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Spatial distribution and species abundance area of Non Timber Forest Products in the Mount Cameroon National Park and adjoining forest zones

Georgiana Engomi Njoh[1] and Clarkson Mvo Wanie[2]

[1]Department of Environmental Science, Faculty of Science, University of Buea, P.O Box 63, Buea, Cameroon
[2]Department of Geography, Faculty of Arts, Letters and Social Sciences, University of Maroua, P.O Box 644, Maroua, Cameroon

Abstract— *Non Timber Forest Products (NTFPs) are an economically, ecologically, culturally and medicinally important component of forests which keeps forests intact and preserve the resource base of the forest, unlike the exploitation of the forest for timber. Notwithstanding, they are under threat in the Mount Cameroon National Park and adjoining forest zones from deforestation, over exploitation, unsustainable harvesting, logging, unsustainable agriculture and infrastructural developments, all driven by the galloping human population growth. There is need to determine their variety for actual and potential economic usage and species abundance area for increased availability and sustainability. This study was undertaken to examine the spatial distribution and species abundance area of NTFPs in the Mount Cameroon National Park and adjoining forest zones. Data on types and their distribution, plants part used and species abundance area was obtained via specie identification in the plant herbarium of the Limbe Botanical Garden in Limbe, reconnaissance surveys, purposive sampling, questionnaires administration, transect line technique and focused group discussions. Collected data was subjected to descriptive analysis in tables and frequency histograms. While the distribution of the NTFPs varied spatially in the four selected clusters, eight (08) species were the most distributed: Plum (Dacryodes edulis), Njangsa (Ricinodendron heudelotii), Bush pepper (Piper guineense), Bush mango (Irvingia gabonensis), Bitter kola (Garcinia kola), Pygeum (Prunus africana), Eru (Gnetum africanum) and Bush onion (Afrosfyrax lepidophyllus). Results on species abundance area showed that most of the species were located in abundance in the Mt. Cameroon National park, farmlands and community forests. It is recommended that intensive ecological and livelihood data on the NTFPs be collected periodically in order to track the change in the performance of the NTFP management status overtime.*

Keywords—Non Timber Forest Products, spatial distribution, species abundance area, forest, Mount Cameroon National Park.

I. INTRODUCTION

Mankind depends on the natural environment and the ecosystem for survival. On this premise, sustainable use of natural resources remains a key to our survival as humans (Nji, 2012). Natural resource management has therefore become a crucial issue in today's world. The exploitation and utilization of Non-Timber Forest Products (NTFPs), which can be any product or service that is produced in forests, other than timber including fruits and nuts, vegetables, fish and game, medicinal plants, resins and a range of barks and fibres such as bamboo, rattans and a host of other palms and grasses and non-timber wood products, is associated with keeping the forest intact, and preserving the resource base of the forest unlike the exploitation of the forest for timber which is associated with clear falling of a wide forest areas (Nkwatoh, 1998). Since the 1970s, NTFPs have emerged to take their place among the many aspects of forest use that guides natural resource decision makers. In the early 1990s, NTFPs were mooted as a potential alternative to deforestation and land conservation activities (Falconer 1990; Plotkin and Famolare, 1992).

In many parts of the world, forest lands are under threat from several sides, leaving the poor even more vulnerable (FAO, 1992). In the developing countries, 80% of the people use forest products for food and personal care (Anon, 2000). In Ghana for example, karite butter is used as cosmetic product distributed by the International Body Shop Chain of Shops (Anon, 2000), while in Nigeria, food security of rural dwellers is improved by growing trees in the home gardens and on farms. Leaves, rattan, honey and gums from small scale industries are important sources of income (Okafor *et al*., 1994). The Nigerian rural economy is also highly dependent on these forest

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products to generate income and to provide medical care (Osemeobo, 1991; Okafor, 1998). However, NTFPs are continually diminishing resources as a result of their dependency on forest which is usually under the pressure of logging, agriculture and development of public infrastructures.

In Cameroon, according to Anon (2000), sales of NTFPs are worth several million euros and go beyond local markets. Market stalls in the metropolises of Douala and Yaounde are full of such products as shea butter, tree plums or safou *(Dacryodes edulis)*, njangsa *(Ricinodendron heudelotti)* used as a condiment and bitter kola (*Garcinia kola*).

The Mount Cameroon National Park (MCNP) and its adjoining forest or support zone is a vast storehouse of many NTFPs. The collection, trade and use of these products have been important to rural economies since before the creation of the national park, and thereafter. At the same time the plants from which these products originate are crucial to healthy ecosystems. The health and functioning of the forest ecosystems and the associated rural communities depend on the sustainable management of the NTFP resources.

II. THE STUDY AREA

Mount Cameroon lies on the coast, in the Gulf of Guinea between 3°57' - 4°27' N and 8°58'-9°24'E. It is a huge volcanic mass with its long axis. The main peak is at 4°7'N and 9°10'E at an altitude of about 4,100 m and is the highest mountain in West and Central Africa with the peak just about 20 km inland from the Atlantic coastline. Mt. Cameroon is an active volcano. The last eruption occurred in 1999, which probably continued and led to minor tremors and lava flows in 2000 (Wantim *et al*., 2011).

