

Monitoring the Implementation of *Prunus Africana* (Rosaceae) Management Plans in the North West and South West Regions of Cameroon: Respect of National Norms

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Abstract

Prunus africana (Hook.f) Kalkman (formerly *Pygeum africanum* Hook.f.), known under its trade/pilot name as pygeum or African cherry is a non-timber forest product (NTFP), listed in the Appendix II of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES). Its harvesting and exports have been regulated in Cameroon as “a special forest product of a particular interest” since 1994 through a system of annual based exploitation permits for dried bark. The CITES Secretariat realized the challenges that range States of *Prunus africana* face to implement CITES requirements and it has teamed up with the International Tropical Timber Organization (ITTO) to help build capacities at the country level and promote the sustainable management of tropical forests including these species. This partnership in the frame of the so called “the ITTO-CITES program” has strengthened considerably and is currently the Congo Basin countries to develop non-detriment findings (NDF) on *Prunus africana*. This paper aims to assess the way the simple management plans developed for *Prunus* and guidelines contained in NDFs reports are being implemented in the field, the North West (Mount Oku) and the South West (Mount Cameroon) regions to be precised. Although Cameroon has made many efforts to promote the sustainable harvesting of *Prunus africana* in the country, many problems still remain in the implementation of the guidelines prescribed in the NDF or SMP developed within the ITTO-CITES program. It is in the North West region where the non-respect of existing norms/standards in term of realization of exploitation inventories, the minimum exploitable diameter (MED) and sustainable harvesting techniques is largely observed. The low buying price tends to be the main cause of the non-respect of national standards by community forest managers and harvesters. The local CITES MA continues to grant the annual quota of 150 tons from community forests of North West in spite of the ban of harvesting occurred in some forests. This element, coupled with the usage of false documents to convey *Prunus* barks by some traders, outlines the urgent need to settle a fair tracking system which will be able to really fix the harvesting of *Prunus* in the space. The study concludes that developing management plans is good, but implementing correctly the guidelines contained in those plans in the field is better. There is an urgent need for the ITTO-CITES program to extend its activities on the implementation of the simple management plans..

Keywords: *Prunus africana*; NTFP; special products; CITES; ITTO-CITES program; norms; non-detriment findings; management plans; sustainable harvesting.

1. Introduction

In Cameroon, when someone is talking about forest products, he is thinking firstly to the timber, and then, to the bush meat. The non-timber forest products (NTFPs) of plants origin are still neglected, due to their informal character and their little contribution in the national budget. There are two categories of NTFPs of plants origins in the country, according to their economical importance for the Government: the first group is composed of NTFPs for which the Government does not require any taxes for their exploitation, and the second group is made of NTFPs from which the Government perceives taxes from their exploitation and trade.

The second group is also known as “special products”. The alinea (paragraph 2) of the article n° 9 of the law N° 94/01 of the 20th January 1994 regulating the forests, fauna, and fishes in Cameroon states that “some forest products such as food, medicinal plants, ... or presenting any particular interest, are considered and designed special products”. The list of the so call “special products” is fixed or established, according to the case, by the competent administration (the forest administration or MINFOF in this case to be precised). The article n° 2 of the Decision n° 0336/D/MINFOF of the 06th July 2006 giving the list of “special products of a particular interest” states that, those are products that are relatively less abundant in the forest or for which some additional measures are indispensable, due to the threatening caused by the non-sustainable harvesting methods used by people. The quotas (sustainable harvesting quantity) of “special products of particular interest” are granted by an inter-ministerial commission comprising representatives from the forest administration, environment, research, finance, and others.

The exploitation of “special products” is regulated in Cameroon mainly by the forest administration, Ministry of Forest and Wildlife. Two main Directorates are concerned in this administration: the Directorate of forests is in charge of the management of the resource, while the Directorate of promotion and processing is concerned with the valorisation. The Ministry of Economy and Finances ensures the collection of taxes through the Forest Revenue Enhancement Program (FREP). The only tax fixed till date by the national financial law for the exploitation of special products is called the regeneration tax, which is 10 FCFA/kilogram of the product (1 US \$ = 550 FCFA).

Prunus africana (Hook.f.) Kalkman (formerly *Pygeum africanum* Hook.f.) is a species of the Rosaceae family, known under its trade/pilot name as pygeum or African cherry. It is a mountain tree species of the tropical Africa. In its distribution area the natural range of *P. africana* is discontinued. Pygeum forests appear fragmented in several isolated sub-stands distributed in a fromontane forests *P. Africana* is a scattered tree species, which grows well in the sub-mountain and mountain forests at an altitude of 1500 – 3000 m. In Cameroon, the plant is largely found in five regions including Adamaoua, North West, Littoral, South west, and West. *P. africana* is an evergreen canopy tree to 30 m tall with thick, fissured bark and straight bole that can reach a diameter of 1.5 m. It is light demanding and responds well to cultivation (Hall et al., 2000; Vivien and Faure, 2011; Fraser et al., 1996; Tchouto, 1996). The bark is black to brown, corrugated or fissured and scaly, fissuring in a characteristic rectangular pattern.

The fruits of *Prunus africana* are drupaceous, fleshy and red-purple in colours and are said to be eaten by a variety of birds and mammals (Cunningham and Mbenkum 1993). The bark is the major source of an extract used to treat benign prostatic hyperplasia, an increasingly common health problem in older men in the western world. Prostate-related diseases increase in prevalence as men age. And as the average age of the world’s population increases, the incidences of prostate diseases will increase as well, triggering a corresponding rise in demand for therapies. According to the World Cancer Research Fund International, prostate cancer is the second most common cancer in men worldwide. Around 910,000 cases of prostate cancer were recorded in 2008, accounting for approximately 14% of all new cancer cases in men (World Agroforestry Centre, 2012). Bark extracts contain fatty acids, sterols and pentacyclic terpenoids (Cunningham and Mbenkum, 1993). The drugs processed from the bark extracts are sold under the brand-name of “Tadenan” in France by Laboratoire Debat, “Pygenil” in Italy by Indena Spa, and “Proscar” in UK by Merck Sharp and Dohme Ltd (ICRAF cit. Ndam, 1996).

The United Nations Food and Agriculture Organization (FAO) reported as far back as 1996 that the demand for the species’ bark, which is used to produce treatments for prostate gland disorders, could lead to its over-exploitation (FAO, 1996). In 1997, the global need is about 4 000 tons of dried barks per year for a value of 220 millions of USD. Two hundred kilogram of dried bark yield 5 kilogram of extract (Cunningham et al., 1997). The trade in dried pygeum bark and bark extract is in the order of 3 000 – 5 000 tonnes a year (Alternative Medicine Review cit. Page, 2003) and the main sources are in Cameroon, Madagascar, Equatorial Guinea, Kenya, Uganda, and Tanzania.

P. africana is classified by the World Alliance for Nature (IUCN) as vulnerable species, which led to its listing in the Appendix II of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES) in 1994, becoming effective in 1995. In theory, this means that countries of export have to issue export permits and countries of import have to check these permits upon entry (Cunningham, et al., 1997).

The Scientific Authority (CITES-SA) of an export country advises its Management Authority (CITES-MA) on the sustainability of a consignment and, ideally, the export permit would be based on sound inventory and management information (so-called "non-detriment" findings (*ibid.*)). In Cameroon, the Directorate of Forests (DIRFOR), in the Ministry of Forestry and Wildlife is the CITES management authority for flora, while the National Forestry Development Agency (ANAFOR) plays the role of the CITES Scientific authority for flora. All of the countries exporting *Prunus africana* bark, including Cameroon, are signatories to CITES. This should ultimately mean that the bark being exported is harvested from a sustainable source. However, the reality is somewhat different and, despite the legislation, the unsustainable exploitation of *Prunus africana* is often well-recorded.

Prunus harvesting and exports have hence been regulated in Cameroon as "a special forest products of a particular interest" since 1994 through a system of annual based exploitation permits for dried bark. This method of special permit attribution was realized, over the years, to have some weaknesses which largely contributed to the gradual depletion of the natural existing *Prunus* stock. The review of the system of the management "special products" in Cameroon dressed by the United Nations Food and Agriculture Organization (FAO) revealed many weaknesses at all levels of the circuit of exploitation in terms of natural resource management and taxes (Betti 2007a, b). For example, quotas and permits were issued without reference to adequate biological baseline information, the attribution of the quota of special products was not based on sound inventory of the existing stock, the harvesting was not well defined in space (specific forest area) and time, official documents settled by the forest administration were not secured, the regeneration tax set at 10 FCFA/kg is too small to really play its role of conservation or sustaining the resource. This situation, coupled with the onset of illegal *Prunus* bark exploitation around the country led in 2007 to the adoption of the zero quota of *Prunus africana* bark exportation from Cameroon by the CITES-MA.

