1992. A study of the Non-timber forest products of Ghana's forest zone. *Friends of the Earth*, London pp 5-135.

Jonkers WBJ, Foahom B. 2003. Sustainable management of rainforest in Cameroon. The Tropenbos-Cameroon Programme, Kribi, Cameroon p.93.

Mbairamadji J. 2006. Gestion écosystémique des forêts basées sur la dynamique « Acteurs-usages-ressources » : Application aux forêts tropicales humides du Cameroun. Thèse de Doctorat en Sciences de l'Environnement, Université Québec p.199.

Mbita-Messi HJC. 1999. Contribution à l'étude des plantes médicinales du Cameroun : le cas des plantes utilisées en médecine traditionnelle pour le traitement des maladies parasitaires. Thèse de Doctorat 3è cycle, Université Yaoundé I.

Piba SC, Tra Bi FH, Konan D, Bitignon BGA, Bakayoko A. 2015. Inventaire et disponibilité des plantes médicinales dans la forêt classée de YAPO-ABBÉ, en Côte d'Ivoire. European Scientific Journal **11,** 1857-7881.

Shackleton SE, Shackleton CM, Netshiluvhi TR, Geach BS, Balance A, Fairbanks SHK. 2002. Use patterns and value of savanna resources in three rural villages in South Africa. Economic Botany **56,** 130-146.

Shilington L. 2002. Non-timber forest products, gender and households in Nicaragua: a commody chain analysis. Thesis, Virginia Polytechnic Institute and State University 137p.

Souare K. 2006. Produits forestiers non-ligneux majeurs dans la périphérie nord du parc national du Mbam et Djerem: ethnobotanique, écologie et stratégies de gestion durable. Mémoire de DEA, Université de Yaoundé I. 79 p.

SouareK. 2014. Gestion intégrée des espèces ressources clés des produits forestiers non ligneux végétaux au Cameroun : cas de la périphérie du parc national du Mbam et Djerem. Thèse de doctorat/Ph.D. Université de Yaoundé I. 112 p.

Sunderl TCH. 1998. A preliminary study of non-timber forest products of Rio Muni, Equatorial Guinea. CARPE and CUREF, Guinée Equatoriale. 30 p.