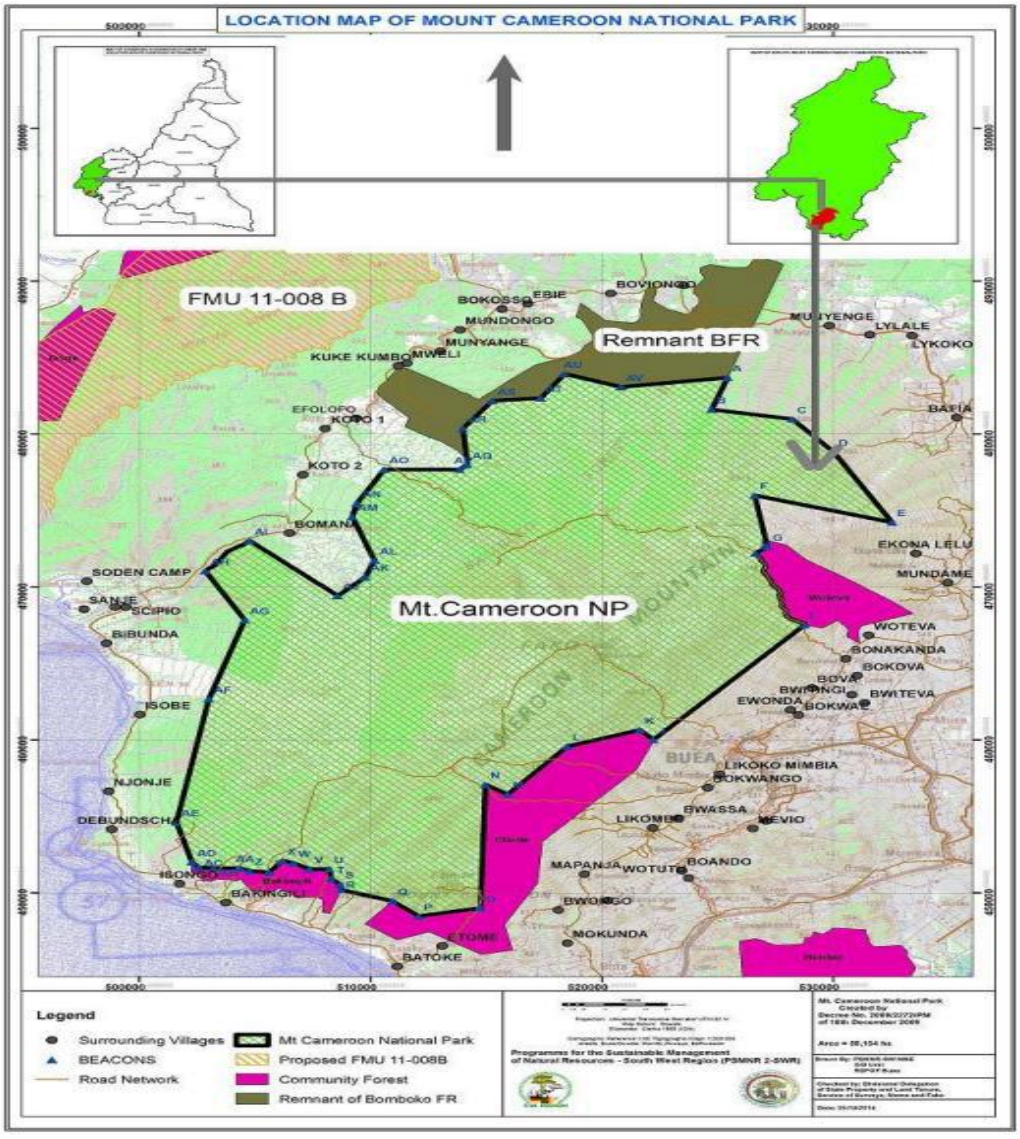

Fig.1: Location of Mt. Cameroon National Park
Source: MINFOF (2014)

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The Mt. Cameroon National Park (MCNP) is located in Fako Division in the South West Region of Cameroon (Fig. 1). It was created by Decision No 2009/2272/PM of 18th December 2009. It covers a surface area of some 58,178 hectares, and shares external boundaries of 128.73 km in length with five Sub-divisions: Buea (46.79 km), Muyuka (19.82 km), Mbonge (38 km), West Coast (24 km) and Limbe II (0.12 km) and other 41 support zone villages whose activities affect (directly or indirectly) the management of the park (MINFOF, 2014).

Three community forests also share direct boundaries with the park: Etinde (4,976 ha), Bakingili (905 ha) and Woteva (1,865 ha). Also, the MCNP shares boundaries with large scale oil palm and rubber plantations belonging to the Cameroon Development Cooperation (CDC), as well as other privately owned plantations, some of which are up to 50 ha. The establishment of oil palm plantations is a major contribution to forest clearance in the Mt. Cameroon area (MINFOF, 2014).

The main problem of the study stems from the fact that despite many scientific publications on the subject in Cameroon and in the MCNP, there is still a knowledge gap on the spatial distribution and species abundance of NTFPs in this area. Determining these in the MCNP and its adjoining forest zone is paramount. This research therefore aims to fill the gap by providing information on these aspects. This study aims to examine the spatial distribution and species abundance area of NTFPs in the MCNP and adjoining forest zones in order to track the changes in the performance of the NTFPs management status overtime in the area.

