SUSTAINABLE MANAGEMENT OF A NATURAL THREATENED RESOURCE: THE CASE STUDY OF *Vepris heterophylla* (Engl.) Letouzey (Rutaceae) IN THE SUDANO-SAHELIAN ZONE OF CAMEROON

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http://dx.doi.org/10.4314/ejesm.v5i4.S4

Received 12th July 2012; accepted 3rd October 2012

Abstract

Useful trees are believed to be threatened. However most evidence about these concerns is anecdotal. The objectives of the study were to document uses of Vepris heterophylla (Engl.) Letouzey, management patterns, determine its population structure and assess the influence of mountain sides in the sudano-sahelian zone of Cameroon. The study was carried out using ethnobotanical and quantitative ecological methods. The results showed that the species was found to be multipurpose and produced six different products and services. The most mentioned services were conservation of the foodstuffs and medicine. Community responses indicated that the species became rare and there were no strategies developed to preserve it. The quantitative inventory supported this community view: the species had a low density (28.8 individuals/ha) and a weak size class distribution with calculated least-squares regression slopes of a_1=-0.435 (Sahelian section) and a_2=-0.263 (Sudanian section). The opposition of the side had an influence on the population (χ^2=33.15; df=9; P <0.001). The species appeared to be threatened by the overexploitation and poor attitude to its conservation. Respondents claimed that they were not interested in conserving it because they lacked propagation materials and skills. The sensitization and the domestication of the plant should be considered urgently.

Keywords: *Vepris heterophylla, Threatened species, Sustainable management, Sudano-sahelian zone, Opposition sides.*

Introduction

The demographic explosion is one of the main problems which the majority of the developing countries are grappling with. This has a more or less significant influence on the biodiversity loss (Bitariho *et al*., 2006). The erosion of biodiversity together with the climate change is likely to lead to reduction of the productive potential of the ecosystems (Birkett and Stevens-Wood, 2005). This is likely to reduce the services that are provided by productive ecosystems to communities. To meet their food and sanitary needs, as well as improve their social well being, communities used increasingly the non woody forest products (Assogbadjo *et al*., 2009; Mapongmetsem *et al*., 2010). The increased pressure on these resources and the natural ecosystems, in general heavily affects the biological diversity of forest ecosystems (Zammouri *et al*., 2009).

Vepris heterophylla (Engl.) Letouzey is an altimountainous shrub of the sudano-sahelian zone of Cameroon (Hamawa *et al*., 2010). It listed among the threatened species although valorized in various domains by the local communities (Ngamo *et al*., 2001). The overexploitation and the habitat loss led the species to be rare. This situation justifies its inscription on the red list of the UICN under the reference IN ALC, B1+2C as threatened species (Ngamo *et al*., 2007a). The empiric data supporting this status is limited in Cameroon. During the last decades, some studies were conducted on the threatened species through the world (Griggs and Jain, 1983; Abd El-Ghani and Marei, 2007). In the case of the sudano-sahelian zone, little works were achieved in this domain. This survey was undertaken to fill this gap through the famer exploitation patterns of the species and its population structure in the sudano-sahelian zone of Cameroon. The aims of the paper were to: a) record the main domestic uses of the plant; b) develop and understand its traditional management patterns and c) assess its population dynamics and the influence of the side of mountain on the species distribution in the context of the sudano-sahelian zone of Cameroon.

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Materials and Methods

Study Site

The study was conducted at the sudano-sahelian zone of Cameroon that is situated between the 8th and 13rd degree of North latitude. It extends from Adamawa to the banks of the Lake Chad on about 100 000 km^2. The area is more than the fifth of the surface of Cameroon (Figure 1).