In order for the exportation to undergo after four years of considerable economic hardship to both the local community and all the other stakeholders involved in the *Prunus* trade, several steps had to be taken by the Cameroon Government to satisfy the International Community and to meet some basic requirements such as an inventory of the existing stock, a review of the method of special permits attributions and prescribing new sustainable methods for *Prunus* bark exploitation with the settlement of the Minimum exploitable diameter (MED) at 30 cm and the prescription of 2x ¼ opposite sides harvesting. Given these challenges a new system for the allocation of special permits for *Prunus* bark exploitation called *Prunus* Allocation Units (PAU) was adopted. The PAU grants long term exploitation rights for the exploitation of *Prunus africana* within a territory specified according to an inventory and subsequent Management Plan for the unit. The Mt. Cameroon region for example shall be considered as a PAU and *Prunus* bark exploitation shall be done in accordance with a Management Plan. One of the CITES strengths has always been its flexibility and its capacity to adapt over time to changes in conservation and management of and trade in wildlife. The interest of Parties in including tree species in the CITES Appendices is increasing considerably and the listings of *Pericopsis elata* (timber) and *Prunus africana* (bark), two species found in Cameroon forests in CITES Appendix II are proof of this tendency.

The CITES Secretariat realized the challenges that range States of these tree species face to implement CITES requirements and it has teamed up with the International Tropical Timber Organization (ITTO) to help build capacities at the country level and promote the sustainable management of tropical forests including these species. This partnership in the frame of the so called "the ITTO-CITES program" has strengthened considerably and is currently funding national activities to assist non-detriment findings by developing inventory, management and silvicultural plans, setting up tracking systems, providing training, and developing training and working material. Since 2008, under the ITTO-CITES Program, ITTO has, in consultation with the CITES Secretariat, funded 25 Activities (projects) in Africa distributed as follow: Cameroon (9 activities), Congo-Brazzaville (5), Democratic Republic of Congo (5), Ghana (2) and four at regional level.

The assistance of the ITTO-CITES Program to date to Cameroon on *Prunus africana* has focused on the development of NDFs (including simple management plans, resource inventories, etc.) for key production regions using limited funds provided by the private sector. The lack of NDFs was identified at the earliest stages (2009) of the Program's work on this species as a key factor leading to bans (in DRC and equatorial Guinea for example) and voluntary zero quotas (in Cameroon) that gave rise to the private sector's interest in funding this work. In 2010-2011, the program funded *Prunus* management inventories in two regions in Cameroon including North West and South West.

The management inventory was conducted with a sampling intensity of 1.11% in Mount Cameroon (South West), 3% in 17 community forests found in the North West, 3% in the flora sanctuary found in the North West, and 0.5% in the area out of community forests in the North West. The method used was the modified “Adaptive Clusters Sampling (ACS)”. We call this method “modified ACS” since, only one circular plot was added at 100 m in each side of the rectangular plot which hosted many stems of *Prunus africana* (Betti et al. 2011). A prediction of the sustainable yield of *Prunus* bark was made from estimates of the natural population (number of exploitable trees), the average yield per tree (55 kg of fresh bark) and the length of time between successive debarkings (rotation) required to allow total recovery of the bark (5 – 10 years). Those sustainable yields or annual quota were reported as follow in each regional NDF document: South West 150 tons of dried bark inside and outside the Mount Cameroon National park, North West 104 tons for community forests, 5.8 tons for Kilum-Ijim flora sanctuary, and 56.3 tons for the area out of community forests.

The NDF reports also proposed specific measures to consider prior to or during harvesting of the bark which are: adoption of a rotation of 10 years or a half rotation of 5 years, dividing the useful area of each forest in five equal annual blocs (clusters) according to the rotation, conducting 100% inventory with standard methods and equation for calculating harvestable yield quotas for each Cluster prior to setting annual quota and exploitation proper (this means that the real quota can differ to the estimated one), apply prescribed norms for harvesting the *Prunus* barks such as the MED (30 cm), the use of 2 x ¼ method of harvesting, harvesting only living trees, setting tracking systems (Amougou et al. 2010, 2011, Betti et al. 2011). This paper aims to assess the way the simple management plans developed for *Prunus* and guidelines contained in NDFs reports are being implemented in the field, the North West (Mount Oku) and the South West (Mount Cameroon) regions to be precised. The specific objective is to check the respect of national norms/standards in the field.

Material and Method

Study Sites

South West

The South West of Cameroon is composed of six divisions including: Fako, Koupé-Manengoumba, Lebialem, Manyu, Meme, and Ndian. The Mount Cameroon is located, between 3°57' – 4°27' latitude North and 8°58' – 9°24' longitude East in the bottom of the Biafra bot berry in the Guinean gulf. It is up to 4095 m and covers a total area of 25 000 square kilometre (km²), in the divisions of Fako and Mémé. The climate is a subequatorial type, on monsoon regime with two seasons: a short dried season from December to March and a long rainy season from April to November. The average temperature is 22°C in the altitude. The relative humidity remains at 75-80% due to the influence of clouds and fogs. Mount Cameroon is an active volcano of the Hawaiian type. Slopes are steep, soils are volcanic, fertile with a low capacity of water retention. Those soils, if well drained are good for agriculture (Ewusi et al., 1996). The Mount Cameroon has a high diversity of plant species. It is the only area in central Africa where the vegetation is continuous from the bottom at the sea level till the summit (ERM, 1998). From bottom to the summit of the mount, there are four main vegetation types including: the sub-mountain forest, the mountain forest, the sub-mountain meadow, and the mountain meadow (**photo1**).



Photo 1: Mount cameroon forests

The mountain forest is less rich in plant species compared to the sub-mountain forest. Characteristic trees found in the mountain forest include *Prunus africana*, *Schefflera abyssinica*, *Canthium dunlapii*, *Nuxia congesta*, *Clausena anisata*, *Syzygium staudii*.

The North West region

The North West region of Cameroon is located between 5°4' and 7°15' latitude North and 9°30' and 11°15' longitude east. It covers a total area of 17 910 km². The North West region is composed of 7 divisions including: Mezam (Bamenda being the capital), Boyo (Fundong), Bui (Kumbo), Ngoketunja (Ndop), Donga Mantung (Nkambé), Menchum (Wum), Momo (Mbengwi). The natural *Prunus* inventory was conducted in the Mount Oku. The mount Oku covers two divisions in the North West region: the Boyo and the Bui divisions to be précised. The side located in the Boyo division is called "mount Ijim" and the one located in the Bui division is called "mount Kilum". Mount Oku is up to 3011 m and belongs to the Cameroonians mountains group (White 1983), closed to the Mount Cameroon (4095m), Bamboutos (2740 m), Manengoumba (2411 m), Koupé (2064 m), and Tchabal Mbabo. The area is composed of a variety of landscapes including small and high mountains with high slopes and valleys. The lowest altitude is about 1169 m towards Babungo. Mount Oku is an inactive volcanic mount and comprises three types of soils: volcanic soils which are black and suitable for agriculture in spite of their low capacity of water retention due to their permeability (porosity), iron and granitic soils which are red and less fertile for agriculture in the Donga Mantung division, and hydromorphic soils found in the flat landscapes of Ndop, Jakiri, Mbaw and Babungo.

The position of the region in the tropical area implies a humid and warm climate, which is however transformed to a temperate and warm climate on the mountains. The Oku region is characterized by two distinctive seasons including the dried season with humid and dried winds which lasts from mid-November to mid-march, and the rainy season going from mid-March to mid-November. The annual rain is about 2000 mm, July and August being the rainiest months. In low levels, the highest temperature is 23°C. Temperatures are low in high levels. December and January are the two months where temperatures are too low. The water network is less dense, composed mainly of small rivers which bear in rocks in mountains and which become bigger in valleys. This gives priority to the protection of those mountains for the regulation of the water regime. There also exists a volcanic lack on the summit of the mount Oku. The Oku vegetation is a direct consequence of the climate, topography and human activities. Following vegetation types can be found: the humid and arbustive savannahs in high altitudes, the *Pennisetum purpurum* vegetation in valleys of low drainage, and the mountain forests which cover the mounts of Nkom, Wum, Kilum and Ijim (**Photo 2**).



Photo 2: North West forests

Prunus africana is often found on slopes of the mount Oku, in association with many other plant species including: *Podocarpus milanjanus* (which abounds between 2700 - 3000 m), *Syzygium staudtii* (1800 - 3000 m), *Nuxia congesta* (1100 - 3100 m), *Rapanea melanophloeos* (1200 - 3100 m), and starting from 2800 m, *Adenocarpus mannii*, *Gnidia glauca*, *Impatiens sakerana*, *Hypericum revolutum*, *Crassocephalum mannii*, *Dipsacus narcisaeus*, *Euphorbia schimperana*, *Discopodium penninervium*, *Mimulops solmsii*.