III. MAERIALS AND METHODS

3.1 Site selection

This study focused on four Cluster Conservation Zones (CCZ) in the Mt. Cameroon Region, including, Buea (hosting the MCNP), Muyuka, West Coast and Bomboko clusters.

3.2 Experimental design

The transect line technique which was employed is similar to previous studies by Buckland *et al*., (1993), Burnham *et al*., (1993) and Sunderland and Tchouto (1999). It enabled us to get practical information on types of NTFPs and their distribution in the various clusters, thereby determining the NTFPs diversity and species abundance area in the field. In each of the selected villages in the 4 clusters, four (04) 1 km line transects were established at 250 m apart in each habitat type. The transect lines (Figure 2) started from the support zone to the park limit and inside the park in the clusters. This was established at a predetermined compass bearing, perpendicular to the main access path from the villages into the habitat types and parallel to each other.

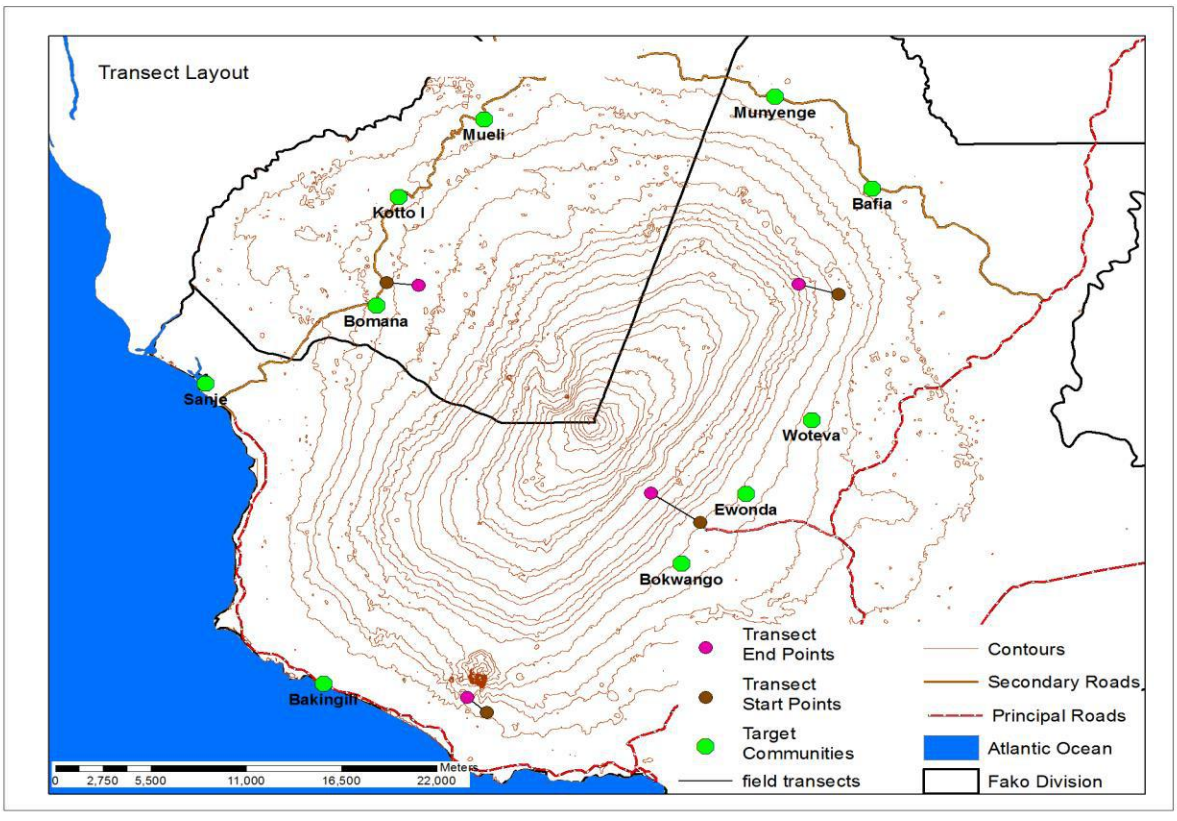

Fig.2: Transect map of NTFPs identification in the study area
Source: Field Work (2016)

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Along each transect, within the range of 20 m on both sides of the central line, a systematic search was made for each NTFPs species and identified species were recorded. The work was done by a team of four persons, that is, the researchers, a botanist and a local assistant.

3.3 Data collection

Data for the study was obtained from secondary and primary sources.

3.3.1 Secondary sources

Secondary data was collected from baseline data from the MCNP service management plan, journals, textbooks, reports, conference presentations and student dissertations related to the topic from both the internet and libraries of the Universities of Buea and Bamenda in the South West and North West Regions of Cameroon.