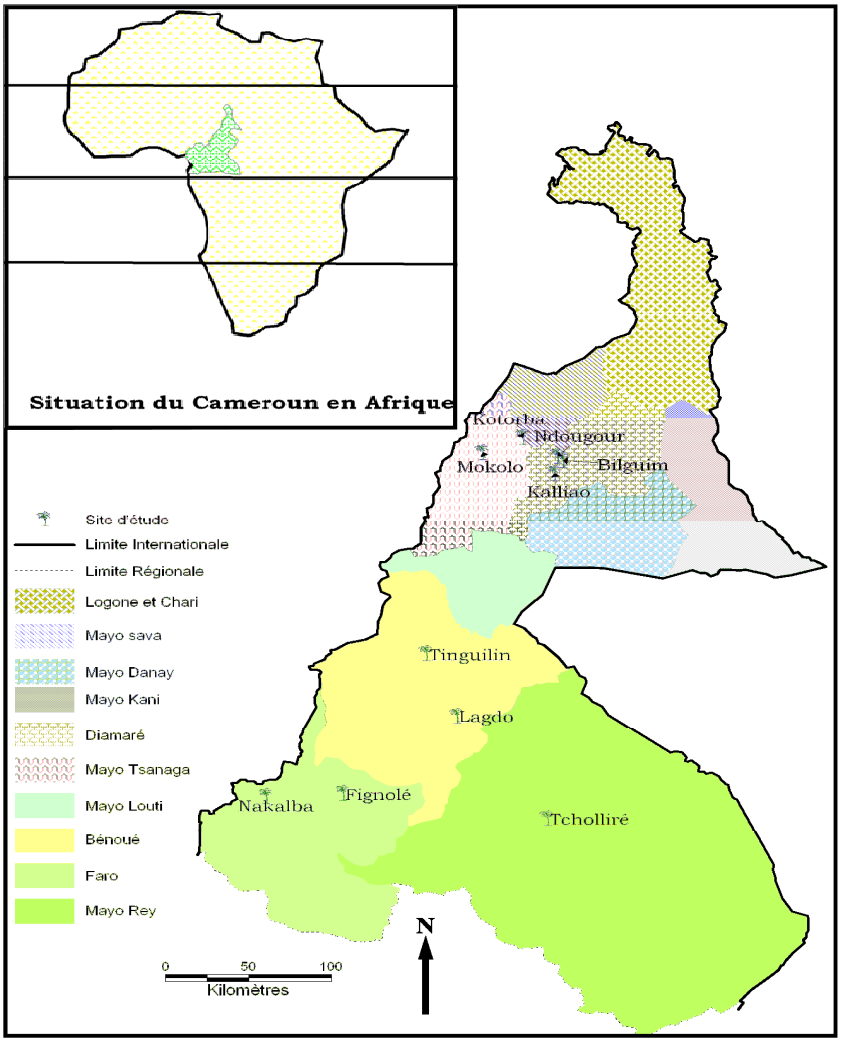

Figure 1 Localization of the study sites

The table 1 provides the characteristics of each locality that was included in the study. The sudanian section is relatively covered by *Mimosa asperata* in some areas. Floating prairies of *Echinochloa stagnina* and *Laersia* sp. cover the ponds but fall on soil during the dry season. On the halomorph soils, *Anogeissus leocarpus*, *Balanites aegyptiaca*, *Annona senegalensis*, *Adansonia digitata*, *Acacia albida* and *Boswellia dalziellii* are the main of vegetation.

The sahelian section is characterized by a large variety of natural landscapes. Vegetation of this section is made up of steppes to sahelian spine. There is a noted characteristic presence of the plants such as *Anogeissus leocarpus* on the unclear soft soils and *Boswellia dalziellii* on the rocky soils as well as *Balanites aegyptiaca* (Boutrais, 1984). Its relief is made up of an alternation of plateau varying between 500 and 1000 m, peneplains varying 200 and 300 m overhang by

some mountainous massifs and inondable plains or "yaérés" scattered inselbergs.

The low rainfall of the region has created a network of permanent (Benue, Deo Logone) and seasonal (Mayo Tsanaga) rivers that flows toward the Lake Chad (Mayo Tsanaga, the Logone) and toward the Katsena (Deo, Benue).