Due to high population density, the fauna of the Oku region is no longer rich. Most of large mammals have almost been extinct. Nevertheless, there exist some endemic and protected bird's species such as *Touraco bannermani* and *Platysteira laticincta*. There also exist some rats and small monkeys in the mountain forests. The populations of the Oku region are largely composed of « Grassfields » groups with the English as the principal language. The “Bororos” group also came from the North Cameroon for searching grasslands for their cows. The main ethnic groups include Banso, Oku, and Kom. Other Cameroonian and Nigerian groups are also found in small quantities. According to the 1987 population statistics, the Oku region host a total number of 1,5 million of persons with a density of 25 inhabits/km². This population density is considered as one of the highest density in Cameroon, it is thrice more high than the national average density. More than 75% of that population leaves in rural areas and practise mainly agriculture. The main crops are maize, bean, cassava, cocoyams, plantain, banana, sugar cane, legums composed mainly of Bitter leaf and Njamajama. Domestic animals are composed of cows, cheeps, porcs, and chicken.

The summit of the mount Oku is subjected to bush fires, used by “Bororos” or Foulani farmers for grazing. The Foulanic farmers are nomadic. There exist many conflicts for lands between farmers. Bush fires constitute one of the main threats for *Prunus africana* in the Northwest region. The Mount Oku hosts the unique natural forest which surrounds the volcanic lack of Oku or the “Oku lack”. To protect this forest which constitutes the scarce habitat of the two endemic and endangered bird species *Touraco bannermani* and *Platysteira laticincta*, one project entitled “the Kilum Ijim project” was launched with the financial support of the Bird Life International in 1993.

To involve local people to the conservation of the forest resources and to the maintenance of the water regime which bears from the mountains, the “Kilum Ijim project” assisted local populations in the acquisition of community forests. The project also proposed the erection of one important part of the forest in a protected area, the flora sanctuary of Kilum-Ijim to be précised. A total number of seventeen (17) community forests were created with the *Prunus* exploitation being the main goal. The simple management plans of all the 17 forests were developed. The problem is that, those simple management plans were developed without suitable *Prunus* inventories and sustainable yield set. Table 1 presents the 17 community forests, the Kilum Ijim flora sanctuary and the area out of the community forests with their surface area.

Method

Data were collected from November – December 2015. Before going to the field (forest), the team of the study hold several meetings with different stake holders including the forest administration officers in the external services (regional and divisional delegates of forestry and wildlife), the representatives of *Prunus* production sites including the Mount Cameroon National park service and the MUTEF Community forest manager (CFM), the private sector. The team also discussed with the Program for the sustainable management of natural resources in the South West region of Cameroon (PSMNR-SWR). The PSMNR-SWR is a development program of the Government of Cameroon, co-financed by the Federal Republic of Germany through the KFW, in cooperation with GIZ. The PSMNR assisted the Mount Cameroon national park authorities to implement the management plan of the Park in collaboration with local populations.

The benefit sharing mechanisms settled in each production site, reports, and official documents including field logging book and way bills were analyzed. We also checked the existence of monitoring system and the control missions to be executed by the local forest administration. In the field, we examined the way simple management plans dressed in 2010 - 2011 are being implemented in terms of annual plots delimitation, systematic inventories of exploitable trees in annual plots, the respect of national standards in terms of the minimum exploitable diameter, the technics of harvesting. To do this, we went to the first annual plot of each selected production site to collect data on diameter at breast high and to describe the technics of harvesting of the bark used (**photo 3**).



Photo 3: Field trip

Results

Since 2011, private/trade companies in Cameroon have access to the resource (*Prunus*) in three ways including: (1) a competing process call of the PAUs (in Adamawa region for example), (2) community forests with approved simple management plans and quota (North West), and (3) tripartite conventions between the trade company, the State (Government), and local communities (South West). The evolution of the Cameroon's export quota on *Prunus* barks is presented as follow since 2010:

- Year 2010 : 150 tons of dried barks (North west);
- Year 2011: 280 tons (North West and South West);
- Year 2012 : 634,763 tons (North West and South West, Adamawa);
- Year 2013 : 634,763 tons (same areas);
- Year 2014 : 974,853 tons (North West and South West, Adamawa, Centre);

1. Respect of Regional quota and Benefice Sharing Mechanisms

1.1. North West region

In 2011, the Cameroon CITES management authority for flora (Ministry of Forestry and Wildlife/Directorate of Forests) authorized to harvest a total of 280 tons of dried bark of *Prunus* in the North West (150 tons) and the South West (130) regions. The 150 tons of the North West region were approved for 12 community forests, the Kilum-Ijim flora sanctuary, and the area out of the community forests. Community forests are those forests that the Government allows local communities to harvest and yield revenues. These revenues are used for implementing development projects such as building schools, dams, health structures. In the dense forest regions of Cameroon such as East, Centre, Littoral and South, community forests are often requested for timber logging. The exploitation of NTFP is considered as a minor activity.

But in the North West and South West regions, community forests are largely requested for the harvesting of special products mostly composed of *Prunus* barks. The activities of the 12 community forests (CF) identified in the North West region were focused on the harvesting of *Prunus* barks. Seventh out of these CF are found in the Bui division and 6 are found in the Boyo division. For the seventh CF of the Bui division, local traditional authorities (rulers) together with their communities refuse to authorize the harvesting of *Prunus* bark in their forests.

This was decided because of some misunderstandings occurred on the benefice sharing mechanisms between the traditional rulers and the mayor of the city of Kumbo. In fact, the mayor of the city of Kumbo, the capital city of the Bui division, wanted to have a total control of the management of the *Prunus* barks revenues yielded from surrounding CFs. The forest administration respected that decision and has never issued the official documents including field log books and way bills to traders for the exploitation of *Prunus* barks in the Bui division. But, the study noted that, the decision was not effectively respected by some trade companies. In fact, some trade companies succeed to convince some villagers and farmers to harvest *Prunus* found in both natural forests and plantations in the Bui division.

They buy some sheets of the way bills documents from the community forests of the Boyo division, to convey their products till the factory and exit port (Douala). The only community forests authorized therefore to harvest *Prunus* in the North West are those located in the Boyo division including ANYANJUA, LAIKOM, MOULOIN, MUTEF and YANG TINIFOINBIMULO. The 2010-2011 *Prunus* management inventories conducted by the National Forest Development Agency (ANAFOR), the Cameroon CITES Scientific authority for flora, within the ITTO-CITES program was conducted in the North West region with an average sampling rate of 2.72 % for the four community forests ranging from 1.85 at MUTEF to 3.25 at YANG. A total annual quota of 14 411.31 tons of dried bark/year was proposed for the four out the five community forests identified in table 2.

For the two first harvesting years (2011 and 2012), the forest service of the regional Delegation of Forestry and Wildlife and the divisional delegation of Forestry and Wildlife of the Boyo assisted local communities in managing their forests as prescribed in NDF reports and SMP. This assistance included: (1) training of harvesters on the national standards of harvesting, (2) the control of harvesting in the forests, (3) distribution of seedlings to farmers, (4) the sensitization of local people on the importance of *Prunus africana*, and (5) the delimitation of annual plots (blocs). Once the annual plot is delimited, the CFM has to conduct the 100% inventory of exploitable trees inside the plot. During the exploitation inventory, all health *Prunus* trees with diameter at breast high ≥ 30 cm are measured, geo-referenced, tagged and recorded for exploitation. The exploitation inventory has never been conducted in any community forest of the Boyo division or in the North West region before harvesting. Since 2013, the assistance has been limited to the distribution of seedlings to farmers and the sensitization of those farmers on the importance of *Prunus africana*. Specific activities such as the control of harvesting in the field have no longer been conducted.

The MUTEF community forest was selected in the North West for the monitoring study due to its important contribution to the divisional quota: 5 948.8 kg of dried bark/year or 12 000 kg of fresh bark/year, representing 41.3% of the total quota. This quota should be harvested in annual plots of 119 ha each. The harvesting of *Prunus* bark started in MUTEF forest in 2011 as scheduled. Once the annual plot is delimited by the local forest services, the CFM of MUTEF engages peoples for harvesting the 12 000 kg of fresh barks attributed. The CFM said, the community does have enough funds to support the exploitation inventories as requested. To ease the control and tracking system in the field, the forest administration reduced the number of private companies authorized to buy *Prunus* barks. For the MUTEF community forest, only one company was authorized to buy barks. The company pays one kilogram of the fresh bark of *Prunus* at 130 FCFA (or 0.24 USD). The benefice sharing mechanism was set as indicated in table 3. The harvesters (46.2%) perceive about the average of the total revenues yielded from the selling of barks. The facilitation of the community participation or the community forest manager (CFM) has the smallest part, only 15.4% of the total revenues.