3.3.2 Primary sources

Primary sources made use of reconnaissance survey in the study area and some communities that are adjacent to the park on the spatial distribution of the NTFPs, carried out between October 2016 and March 2017. During this phase, contacts were also made with some stakeholders, community members and park authorities. Purposive sampling was used to select the sample villages for data collection. The Mt. Cameroon area cuts across five Sub Divisions: Buea, Limbe II, Muyuka, West Coast and Mbonge. From the five Sub-Divisions, four (04) CCZs: West Coast (A), Bomboko (B), Buea (C), and Muyuka (D) clusters were selected for sampling. The sampled clusters (A-D) were further sub-divided into different villages as shown in Table 1 and Figure 3.

Table.1: Villages Selected for NTFPs species diversity in the four selected clusters

Clusters	Villages Selected for Socio-economic Survey
A : West Coast Cluster	Bakingili and Sanje
B: Bomboko Cluster	Bomana, Kotto 1, and Mueli
C: Buea Cluster	Ewonda, Woteva and Bokwango
D: Muyuka Cluster	Bafia and Munyenge

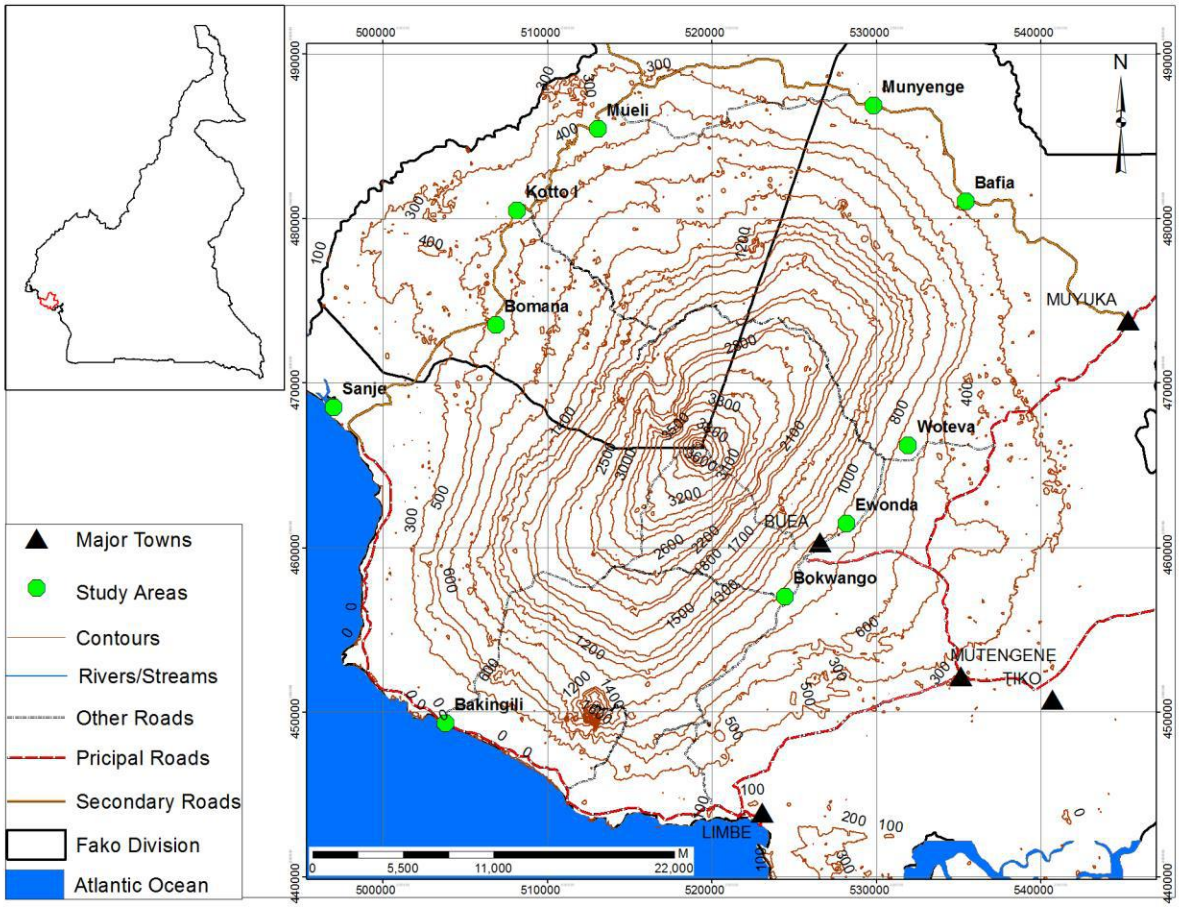

Fig.3: Villages selected for NTFPs species diversity in the four selected clusters
Source: Field Work (2016)

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From the four clusters sampled, 10 villages were selected randomly but with reference to distance so as to check the NTFPs species diversity in the clusters. In each of the 10 villages selected, a total 30 questionnaires were distributed to each village. Thus, making a total of 300 questionnaires administered. The questionnaires were made up of both open and close ended questions. They were administered in conjunction with appropriate PRA tools. The questionnaire was divided into two sections: A and B. Section A targeted data on demography of the respondents in the various clusters. Section B targeted information on the inhabitants knowledge of NTFPs species distribution in the area and species abundance areas. Both random and purposive sampling techniques were used to identify respondents to the questionnaire who constituted Men, Women and Youths who had massive knowledge on local participation in NTFPs management and associated activities in their respective areas. We formed a team of four (04) persons to administer the questionnaires and complete the field work. The team included the two researchers who mostly recorded the information and asked questions, a field botanist from the Limbe Botanical Garden who identified NTFPs on the spot and samples of plants which could not be identified were taken to the plant herbarium of the Limbe Botanical Garden for identification. In each cluster also, a local assistant was also recruited through the Village Forest Management Committee (VFMC) to lead the team to the park, establish transect line and assisted in the identification of the NTFPs in their traditional, common names. The questions were asked in English and Pidgin English which is the predominant language spoken in the villages sampled, but the questionnaires were written in the English language. The interviewer administered the questionnaire mostly to heads of the households and farmers concerned with NTFPs production and commercialization.