Table 1 Site characteristics

Sites	Latitude	Longitude	Altitude
Kalliao	10° 61508 N	014° 201220 E	437 m
Bilguim	10° 69807 N	014° 24838 E	165 m
Ndougour	10° 7241 N	014° 21632 E	488 m
Kotorba	10° 84486 N	01402814 E	702 m
Mokolo	10° 74786 N	013° 80 819 E	698 m
Tinguilin	09° 45326 N	013° 5009 E	146 m
Lagdo	09° 05678 N	013° 66756 E	242 m
Nakalba	08° 53985 N	012° 62386 E	357 m
Fignolé	08° 55957 N	013° 04565 E	371 m
Tcholliré	08° 39861 N	014° 16403 E	385 m

Methods

The fieldwork took place from March 2007 to December 2009 using both some ethnobotanical and ecological studies. The ethnobotanical investigations entailed structured interviews that were conducted using questionnaires. These were administered face to face. A total of 200 persons living in the localities above since a long time were interviewed. The interviewed people had aged that ranged between 30 and over 60 years and those had a good knowledge of local plant species. The questions asked concerned the habitat of the species, the patterns of harvest, the different uses of the species and the attitude of the local community towards its conservation.

For the ecological part, in each explored village, the mountainous massifs were identified and geo-referenced (altitude, longitude and latitude). On the whole, 10 villages including mountainous massifs were retained, five in each ecological sector. In the sahelian section, the explored mountains were the mounts of Bilguim, Kalliao, Ndougour, Mbélessé (Kotorba) and Mokolo while in the sudanian section, the mounts of Tinguilin, Lagdo, Nakalba, Fignolé and Tcholliré were explored. In Guinean region, the preliminary investigations do not reveal the presence of the species. To better appreciate the dynamics of the species, we assessed the influence of the sides of the mountainous massifs on the distribution of *V. heterophylla*. For this purpose, the quadrats of 250 m×10 m achieved from the base of the mountain to the summit with an interval of 100 m between the quadrats and at each altitude were established. According to Achoundong (1996), the north and south sides were retained. The universal compass was used to determine the side of the mountains and the Global Positioning System (GPS) permitted to note the altitudes. To facilitate the numbering, the under-quadrats of 2 m×5 m were established and all individuals of *V. heterophylla* were recorded and marked to avoid possible mistakes of numbering. The parameters as the height of the individuals and the diameter at breast height (dbh) were assessed. In whole, 240 quadrats were established at the rate of 126 in the sudanian sector 114 in the sahelian one.

Analysis of data

The ethnobotanical data were coded and summarized as diagrams. From the quantitative inventory, the species density was calculated. A

size class frequency distribution plot (SCD) was drawn by plotting the number against size class. The Chi-squared tests (Fowler and Cohen, 1988) were used to compare the abundance of species on the sides (north, south). According to Lykke (1998), the slope of regression and the coefficient of determination were calculated for every sector with regard to the distribution by diameter class. The SCD slope summarizes in a single number, the shape of the SCD (Tabuti and Mugula, 2007). If a population has a strong negative slope, it is interpreted like a stable and naturally able to replace itself whereas the weak negative slopes or the flat slopes show a poor restoration and declining population (Hall and Bawa, 1993; Lykke, 1998).

To calculate the slope, the size-class midpoint (d_1) was considered as the independent variable and the number of individuals (N_1) of every class as the dependent variable. To get the straight line, N_1 was transformed in Ln (N_1+1) because some classes have any individuals. The regression was calculated between d_1 and Ln (N_1+1) (Lykke, 1998; Obiri *et al*., 2002).

RESULTS

Main uses of Vepris heterophylla (Engl.) Letouzey

The different parts of *V. heterophylla* harvested by the local populations permit to offer various services and products (Figure 2). Thirty three percent of the respondents indicated that the Rutaceae was mainly used for the conservation of the foodstuffs. The human and veterinary pharmacopeia came second with 22.5% of interviewed people mentioning this use. The uses relative to the houses construction, the firewood and the handcraft represented 45%. In the domain of the conservation of the foodstuffs, the cool leaves are the most appreciated part of the plant. Once harvested, it is crushed and kneaded in water. The whole is mixed to the foodstuffs (cereals such as *Zea mays* and *Sorghum* spp.; leguminous among which *Vigna unguiculata*, *Voandzeana subterrana*) in a conservation module which can be the granary, the pot in terracotta, the stock or the calabash tightly closed after product application.