In 2013, two years after the implementation of this agreement, the harvesters complained with their salary. They said, the salary was too small compared to the hard and dangerous work of the harvesting of *Prunus*. They requested to be paid at 80.0 FCFA/kg and the CFM at 50 FCFA/kg. The reason of this was that, the authorized annual plots (bloc 3 – 5) were being located far and far from the village (houses). But the CFM refused to obey. Harvesters then started debarking *Prunus* trees using un-sustainable methods. These harvesters can be distinguished in five groups according to their practices (behaviour). The first group of harvesters returned in the first annual plots harvested in 2011 and 2012 to debark non-mature/exploitable trees (these are trees with diameters < 30 cm). The second group of harvesters also returned back to the same previous plots and started removing one of the remaining portions of the bark (the third quarter) that was left to be harvested after five years according to the guidelines; finally the $3 \times \frac{1}{4}$ of the tree was harvested, what is not normal. The third group of harvesters removed all the remaining bark, which are the third and the fourth quarters; they practiced a total debarking = $4 \times \frac{1}{4}$ of the tree, which is prohibited. The fourth group of harvesters started harvesting the bark of *Prunus* found in private farms, close to the village. Other harvesters (the last group) resigned, abandoned the job because of the low buying price and the hard work. In 2014, the CFM of MUTEFF wrote a letter to the Minister of Forestry and Wildlife, asking the authorization of harvesting *Prunus* barks from private farms and plantations. The reason presented in the letter was that, there was not enough *Prunus* in the blocks 4 and 5. At the same time, there were many *Prunus* found in private farms and plantations surrounding the community forest. The Minister accepted the request and authorized the MUTEFF community to start harvesting *Prunus* from private farms and plantations. The CFM of MUTEFF then decided to revise the benefice sharing mechanism as shown in table 4. The farm owners (46.5%) and harvesters (30.8%) are in this order the stake holders who perceive the high amount of the funds generated by the community forest.

This new arrangement was agreed by all parties and is the one which is working now in the MUTEFF community forest since 2014. If the buying price of *Prunus* was quite high, at least 500 FCFA/kg for example, the CFM should be able to conduct the 100% exploitation inventory in each annual plot and harvesters should continue to harvest inside the community forest without problem. The funds generated by the selling of *Prunus* have been effectively used by the CFM who contributed to the building of the MUTEFF secondary school, and to the buying of tables and chairs for the local nursery school (**Photo 4**).



Photo 4: the CFM showing the dampt built with the revenues of the MUTEFF CF

1.2. Mount Cameroon

The 2010 *Prunus* management inventories conducted by ANAFOR in the Mt Cameroon PAU proposed an annual quota of 178 tons of dried bark inside (158 tons) and outside (20 tons) the park, for a total useful area of 22844 ha. As a conservative measure and conscious of the status (national park) of the Mt Cameroon, the conservation service of the park together with the Regional Delegation of Forestry and Wildlife of the South West, decided to reduce that quota at 130 tons/year for the first rotation of 5 years exploitation. The service of the park divided the Mt Cameroon into 5 annual plots called clusters as showed in table 5.

The five plots (blocs) are illustrated in figure 1. The 100% *Prunus* exploitation inventories are carried out in each bloc prior to exploitation as scheduled. During the inventory, all health *Prunus* trees with diameter ≥ 30 cm are measured, geo-referenced, tagged, and recorded for exploitation. Till date, the exploitation inventories are supported by the PSMNR-SW program. A total amount of 80 000 000.0 FCFA was estimated to cover the exploitation inventories on the five blocs, totalizing 32 000 ha. This gives an average cost of 2 434.0 FCFA/ha (table 6).

Although the authorized quota based on the previsions of the management plan was set at 1 260 tons of fresh bark/year for a 5 year rotation period, so far only about 510 tons of fresh bark of healthy exploitable trees have been recorded in the half area of the Mount Cameroon PAU. *Prunus* regeneration is promoted through enrichment in Community Forests and Communal land, and trees planting in farms and plantations. The participation of local communities constitutes an integral aspect of the management. A fair and equitable benefit sharing mechanism was developed and is being implemented to assist in poverty alleviation in the surrounding village communities. Exploitation inventories, harvesting, weighing, and payment are done under the supervision of the Park Service and the Regional Delegation of Forestry and Wildlife with the assistance of the PSMNR-SW program. The Mont Cameroon communities association (MOCAP), a locally organized Community initiative Group (CIG) was created for the organization and monitoring of sustainable exploitation and management of *Prunus* at village level on Mount Cameroon. MOCAP regroups all villages surrounding the Mount Cameroon National Park. The trade company buys the fresh bark to MOCAP at 550 FCFA/kg, and this payment is distributed to different stakeholders/activities as illustrated in table 7. Harvesters, field equipment, and medication appear to be the post which has the highest cost (43%). It is followed by the park management (20%). The monitoring and controls are strengthened to insure traceability and sustainability. Better coordination between central, regional and divisional Forestry Administration is ensured.

2. Respect of norms during harvesting

The national standards recommend that $\frac{1}{4}$ of the stem be stripped from opposite sides and leave the other sides unexploited for 5 years to permit the bark to regenerate before exploitation. This should begin at 1.3m above the ground level and end at the first big branch. Harvesting of *Prunus* bark shall be carried out only by trained farmers/harvesters in possession of a harvester's certificate. Harvesters shall only debark trees that have been tagged and geo-referenced. Harvesting shall be done along $\frac{1}{4}$ strips on opposite sides of the stem up to the first big branch for trees between 30 and 50 cm DBH. The $\frac{4}{8}$ quarters or the $\frac{3}{6}$ quarters shall be used for all trees above 50 cm DBH. Felling of trees is prohibited. During harvesting, the order number, size and health of every tree exploited as well as the wet weight of the harvested bark shall be registered daily in a field logbook.

2.1. Boyo division

A total of 63 exploited trees were sampled in Bloc 1 of the MUTEF community forest (table 8). Fifty six trees were found in the community forest and 7 were found in adjacent private farms. As said, for each tree identified, the team noted the diameter at breast high (dbh), the health status (living, dead, wilting), the technic of harvesting used.

Figure 2 illustrates the distribution of the trees harvested in different diameter classes. The average diameter of trees exploited is 27.2 cm, which is less than the minimum exploitable diameter (MED) fixed by the forest administration (30 cm). A total of 46 trees, representing 73% of the total number of the trees sampled were harvested below the MED. Seventh trees were harvested below 10 cm, most of them coming from adjacent private plantations. Only 17 trees, representing 27% have attended the MED. Harvesters in the MUTEF use two techniques of harvesting: the $\frac{2}{4}$ opposite sides technique and the $\frac{3}{4}$ technique. The $\frac{2}{4}$ technique was observed on 63.7% of trees while the $\frac{3}{4}$ technic was observed on 33.3% of trees. The $\frac{3}{4}$ technique may be detrimental to the survival of the resource and therefore it is not recommended according to the national standards.

2.2. Bui division

The respect of norms was examined on 38 trees sampled in one private farm harvested in 2012 (table 9) in Kumbo. The distribution of trees harvested in different diameter classes is illustrated in figure 3. The average diameter of trees exploited is 22.0 cm, which is less than the minimum exploitable diameter (MED) fixed by the forest administration (30 cm). A total of 36 trees, representing 94.7% of the total number of the trees sampled were harvested below the MED. Only two trees were harvested using the $3 \times \frac{1}{4}$ technique. Almost all trees were harvested using the $2 \times \frac{1}{4}$ opposite side's technique.

2.3. Mount Cameroon

The bloc 1 of the Mount Cameroon PAU, harvested in 2011 was chosen for this study. A total of 126 trees were sampled (table 10). Figure 4 illustrates the distribution of trees harvested in different diameter classes. The average diameter of trees exploited is 73.3 cm, which is high than the 30 cm settled as the minimum limit. A total of 119 trees representing 94% were exploited in respect of the MED. Only total of 5 harvested trees sampled representing 4% has diameter below 30 cm.

Two broad techniques of harvesting are used in the Mount Cameroon including the harvesting of the half part of the bark and the harvesting of the full bark (table 9). The harvesting of the total (full) was observed only on 1.7% of the trees sampled, while the harvesting of the half part was observed on 98.3% of trees. The technique of harvesting the half part of the bark can further be distinguished in two components including the technique of harvesting the $2 \times \frac{1}{4}$ opposite sides and the technique of harvesting the $3 \times \frac{1}{6}$ opposite sides. The $2 \times \frac{1}{4}$ opposite side appears to be the most used with 70.2%.

3. Discussion

In general speaking, the Cameroon Government has made many efforts to promote the sustainable harvesting of *Prunus africana* in the country. The review of the NTFP sector conducted within the FAO project GCP/RAF/398/GER,FAO – COMIFAC - GTZentitled (enforcing food security through the sustainable management and utilization of non-timber forest products in the central Africa (Betti 2007a, b) noted that the development of the NTFP sector was facing many problems in the Congo basin countries. Most those problems were caused by the insufficient knowledge of those resources in quality and quantity. Policies on timber and wildlife are almost quite defined, but less has been done for what concerns NTFP of plant origin sector.