Focus group discussions of 6 to10 members were held in the sampled villages. The groups were made of key actors in the field of NTFPs harvesting, gathering, processing, storage and marketing the products in the different clusters. Focus groups had members of the Village Forest Management Committees (VFMC) and members of the Village Traditional Council (VTC). This tool gave respondents considerable liberty in expressing their opinion on questions presented to them as simple as possible thereby providing valid information.

3.4 Data analysis

Organizing of collected data and presentation was done using the two (02) types of descriptive statistics; tabular analysis and frequency histograms.

IV. RESULTS

The spatial distribution of the NTFP species (scientific name, common name and plants part used) in the different clusters of the study area is presented in Table 2 and their frequencies in Figure 4. Furthermore, the NTFP species abundance area is presented in Figure 5.

V. DISCUSSION

Results of the spatial distribution of the NTFPs revealed that the most distributed NTFP species in the clusters were Plum, Njangsa, Bush pepper, Bush mango, Bitter kola, Prunus africana, Eru and Bush onion. These species hold enormous economic value to the inhabitants thus making them significant to the local, national and international economies. They are also important in relation to income generation, food security and medicinal purposes on a major scale while employment and cultural value of the products in the area was on a minor scale. On the other hand, the least distributed NTFP species in the various clusters were Kola nuts, Bush meat, Two-side leaf, Alligator pepper, Charcoal, Ngongo leaf and Rattan.

The following are some common and recurrent NTFP species that were found to be spatially distributed in the area, their means of production/processing and importance.

Garcina kola from the family of Guttiferae commonly called bitter kola is a medium to large deciduous forest tree with dense and heavy crown. It is up to 30 m height, but usually about 15-20 m often remaining in the understory. The flowers are greenish-white, fruits are reddish-yellow, has the size of an orange containing many seeds. It is being distributed in the high forest, found in West Coast, Bomboko and Muyuka clusters. *Garcina kola* is very importance for medicinal purpose and in effect generates income to producers and traders. The seed is chewed to relieve gastric pain and cough. It is also chewed, crushed and the paste applied on the breast after a baby is weaned to save the mother from breast pain and swelling.

Piper guineense is from the family of Piperaceae commonly known as bush pepper. It is a herbaceous woody climber of up to 12 m high; the fruits are reddish brown when ripe and black when dry. Bush pepper is distributed in the high forest and secondary growth, thus widely distributed. It was found in all the clusters. *Piper guineense* is an important mixing agent for medicine and is taken as food (usually in soup and stews) to build strength and treat stomach problems. The fruit is used in pepper soup as a very popular spice and is also used in spicing ingredient before frying or roasting for instance fish or chicken. It also generates income through it sales. Bush pepper is harvested in two ways; the first way is by dragging the stems from easily accessible tree on which they are found and plucking the clusters. Secondly, if found on very tall trees, the stem is completely cut at the

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base. The stems are allowed for about 7 days and the seed cluster withers, fall to the ground and are handpicked. It is consumed both fresh and dry. Drying is easily done by exposure to the sun light for about a month and the dried bush pepper turns black when dried.

Prunus africana from the Rosaseae family commonly called pygeum with a tree of 25 m or more with dark longitudinal-fissured bark. The fruits are fleshy purple black. *Prunus africana* is found in the montane forest above 800 m more commonly in the secondary forest and the species distribution was dominant in the Buea cluster and exits on a lighter scale in Muyuka and Bomboko clusters respectively. It is a major income source for forest based communities and enterprises since its bark is also the raw material for the pharmaceutical enterprises producing drugs to treat prostate problems and health supplements. The is international trade interest in *Prunus africana* bark extract as the basis of drugs for the treatment of benign prostatic hyperplasia and also boiled to treat fever. MOCAP-CIG (Mount Cameroon Prunus Management Common Initiative Group), a locally organized CIG is responsible for the organization and monitoring of sustainable exploitation and management of *Prunus africana* at village level in the Mt. Cameroon area. Initially PLANTECAM Ltd started exploiting the Mt. Cameroon area in the mid-1970s, but they were only using their experienced or trained harvesters from Western region and the concerned villages were limited to tokens given to village chiefs and traditional councils for exploiting their areas.