In the case of the human pharmacopeia, *V. heterophylla* is used to treat two or three illnesses. The leaves ground with fingers are inhaled to treat some headaches whereas the decoction of the leaves is taken against the stomach ache. Some similar results were reported in West Africa by Keita and Ouattara (1995). For the veterinary medicine, the deducted bark is dried and crushed. The gotten powder is put in the salt water. This product is given to the livestock against the worms. The cool leaves crushed and mixed to kerosene are used to spray the enclosures of the livestock (ovine and caprin).

Farmer perception on sustainable management of V. heterophylla in sudano-sahelian zone

The management and the conservation of *V. heterophylla* in the survey zone remained a preoccupying subject in peasant environment. However anyone dared to take the front. Some thought that it is a gift of " Allah " and the resource will always be available (Mapongmetsem, 2005). Nevertheless others become aware that with the overexploitation, the resource becomes more and more depleted and the communities ignored what strategies to adopt for solve this problem. The management pattern is variable. It goes from the cut to the selective deduction of the parts (leaves, bark and trunk) of the plant following the problem to solve. Fifty two percent (52%) of the interviewed people did not present a defined program of harvest of *V. heterophylla*. However they indicated that the harvesting period of the foodstuffs seems to be the period during which the leaves of *V. heterophylla* are more solicited. As the pattern of harvest of the plant's parts, the number of deduction per year is variable. The periodicity of the harvest depends on the individuals and the size of the problems met. 8% of people affirmed that they harvested the parts of this resource six times per year (Table 2). Like the exploitation of *V. heterophylla* is done at the wild state, some opinions are different on its conservation. Forty six percent (46%) of the interviewed people thought that the exploitation of the species must stay free whereas twenty eight percent (28%) of them agree the controlled exploitation of the resource. Those who wished a sustainable exploitation represented twenty two percent (26%) of the whole interviewed population (Table 2).

Table 2 Farmer perception on the management of *Vepris heterophylla*

Variables	Opinions of farmers %
Pattern of harvest	
No definite schedule	52
2 times/year	21
4 times/year	15
6 times/year	12
Conservation	
Against	46
For	34
Wish	20

Density and distribution of V. heterophylla (Engl.) Letouzey

A total of 719 individuals were recorded from the ten study sites. Determination of density distribution reflected the occurrence of 28.8 individuals/ha. In the sahelian section, these were 31.28 individuals/ha whereas in the sudanian region, it was 26.24 individuals/ha. Both at the sahelian section and at the sudanian one, any plant of *V. heterophylla* was met on the base of the mountains. The totality of the individuals was recorded in altitude at the rocky slopes level (Hamawa *et al.*, 2010). The analysis of the population of *V. heterophylla* revealed in average that its number was important (57 individuals) on the north side than on the south side (15 individuals) excepted the mountains of Ndougour and Tinguilin that had nothing on their south sides (Table 3). The opposition of the sides has a significant influence on the distribution of the number of *V. heterophylla* (χ^2=33.15; t= df=9; P <0.001). This result is in agreement with the one of Achoundong (1996) in the forest zone of Cameroon.

Table 3 Distribution of the population of *V. heterophylla* according to the mountain sides

	Number of trees by mountain side	
Mountains	North side	South side
Kalliao	60	10
Bilguim	60	13
Ndougour	36	0
Kotorba	70	23
Mokolo	90	22
Tinguilin	37	0
Lagdo	50	10
Nakalba	65	28
Fignolé	52	22
Tcholliré	47	17
Average	56,7	14,5

Population structure of V. heterophylla (Engl.) Letouzey

It was noted that the diameter of the population varied from 0.5 to less than 16 cm. Individuals belonging to the class diameter of 0.5-4 cm were the most abundant (49.65%). These were followed by those belonging to the diameter class of 4.1-8 cm (36.16% of the total population). The adult individuals represented approximately 3% of the population of *V. heterophylla* (Table 4). Contrary to the results of Geerling (1987) in West Africa, in the sudano-sahelian zone, the population of *V. heterophylla* presented a weak diameter.