The project noted that in spite of many problems observed, Cameroon was the country where many progress have been made compared to other central African countries. The monitoring mission conducted by the forest administration (MINFOF) in 2008 in the Adamawa, Mount okou, and Mount Cameroon revealed many problems in the specific trade of *Prunus africana* (Akagou and Betti 2008, Betti 2008). *Prunus* barks were harvested without respecting anything in terms of the production site, annual plot, quota, sustainable harvesting techniques. The buying price of the bark was too low, less than 100 FCFA and many trees were cut or totally debarked. In spite of the small amount of the regeneration tax (10 FCFA/kg), trade companies did not paid the total.

The FAO project together with the MINFOF mission report suggested many actions to be taken to better ensure that trade on NTFP in general and *Prunus africana* in particular should not be detrimental to the survival of the resources yielding those products. Some most important recommendations were (1) to manage NTFP as what is being done on the timber sector including the limitation of the harvesting of NTFP in the space and time through fair management plans of delimited production units, (2) the development of national norms/standards including but not limit the MED, the harvesting techniques, the rotation period, on a science basis, (3) the review of the fiscality sector as to better use the funds generated by the trade to ensure the conservation of the resource,In 2008-2009, FAO, CIFOR, SNV and ICRAF, collaborated with the forest administration, private sector, research and community based organizations in the *P. africana* market chain in the North West and South West of Cameroon to elaborate guidelines for management plan for *P. africana* in Cameroon. The work was conducted within the project GCP/RAF/408/EC entitled « Mobilisation and capacity building of small and medium scale enterprises involved in the trade of NTFP in Central Africa ». As proposed in previous studies, the project report proposed to the Cameroon Government to undertake the management of *Prunus africana* similarly to what is done for timber resources, with clear distinction between the permanent and the non-permanent forest domains. The major landscapes of Cameroon containing *P. africana* have been agreed, defined and consolidated into *Prunus* Allocation Units that cover six mountane areas (Ingram et al. 2009).

Compared to the situation observed in 2007-2008 (Betti 2007a, b, Akagou and Betti 2008, Betti 2008), it is clear that Cameroon had made many progress to sustain *Prunus* trade in the country. *Prunus* range areas are since 2009, delimited in production units as proposed, called *Prunus* Allocation Units (PAUs). PAUs delimited out of protected areas and community forests are attributed to trade companies on a competitive basis. For each PAU, the simple management plan and the annual quota are defined on a scientific basis. Trade companies have the obligation of conducting exploitation inventories prior to the harvesting in each annual plot. The MED has been fixed and sustainable harvesting techniques have been defined. Log books have been set by the forest administration to register day to day, the trees harvested with their TAG number, their weight, and the name of harvester. Raw barks are being conveyed to the factory or exit points with way bills. These tools constitute the preliminary documentary tracking system. These progresses were being possible with the assistance of SNV, CIFOR, FAO, ICRAFT and recently ITTO and CITES through the ITTO-CITES program. The monitoring study conducted in November – December 2015 in the North West and South West regions of Cameroon, reveals that the degree of the implementation of the *Prunus* simple management plans developed within the ITTO-CITES program varies from one region to another, and sometimes in the same region (North West for example), from one division to another. As noted in the past studies, sometimes, management plans are well developed, but the problems resides on their implementation in the field (Betti et al. 2016).

Harvesting guidelines, have been developed. These build on decades of experience (MINFOF 2010). However, experiences strongly indicate that without adequate monitoring and control by regulatory authorities, local communities and customary rulers, guidelines and laws alone do not guarantee sustainable harvesting. This failure has been attributed to high demand for bark and the power and influence exporters and importers have in the value chain (Ingram 2014, Cunningham et al. 2014). Development, research, and conservation organizations have often had a critical role in ensuring enforcement and rising concerns about illegal and unsustainable harvesting (Cunningham et al. 2014, Tchouto et al. 2014, Meuer 2007, and WHINCONET 2005). The quantity of *Prunus* barks provided by the North West region is coming from both natural forests and private farms/plantations. In reality, the Cameroon quota does not yet include the *Prunus* barks existing in plantations/farms. Some peoples tend to justify the use of *Prunus* from farms by the lack of sufficient stock in the natural forest, community forests, which may itself be caused by the limit method used for the calculation of the quota. In theory, the possible absence or low density of *Prunus* in some annual plots (blocks 4 and 5 of MUTEF for example) of inventoried production sites is acceptable, due to the clustering feature of the specie, and the type of inventories used to define the quota (estimation).

Prunus africana is a scattered tree species (Ndam 1996, Fraser et al. 1996), this means that there will be some areas of the forest where the specie will be absent or less abundant. The second reason that can explain the lack of enough *Prunus* in some plots is the type of the inventory used to define the quota. In fact, the *Prunus* quota was calculated based on management inventories. These are inventories conducted with low sampling rates (1 – 3%). The results cannot be similar to those obtained with the systematic or exploitation inventories which are conducted at 100% of exploitable trees. The big difference observed between the estimated quota and the real quota harvested in the four first years observed in the Mount Cameroon is due, not only to the scattering feature of *Prunus* or the sampling method, but mostly to the unequal delimitation of the annual plots by the local forest officers. The national standards suggest to divide the total useful area of the production site by the rotation to obtain the surface area of a single annual plot (bloc).

In the case of the Mount Cameroon national park, the useful area defined during the 2010 management inventories was 22 000 ha. On this basis, a single annual plot was supposed to have about 4 400 ha. The park service decided an arbitrary delimitation of annual plots (blocs), independent to the useful area and quotas. The total surface area delimited for the five plots is 32 800 ha, which is 1.5 times high compared to the useful area estimated by the 2010 inventories (Betti et al. 2011, Amougou et al. 2010). In the arbitrary delimitation, the blocs 3 and 5 are twice larger than the blocs 1 and 2. The bloc 44 is thrice higher than the bloc 1 and 2. In this context, one cannot expect an equal annual quota of 130 tons for all blocs in the Mount Cameroon. If the park service officers wanted to be rational, they should reconsider the 2010 management inventory data per delimited blocs, limiting the quota in the lines identified in each bloc, instead of mixing all. Anyway, based on the results obtained in real *Prunus* production in different regions, it is essential that the annual quota be calculated based on the exploitation inventories which are done at 100% of exploitable trees. Data from management inventories are still important since they guide the decision of harvesting in a given production site based on the population structure.

Some 73% of the total number of the trees sampled in the MUTEF community forest in the Boyo division and 94.7% of those sampled in one plantation in the Bui division were harvested below the MED (30 cm). In Mount Cameroon, only 4% of trees sampled were harvested below the MED. If we consider an annual growth rate in diameter of 0.7 cm, we can say that most of the trees were harvested at diameter 23.5 cm in the Boyo and 18.5 cm in the Bui division. These results (diameter) are 1.3 times less than the authorized MED in the Boyo and the half of the required MED in the Bui division. These findings corroborate with what was explained by the Manager of the MUTEF community forest (CFM) concerning the behavior of harvesters in reaction to the low buying price practiced in the North West region. The buyer (local trade company) in the North West buys the bark of *Prunus* at very low price, which discourage the harvesters. The buying price used by the trade company in the North West is 130 FCFA/kg of fresh bark, which is 4.23 times less than the 550 FCFA/kg practiced in the Mount Cameroon National park. As results, local CFM do not have enough funds to support the exploitation inventories and we assist to the overharvesting of *Prunus* trees in first blocs.

In mount Cameroon, the average cost of exploitation inventories is 2 434.0 FCFA/ha. If the trade company practiced the same buying price (550 FCFA/kg) used in the Mount Cameroon in the North West (Boyo division), the CFM could use 1/3 of its part (15.4% of the total revenue yield by the bark) to support exploitation inventories without any problem and keeps the remaining funds for development projects. Also, due to the low buying price practiced in the North West, harvesters prefer over-harvesting trees harvested in the first annual plots (blocs) or in the adjacent private farms using bad techniques, than taking the risk to go far in the forest to harvest in authorized plots. Harvesters in the MUTEFF community forest do not respect national norms for the harvesting of *Prunus africana* in terms of the diameter and the techniques of harvesting. This problem is more crucial in the private farms where harvesters do not hesitate to debark totally some trees. These findings tend to show that the current harvesting scheme of *Prunus africana* in the North West region is detrimental to the survival of the resource and then to the survival of the *Prunus* trade in Cameroon.

The Cameroon CITES MA continues to grant the annual quota of 150 tons from community forest of North West in spite of the ban of harvesting occurred in the Bui division. Finally, trade companies obtained their products from un-authorized forests (plantation/farms). This problem, coupled with the usage of false documents to convey *Prunus* barks by some traders, outlines the urgent need to settle a fair tracking system which will be able to really fix the harvesting of *Prunus* in the space. The ongoing ITTO-CITES program activities on the settlement of a tracking system using DNA to better control the origin of the barks is therefore welcome and should be extended to all PAUs in Cameroon.