Recinodendron heudelotti from the family of Apocynenceae is a fast-growing late secondary forest tree found in the humid forests reaching up to 50 m in height with short buttress; smooth at first, becoming scaly with aging; slash dark red. It is valued for its distinctively flavored seeds, commonly called "njangsa", which are dried, ground and used as flavouring and thickening agent in food. It was found in all the clusters. According to Taylor (1960) and Burkill (1994), *R. heudelotii* is a light-demanding species occurring most frequently in the secondary forests. The species is often retained when land is cleared and is common on abandoned farmlands. In the Mt. Cameroon region, an infusion of the bark or root bark is taken to treat diarrhea (Laird *et al*., 1997). The fruits drop towards the end of the rainy season and are collected into piles under the tree, usually by women and children of the village. It takes about 3–4 weeks for the fruit to decompose, then the fleshy parts are removed and the nuts are given a long boiling to crack them. Finally, the kernels are dried in the sun or in an oven and later on sold to traders for commercialization of the product.

Irvingia gabonensis belongs to family Irvingiaceae commonly called bush mango. It is a tree of 10–40 m tall; buttresses to 3m high; with evergreen foliage. Irvingia specie is distributed in the humid forest. It reaches maturity and begin flowering at 10-15 years of age (Lapido *et al*., 1996; Moss, 1995). Bush mango was found in three clusters, except in the Buea cluster. Harvesting takes place mostly in the months of July-September. Bush mango is important as it is used as a food thickener in soup and also medicinal for diabetic patients as founded by Adamson *et al*., (1986), thus generates income. Drying takes two 2-5 days depending on the intensity of the heat of the sun; a process which gives rise to clean an attractive cotyledon which attracts better markets.

Gnetum africanum belongs to the family Gnetaceae commonly called eru. It is a vine found in humid tropical forests below 1500 m elevation. Eru grows in the understory of humid forests and it was found in the West Coast and Muyuka clusters. Eru is shade-tolerant and does not do well in full sunlight and is relatively homogenous in areas where secondary forests predominate. The leafy vegetables play an important nutritional role in household diets. In the West Coast and Muyuka clusters, Eru was mostly domesticated. Eru as a vine climbs on nearby tress. It is harvested from these trees by dragging of the stems to the ground and leaves plucked by hand. If the tree is very tall and dragging is not feasible, the tree is completely cut down and eru leaves harvested. The leaves are then tied into bundles using the stem and marketed.

Dacroydes edulis commonly known as plum is obtained from cultivated stands in agricultural fields, agroforestry planting and compound farms. *D. edulis* fruit is consumed as food supplement. It is eaten raw, roasted or boiled, usually between meals, particularly together with boiled or roasted maize, during the season. It is harvested by climbing and plucking the fruits by hand, if the tree is very tall and climbing is not feasible, the tree is completely cut down and plum fruits harvested in case were production is high or otherwise plucked with the help of a stick. The fruits are sold either in basin or a 1 (50kg) bag as equivalent in measurements.

In addition, results on species abundance area revealed that in terms of their locations recorded, NTFPs in the West Coast cluster were abundance mostly in the farmlands with 28.3%. In the Bomboko cluster, the NTFP species were mostly located in the farmlands and the community forest with 35.6%, while in the Buea cluster, species where mostly located in the park and farmlands with 42.2%. For the Muyuka cluster, the NTFP species were mostly common in the farmlands with 31.7%. The least option was the combination of park, farmland and settlements, where West Coast recorded a 0.0%, Bomboko had 4.4%, Buea with 2.2% and Muyuka with 1.7% in the respective clusters. Therefore, the NTFPs species were located in abundance in the park; farmlands and community forest. In the West Coast cluster, NTFPs

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species such as Bush mango, Bitter kola, Bush pepper and Eru were said to be in abundance in the farmlands. From the Bomboko cluster, NTFPs like Bitter kola, Bush mango, Njangsa, Plum, Fewe and Bush pepper were located more in the farmland and community forest. In the Buea cluster, the NTFPs specie distribution was dominant in the park and farmlands with *Prunus africana* being the most dominant NTFP species located. Finally, the NTFP species of Bush mango, Bitter kola, Njangsa and Plum were in abundance in the park and farmlands in the Muyuka cluster.

VI. CONCLUSION AND RECOMMENDATIONS

In this study, the distribution of NTFP species varied spatially in the studied clusters. However, the most distributed NTFPs in the clusters were Plum, Njangsa, Bush pepper, Bush mango, Bitter kola, Prunus africana, Eru and Bush onion. These NTFP species are of immense importance to the inhabitants in relation to income generation, food security, employment, medicinal purposes and cultural values. Regarding the species abundance area, the NTFP species were located in abundance in the park (MCNP), farmlands and community forest. It is recommended that intensive ecological and livelihood data on the NTFPs needs to be collected periodically in order to track the change in performance of NTFP management status overtime in the area. Also, similar studies is strongly recommended to be carried out in the other forested regions of the country in order to know which of the NTFPs prevail and is or are more productive for economic development of the region, country and internationally.