Table 4 Distribution of trees according to the diameter class sizes

Distribution of trees by diameter classes (cm)		
Number of trees	dbh (cm)	%
357	0.5-4	49.65
260	4.1-8	36.16
82	8.1-12	11.4
15	12.1-16	2.08
5	>16	0.69

Despite the fact that the species was presented in the region, all the farmers affirmed that the individuals of large size had all or nearly extinct. They also declared that this species became more and more rare (42.5%). The perception of the local communities was confirmed by the analysis of the population structure. The population had weak size class distribution (sahelian sector: $a_1 = -0.435$; $R_1^2=0.873$; $t_1=-4.453$; $P_1 <0.05$ and sudanian sector: $a_2=-0.263$; $R_2^2=0.982$; $t_2=-12.80$; $P_2 <0.001$).

The plots of size class distribution showed that the population was made up of juveniles and that there was a remarkable absence of adult individuals. The population distribution presented an appearance in the "L" shape. Such shape suggested that the population of *V. heterophylla* regenerated well in the sudano-sahelian zone but that the old individuals are little represented and did not maintain themselves. Mortality of seedling was height (about 90%) (Figure 3). The results of the quantitative inventory revealed equally that the population of this altimountainous rutaceae was estimated at 719 trees of which the majority (617 individuals) was young with less than 8 cm of diameter. This result implied that the species was overexploited by the local population in the region.

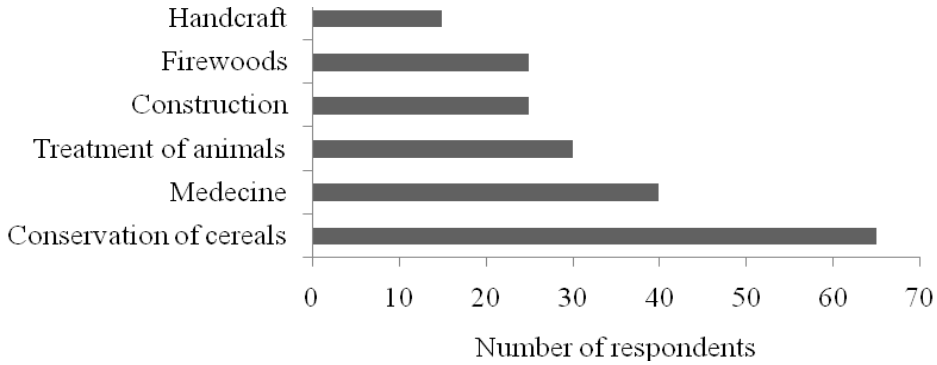

Figure 2 Products and services of *V. heterophylla* in the sudano-sahelian zone

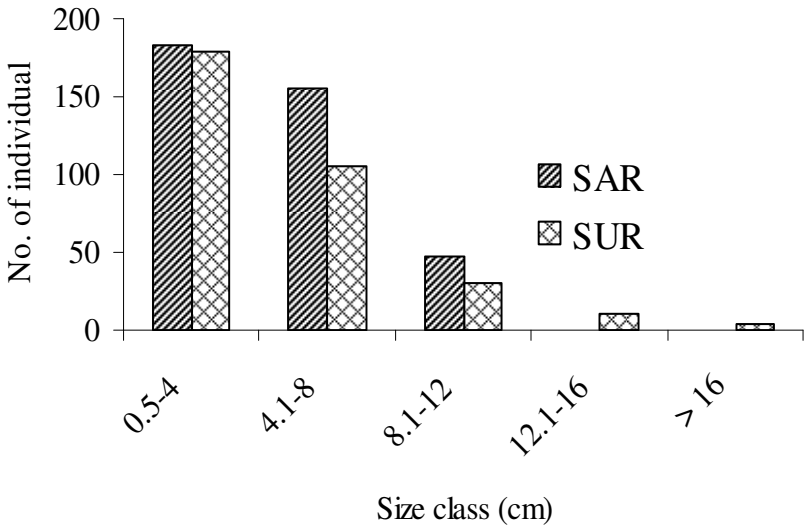

Figure 3 The frequencies distribution class (Number of stem) of *Vepris heterophylla* in the sudano-sahelian zone: sahelian region (SAR); sudanian region (SUR)