In general, the study noted that, it is in the North West region where harvesters do not really respect the norms of harvesting in terms of harvesting techniques and exploitable diameter. This situation is more observed in private farms/plantations where there is no control. The sustainable management of *Prunus* requires a lot of financial and technical inputs. The relatively good results recorded in the Mount Cameroon may be attributed to the financial and technical support of the Programme for the sustainable management of natural resources in the South West region of Cameroon (PSMNR-SWR).

Conclusion

Cameroon Government has made many efforts to promote the sustainable harvesting of *Prunus africana* in the country, but many problems still remain in the implementation of the guidelines prescribed in the NDF or SMP. The forest administration should fix the minimum buying price of *Prunus* as to avoid the destruction of the resource in the forest. This study did not cover the Adamawa region considered as the most important in terms of the contribution in national quota (more than the half: 600 tons of dried bark). We assume that the same problems observed in non-control areas such as in the North West region can be observed here, and may be with very bad situation. In this region, peoples are not organized in community forests as in the North West nor in a kind of association as in Mount Cameroon with MOCAP. Villagers are directly faced to local trade companies who may decide to pay what they want. We recommend that the study be extended to that region to better have a global idea of the Cameroon situation. There is a urgent need for the ITTO-CITES program to extend its activities on the implementation of the simple management plans developed. This includes: delimitation of annual plots on useful forests, conduction of exploitation inventories, setting fair tracking system, sylviculture (nurseries and plantations), and training harvesters on the use of good techniques, conducting research to better refine management parameters...

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Table 1: Community and non community forests of the Mont Oku

Order n°	Forest	Total surface area(ha)	Division
1	ABUH	354	Bui
2	AFUA - DICHANI	1121	Bui
3	AJUNG	630	Bui
4	AKEH	294	Bui
5	ANYAJUA	1034	Boyo
6	BIKHOV	357	Bui
7	EMFVEMI	1377	Bui
8	IJIM	468	Bui
9	KEDJEM MAWES	1717	Bui
10	LAIKOM	651	Boyo
11	MBAI	122	Bui
12	MBOH MBOLENG ILUNG	475	Bui
13	MUTEF	595	Boyo
14	NCHILY	435	Bui
15	NJUAMBUM	350	Bui
16	UPPER SHINGA	1556	Bui
17	YANG TINIIFOIN BIMULO	431	Boyo
18	KILUM IJIM FLORA SANCTUARY	1081	Bui
19	AREA OUT OF THE COMMUNITY FORESTS	18585	
	Total	31 635	

Table 2: Characteristics of the four community forests inventoried in the North West region within the ITTO-CITES program in 2010

Community forest	Total useful surface area (ha)	Proposed or previous sampling rate (%)	Real surface area surveyed (ha)	Realised sampling rate (%)	Surface area of annual plot	Annual quota (5 years rotation)
ANYAJUA	1034	3	29	2.81	206.8	3136.45
LAIKOM	651	3	19.5	2.99	130.2	3123.37
MUTEF	595	3	11	1.85	119	5948.8
YANG TINIIFOIN BIMULO	431	3	14	3.25	86.2	2202.69
Total/or average	2 711		29	2.72	542.2	14 411.31

Table 3. Agreed benefices sharing for *Prunus* from the MUTEF community forest, Boyo division, north west region in 2011-2013.

N°	Cost headings	FCFA/kg of fresh bark	% cost
1	Harvesters	60	46.2%
2	Village development fund	50	38.5%
3	Facilitation of community participation	20	15.4%
	TOTAL	130	100%

Table 4. Revised benefices sharing for *Prunus* from the MUTEF community forest, Boyo division, north west region in 2014 - 2015.

N°	Cost headings	FCFA/kg of fresh bark	% cost
1	Harvesters	40	30.8%
2	Village development fund	15	11.5%
3	Facilitation of community participation	15	11.5%
4	The farm owner (farmer)	60	46.5%
	TOTAL	130	100%

Table 5: Clusters delimited in the Mount Cameroon PAU

Bloc (Cluster)	Surface area (ha)
1	3691
2	3939
3	6291
4	12248
5	6699
TOTAL	32 868

Table 6: Clusters delimited in the Mount Cameroon PAU

Bloc (Cluster)	Surface area (ha)	Total cost estimated for the exploitation inventory (FCFA)	Cost/ha
1	3691	14 000 000	3793.01
2	3939	12 000 000	3046.458
3	6291	16 000 000	2543.316
4	12248	26 000 000	2122.796
5	6699	12 000 000	1791.312
TOTAL	32868	80 000 000	2433.978

Table 7. Agreed benefices sharing for *Prunus* from the Mount Cameroon national park

N°	Cost headings	FCFA/kg of fresh bark	% cost
1	Harvesters, field equipments, medication	237	43%
2	Village development fund	88	16%
3	Facilitation of community participation	38.5	7%
4	Park management	110	20%
5	Regeneration of <i>Prunu</i> strees	38.5	7%
6	Transport	22	4%
7	Warehouse	16.5	3%
	TOTAL	550	100%

Table 8: Diameters and healthy of trees sampled in the MUTEFF community forest, Boyo division, North west region of Cameroon, in 2015.

Diameter classes are defined as follow: C110_20 = diameters comprised between 10 cm and 19 cm; C120_30 = diameters between 20 and 29 cm.

Order number of the trees	Diameter at breast high (cm)	Diameter classes	Healthy	Harvesting techniques
1	51.0	C150_60	Living	3x1/4
2	18.2	C110_20	Living	3x1/4
3	28.0	C120_30	Living	3x1/4
4	16.9	C110_20	Living	3x1/4
5	25.2	C120_30	Dead	3x1/4
6	32.5	C130_40	Living	3x1/4
7	76.4	C160 et +	Living	3x1/4
8	33.8	C130_40	Living	3x1/4
9	34.8	C130_40	Living	3x1/4
10	19.5	C110_20	Living	2 x 1/4 opposite sides
11	14.2	C110_20	Living	2 x 1/4 opposite sides
12	19.2	C110_20	Living	2 x 1/4 opposite sides
13	17.7	C110_20	Living	2 x 1/4 opposite sides
14	19.2	C110_20	Living	2 x 1/4 opposite sides
15	93.3	C160 et +	Living	2 x 1/4 opposite sides
16	57.3	C150_60	Living	2 x 1/4 opposite sides
17	17.9	C110_20	Living	2 x 1/4 opposite sides
18	25.5	C120_30	Living	2 x 1/4 opposite sides
19	10.3	C110_20	Living	2 x 1/4 opposite sides
20	10.4	C110_20	Living	2 x 1/4 opposite sides
21	3.7	C10_10	Living	2 x 1/4 opposite sides
22	5.2	C10_10	Living	2 x 1/4 opposite sides
23	6.5	C10_10	Living	2 x 1/4 opposite sides
24	19.0	C110_20	Living	2 x 1/4 opposite sides

Order number of the trees	Diameter at breast high (cm)	Diameter classes	Healthy	Harvesting techniques
25	33.9	C130_40	Living	2 x 1/4 opposite sides
26	25.4	C120_30	Living	2 x 1/4 opposite sides
27	14.4	C110_20	Living	2 x 1/4 opposite sides
28	14.8	C110_20	Living	2 x 1/4 opposite sides
29	7.6	C10_10	Living	2 x 1/4 opposite sides
30	22.5	C120_30	Living	2 x 1/4 opposite sides
31	13.8	C110_20	Living	2 x 1/4 opposite sides
32	54.1	C150_60	Living	2 x 1/4 opposite sides
33	10.2	C110_20	Living	2 x 1/4 opposite sides
34	14.0	C110_20	Living	2 x 1/4 opposite sides
35	33.7	C130_40	Living	2 x 1/4 opposite sides
36	36.8	C130_40	Living	2 x 1/4 opposite sides
37	22.0	C120_30	Living	2 x 1/4 opposite sides
38	28.0	C120_30	Living	2 x 1/4 opposite sides
39	24.2	C120_30	Living	2 x 1/4 opposite sides
40	27.1	C120_30	Living	2 x 1/4 opposite sides
41	12.1	C110_20	Living	2 x 1/4 opposite sides
42	18.8	C110_20	Living	2 x 1/4 opposite sides
43	27.1	C120_30	Living	2 x 1/4 opposite sides
44	28.2	C120_30	Living	2 x 1/4 opposite sides
45	12.1	C110_20	Living	2 x 1/4 opposite sides
46	25.2	C120_30	Living	2 x 1/4 opposite sides
47	24.6	C120_30	Living	2 x 1/4 opposite sides
48	22.0	C120_30	Living	2 x 1/4 opposite sides
49	22.4	C120_30	Living	3x1/4
50	34.6	C130_40	Living	3x1/4
51	35.7	C130_40	Living	3x1/4
52	27.2	C120_30	Living	3x1/4
53	7.0	C10_10	Living	3x1/4
54	6.7	C10_10	Living	3x1/4
55	4.8	C10_10	Living	3x1/4
56	44.1	C140_50	Living	2 x 1/4 opposite sides
57	14.2	C110_20	Living	3x1/4
58	11.8	C110_20	Living	3x1/4
59	25.2	C120_30	Living	2 x 1/4 opposite sides
60	41.4	C140_50	Living	2 x 1/4 opposite sides
61	55.4	C150_60	Living	3x1/4
62	14.0	C110_20	Dying	3x1/4
63	38.2	C130_40	Living	3x1/4
Mean	27.9			

Table 9: Diameter, techniques and thickness of the bark of trees harvested in one plantation in 2012 in Kumbo, Bui division, North West region of Cameroon.