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Table.2: The spatial distribution of the NTFP species of the Study Area

Etome Village (West Coast Cluster)

	Species scientific name	Common name	Plant part used
1	Irvingia gabonensis	Bush mango	Fruits, Seeds
2	Dacryodes edulis	Plum (safoa)	Fruit
3	Ricinodendron heudelotii	Njangsa	Seeds
4	Gnetum africanum	Eru	Leaves
5	Afrosfyrax lepidophyllus	Bush onion	Bark, seed
6	Aframomum melegueta	Alligator pepper	Bulb, seed
7	Piper guineense	Bush pepper	Fruits, leaves
8	Garcinia kola	Bitter kola	Nut bark
9	Garcinia mannii	Chew Stick	Stem
10	Costus afer	Ginger lily (Monkey sugar cane)	Stem
11	Aframomum flavum	-	-
12	Monodora myristica	Gengat	
13	Megaphrynuim macrostachyum	Okakon	Leaves
14	Maranthochloa purpurea	Ngongo leave	Leaves
15	Sterculiar hinopetala	Mbonda	-
16	Palisota ambigua	Ntom	-
17	Selaginella abyssinica	-	-

Bomana Village (Bomboko Cluster)

	Species scientific name	Common name	Plant part used
1	Ricinodendron heudelotii	Njangsa	Seed
2	Afrostyrax lepidophyllus	Bush onion	Bark, seed
3	Irvingia gabonensis	Bush mango	Fruits, Seeds
4	Garcinia kola	Bitter kola	Bark,Seeds, leaves
5	Monodera myristica	Gengat	-
6	Piper guineense	Bush pepper	Fruit, Leaves
7	Tetrapleura tetraptera	Aidan tree	Fruits, Seeds
8	Treculia africana	-	-
9	Garcinnia mannii	Chewing stick	Stem

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10	Megaphryynuim macrostachyum	Okakon	Leaves
11	Annickia chlorantha	Yellow bark	Bark
12	Vernoria conferta	-	-
13	Musanga cecropioides	Milk stick	Stem
14	Alstonia boonei	Stool wood	Bark, Latex
15	Chinconia spp	Quinine	Bark

Buea Village (Buea Cluster)

	Species scientific name	**Common name**	**Plant part used**
1	Prunus africana	Pygeum	Bark
2	Kigelia africana	Sausage tree	Leaves, Seeds
3	Solonuion linn	-	-
4	Hypselodelphus scandes	-	Leaves
5	Eremomastax speciosa	Two-sided leaf	Leaves

Ekona Lelu (Muyuka Cluster)

	Species scientific name	**Common name**	**Plant part Used**
1	Costus afer	Monkey sugar cane	Stem
2	Hypselodelphus scandes	-	Leaves
3	Aframomum flavum	-	-
4	Musanga cecropioides	Milk stick	Stem
5	Prunus africana	Pygeum	Bark
6	Agauria salicifolia	-	-
7	Ricinodendron heudelotii	Njangsa	Seeds
8	Gnetum africanum	Eru	Leaves
9	Irvingia gabonensis	Bush mango	Seeds, Fruits
10	Garcinia kola	Bitter kola	Seed, Fruit

Source : Field Work (2016/2017)