Order number of the trees	Diameter at breast high (cm)	Diameterclasses	Harvestingtechniques
1	16.9	CI10_20	2x1/4 opposite side
2	28.2	CI20_30	2x1/4 opposite side
3	21.0	CI20_30	2x1/4 opposite side
4	16.9	CI10_20	2x1/4 opposite side
5	6.1	CI0_10	2x1/4 opposite side
6	18.2	CI10_20	2x1/4 opposite side
7	6.0	CI0_10	2x1/4 opposite side
8	24.3	CI20_30	2x1/4 opposite side
9	15.4	CI10_20	2x1/4 opposite side
10	11.7	CI10_20	2x1/4 opposite side
11	31.7	CI30_40	2x1/4 opposite side
12	18.5	CI10_20	2x1/4 opposite side
13	12.8	CI10_20	2x1/4 opposite side
14	15.9	CI10_20	3x1/4
15	10.0	CI10_20	3x1/4
16	22.4	CI20_30	2x1/4 opposite side
17	31.0	CI30_40	2x1/4 opposite side
18	27.9	CI20_30	2x1/4 opposite side
19	18.6	CI10_20	2x1/4 opposite side
20	25.5	CI20_30	2x1/4 opposite side
21	25.5	CI20_30	2x1/4 opposite side
22	23.6	CI20_30	2x1/4 opposite side
23	22.9	CI20_30	2x1/4 opposite side
24	26.1	CI20_30	2x1/4 opposite side
25	23.2	CI20_30	2x1/4 opposite side
26	36.9	CI30_40	2x1/4 opposite side
27	26.1	CI20_30	2x1/4 opposite side
28	41.1	CI30_40	2x1/4 opposite side
29	24.4	CI20_30	2x1/4 opposite side
30	18.5	CI10_20	2x1/4 opposite side
31	19.7	CI10_20	2x1/4 opposite side
32	27.1	CI20_30	2x1/4 opposite side
33	18.9	CI10_20	2x1/4 opposite side
34	18.2	CI10_20	2x1/4 opposite side
35	25.3	CI20_30	2x1/4 opposite side
36	28.8	CI20_30	2x1/4 opposite side
37	29.3	CI20_30	2x1/4 opposite side
38	22.3	CI20_30	2x1/4 opposite side
Mean	22.0		

Table 10: Distribution of exploited trees in different diameter classes in Bloc 1 of Mount Cameroon, South west region of Cameroon

Order number of the trees	Diameter (cm)	Diameter classes	Harvesting technique
1	120.1	C1120_130	3x1/6
2	59.2	C150_60	2x1/4 opposite side
3	58.0	C150_60	2x1/4 opposite side
4	73.9	C170_80	2x1/4 opposite side
5	51.6	C150_60	2x1/4 opposite side
6	43.9	C140_50	2x1/4 opposite side
7	69.4	C160_70	2x1/4 opposite side
8	50.3	C150_60	2x1/4 opposite side
9	68.5	C160_70	2x1/4 opposite side
10	47.8	C140_50	2x1/4 opposite side
11	87.6	C180_90	2x1/4 opposite side
12	98.7	C190_100	2x1/4 opposite side
13	73.2	C170_80	Not harvested
14	71.7	C170_80	total
15	140.1	C1140_150	3x1/6
16	73.9	C170_80	3x1/6
17	64.3	C160_70	3x1/6
18	95.2	C190_100	Not harvested
19	73.2	C170_80	2x1/4 opposite side
20	30.9	C130_40	Not harvested
21	111.5	C1110_120	3x1/6
22	35.0	C130_40	2x1/4 opposite side
23	60.2	C160_70	2x1/4 opposite side
24	47.1	C140_50	2x1/4 opposite side
25	165.0	C1150 et +	3x1/6
26	27.7	C120_30	Not harvested
27	62.7	C160_70	3x1/6
28	53.5	C150_60	2x1/4 opposite side
29	47.1	C140_50	3x1/6
30	325.2	C1150 et +	3x1/6
31	109.9	C1100_110	3x1/6
32	40.4	C140_50	2x1/4 opposite side
33	33.4	C130_40	2x1/4 opposite side
34	21.7	C120_30	2x1/4 opposite side
35	39.8	C130_40	2x1/4 opposite side
36	39.8	C130_40	2x1/4 opposite side
37	35.7	C130_40	2x1/4 opposite side
38	179.9	C1150 et +	2x1/4 opposite side
39	37.9	C130_40	2x1/4 opposite side
40	49.0	C140_50	2x1/4 opposite side
41	56.4	C150_60	2x1/4 opposite side
42	43.3	C140_50	2x1/4 opposite side
43	63.7	C160_70	2x1/4 opposite side
44	58.0	C150_60	2x1/4 opposite side
45	52.5	C150_60	2x1/4 opposite side
46	72.6	C170_80	3x1/6
47	64.3	C160_70	2x1/4 opposite side
48	65.3	C160_70	3x1/6
49	55.1	C150_60	2x1/4 opposite side
50	36.3	C130_40	Not harvested

Order number of the trees	Diameter (cm)	Diameter classes	Harvesting technique
51	53.2	C150_60	2x1/4 opposite side
52	56.7	C150_60	2x1/4 opposite side
53	63.1	C160_70	3x1/6
54	101.9	C1100_110	3x1/6
55	37.6	C130_40	2x1/4 opposite side
56	66.2	C160_70	2x1/4 opposite side
57	79.9	C170_80	3x1/6
58	54.8	C150_60	2x1/4 opposite side
59	97.1	C190_100	3x1/6
60	55.4	C150_60	3x1/6
61	120.1	C1120_130	3x1/6
62	115.0	C1110_120	2x1/4 opposite side
63	109.9	C1100_110	2x1/4 opposite side
64	68.5	C160_70	2x1/4 opposite side
65	140.1	C1140_150	3x1/6
66	58.3	C150_60	2x1/4 opposite side
67	119.3	C1110_120	2x1/4 opposite side
68	16.1	C110_20	2x1/4 opposite side
69	56.4	C150_60	2x1/4 opposite side
70	135.4	C1130_140	2x1/4 opposite side
71	78.5	C170_80	3x1/6
72	120.0	C1120_130	3x1/6
73	130.0	C1130_140	four on height (4/8)
74	73.1	C170_80	2x1/4 opposite side
75	56.4	C150_60	2x1/4 opposite side
76	61.5	C160_70	2x1/4 opposite side
77	61.3	C160_70	2x1/4 opposite side
78	16.1	C110_20	2x1/4 opposite side
79	37.0	C130_40	2x1/4 opposite side
80	66.9	C160_70	3x1/6
81	131.2	C1130_140	four on height (4/8)
82	130.0	C1130_140	four on height (4/8)
83	59.0	C150_60	3x1/6
84	45.0	C140_50	2x1/4 opposite side
85	57.4	C150_60	2x1/4 opposite side
86	46.0	C140_50	2x1/4 opposite side
87	54.9	C150_60	2x1/4 opposite side
88	38.0	C130_40	2x1/4 opposite side
89	149.7	C1140_150	2x1/4 opposite side
90	175.2	C1150 et +	3x1/6
91	132.2	C1130_140	3x1/6
92	156.1	C1150 et +	3x1/6
93	178.3	C1150 et +	2x1/4 opposite side
94	42.8	C140_50	2x1/4 opposite side
95	126.0	C1120_130	2x1/4 opposite side
96	42.7	C140_50	2x1/4 opposite side
97	25.5	C120_30	2x1/4 opposite side
98	43.4	C140_50	2x1/4 opposite side
99	53.6	C150_60	2x1/4 opposite side
100	32.0	C130_40	3x1/6
101	73.6	C170_80	2x1/4 opposite side
102	42.6	C140_50	2x1/4 opposite side

Order number of the trees	Diameter (cm)	Diameter classes	Harvesting technique
103	50.0	C150_60	2x1/4 opposite side
104	38.9	C130_40	2x1/4 opposite side
105	35.5	C130_40	2x1/4 opposite side
106	88.0	C180_90	2x1/4 opposite side
107	30.2	C130_40	2x1/4 opposite side
108	37.1	C130_40	2x1/4 opposite side
109	48.1	C140_50	2x1/4 opposite side
110	48.5	C140_50	2x1/4 opposite side
111	42.3	C140_50	2x1/4 opposite side
112	42.5	C140_50	2x1/4 opposite side
113	34.7	C130_40	2x1/4 opposite side
114	33.4	C130_40	2x1/4 opposite side
115	57.6	C150_60	2x1/4 opposite side
116	143.3	C1140_150	3x1/6
117	44.5	C140_50	2x1/4 opposite side
118	37.6	C130_40	2x1/4 opposite side
119	70.1	C170_80	2x1/4 opposite side
120	176.4	C1150 et +	3x1/6
121	51.0	C150_60	2x1/4 opposite side
122	51.4	C150_60	2x1/4 opposite side
123	59.9	C150_60	2x1/4 opposite side
124	178.3	C1150 et +	Totaldebarking
125	98.5	C190_100	2x1/4 opposite side
126	61.5	C160_70	2x1/4 opposite side
Mean	73.3		

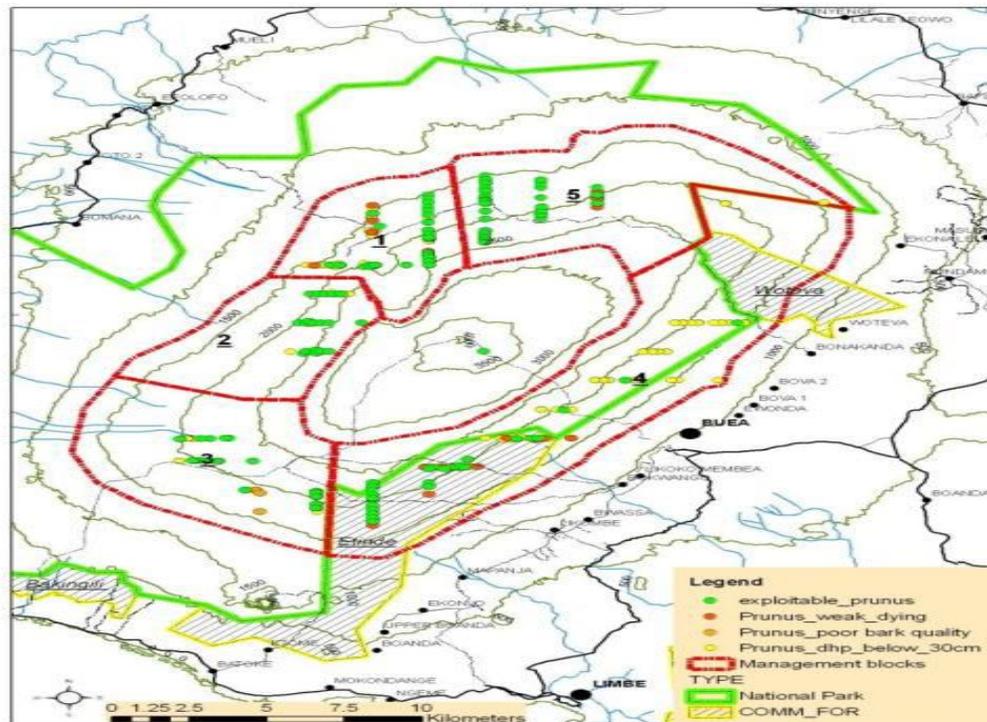


Figure 1: Delimitation of the five blocs (clusters) in the Mount Cameroon National Park (source: EbenEbai 2011).

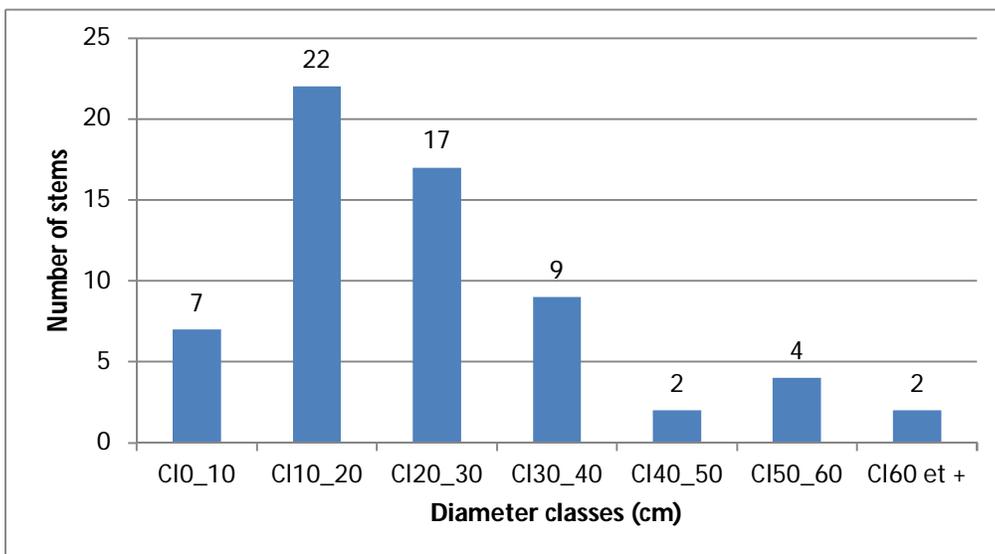


Figure 2: Distribution of *Prunustrees* harvested in different diameter classes in the bloc 1 of the MUTEF community forest, the Boyo division.

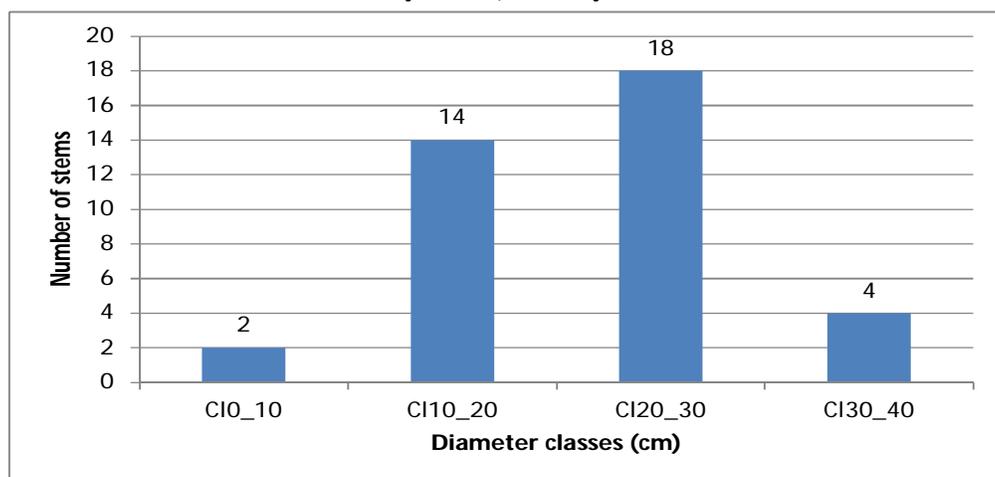


Figure 3: Distribution of *Prunustrees* harvested in different diameter classes in a private farm found in Kumbo, the Bui division.

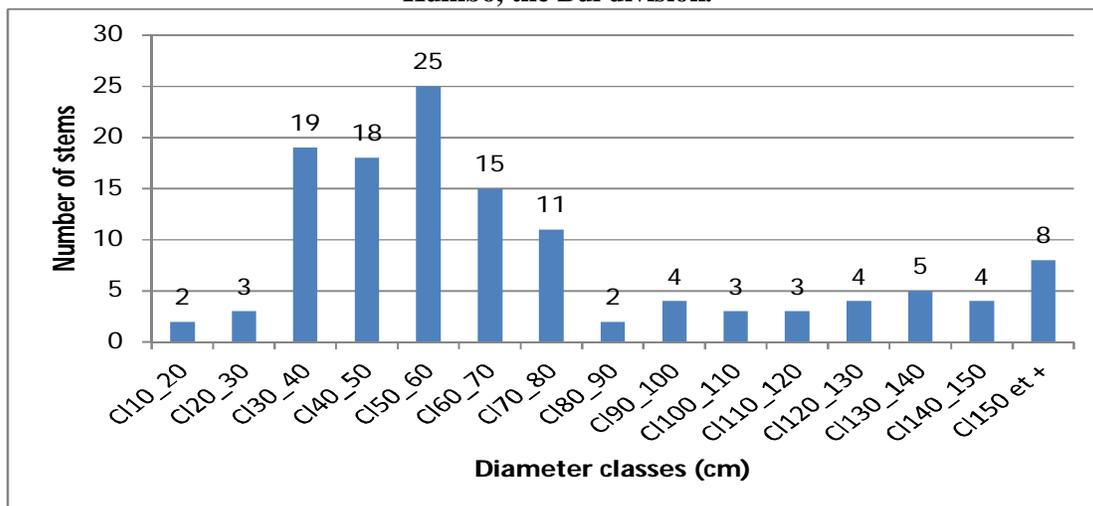


Figure 4: Distribution of *Prunustrees* harvested in different diameter classes in Bloc 1 of the Mount Cameroon PAU, South West region.