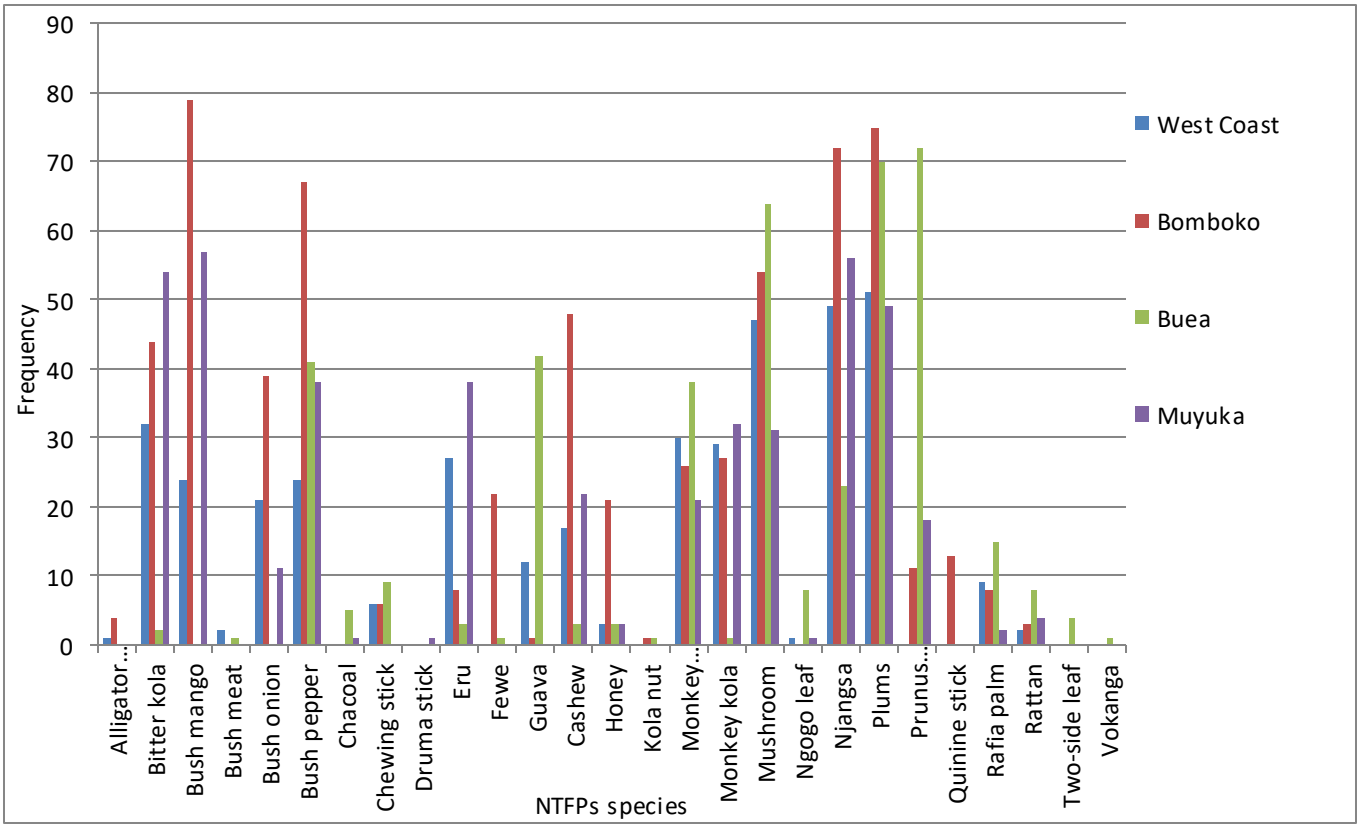

Fig. 4: Frequency distribution of NTFP species in the four sampled clusters

Source: Field Work (2016/2017)

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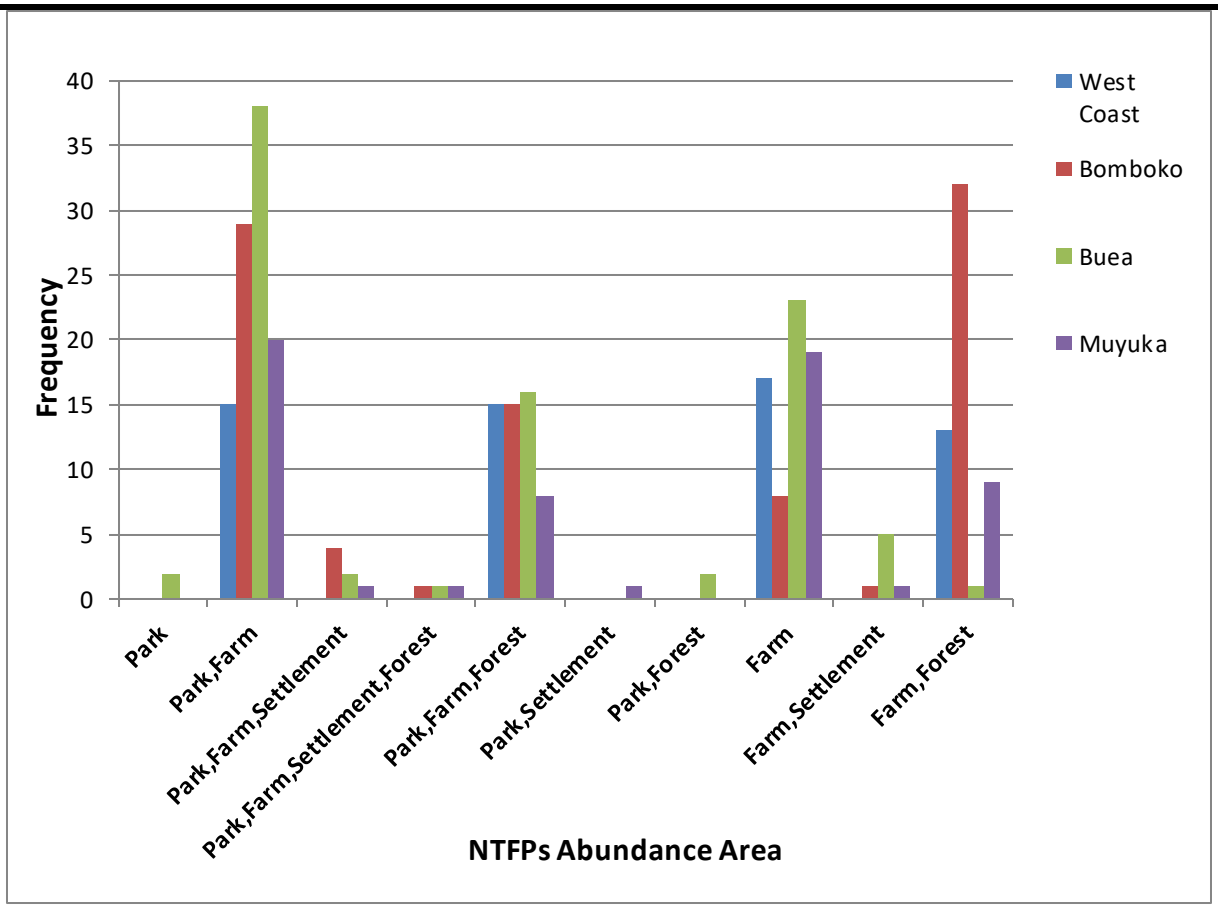

Fig.5: NTFP species Abundance Area in the four sampled clusters
Source: Field Work (2016/2017)