Discussion

Species Uses and Farmer Perceptions

Vepris heterophylla is known as a useful species. Despite of its socioeconomic characteristics, it does not seem to be highly protected by the local communities of sudano-sahelian zone of Cameroon. This assumption is based on the fact that most peasants affirmed that they were not encouraged to protect this species. Someone thought that it was a gift of " Allah " and the resource will always be available (Mapongmetsem, 2005). That was what explained their behavior opposite the species conservation. In whole zone of study, the measures of collective management of the trees of *V. heterophylla* were remarkably absent in the zone and the individual initiatives were timid or even non-existent. Anyone did not undertake to preserve a young tree of *V. heterophylla* in his field under pretext that the species was available naturally in the nature. Only 26% of the interrogated persons show their interest for the sustainable management of the species. Although the majority does not recognize the necessity to keep *V. heterophylla* but it confirms nevertheless the importance of this species in their different activities. For those who show a desire to domesticate the species, they have a little knowledge on the propagation techniques. The introduction of *V. heterophylla* in the field consists mainly in harvesting some seeds; the management can also make by transplanting the young plants when met. Considering the seeds, they are rare because searched for by the birds, therefore the domestication of the plant must be considered in farmer environment with vegetative propagation patterns (cutting, layering, grafting, suckering, etc.) at weak cost (Mapongmetsem *et al*., 1999; Mapongmetsem, 2006).

Population structure

The local population of *V. heterophylla* appeared threatened. According to the respondent's, the adult individuals of species were scarce and declining in abundance. The quantitative inventory supported the respondents view. The analysis of SCD indicated that the species had a weak population structure. It exhibited an L-shaped slopes (-0.435 and -0.263 respectively for sahelian and sudanian regions). Species with weak slopes generally have a poor regeneration potential and may be declining (Tabuti and Mugula, 2007).

The SCD plots (Figure 2) showed a higher number of young individuals but these were died out the population before they had recruited into sapling or mature individuals. This loss of young individuals weakened thus the population. For population to maintain itself, it needs to have abundant juveniles which will recruit into adult size class (Bationo *et al*., 2001). Similarly, the absence of adult in population affects recruitment into the population by lack of seeds (Mapongmetsem *et al*., 2011). The wide mortally of seedling may be explained by the constant disturbance of overexploitation for different uses. Most respondents related the precarious status of *V. heterophylla* to overexploitation and land clearance. Grazing was perhaps less important in to disappearance of the young individuals in the nature (Tabuti and Mugula, 2007).

The number of *V. heterophylla* is higher on the north side of all mountains explored. According to Avohou and Sinsin (2009), the habitat influences the distribution and the number of the species. In this survey, more individuals of *V. heterophylla* were found on the north side than on the south one in the whole sudano-sahelian zone. The observation was consistent with the study of Achoundong (1996) who reported that the opposition of the mountains sides had some influences on the vegetation of the mountain. This work showed that this influence could be both qualitative and quantitative. Generally the north side was not very solicited by the local communities because of the hot and dry wind of the harmattan coming from the desert. The absence of human activities on this side encouraged the establishment and the development of the species. In the case of this survey, it was important to note that the weak traces of the human activities, as it was the case on the north side of mountains, militated much in favor of the development of *V. heterophylla* on this side. The weak human presence led less pressure on the population of *V. heterophylla*.

Conclusion

This survey permitted to identify the different uses of *V. heterophylla* among which the conservation of the foodstuffs and medicine were the most cited. The north side of the mountains was richer in individuals than the south one. The species develop better at the level of the rocky

slopes mountains. The structure of the individuals showed a dominance of young individuals. The harvest of the species was made at irregular periods and it depends on the farmer. The conservation of the species was again timid or in the worse of the cases non-existent among the local communities. It was therefore necessary and urgent to develop a program of participatory domestication of this plant in the interest of the present and future generations. The implication of the local communities in the management of the species is the key of arch of its conservation. The resident communities have need to be sensitized in general on the true value of the multifunctional local plants and of *V. heterophylla* in particular.

Acknowledgments

The authors of the work thank those who guide or inform in the field. They are also in debt to anonymous readers for their useful comments which helped them to improve the quality of the manuscript.

References

Abd El-Ghani, M.M. and Marei, A.H. (2007). Environment and vegetation of *Randonia africana*: an endangered desert plant in Egypt. . *Afr. J. Ecol*., 45, 469–475.

Achoundong, G. (1996). Les forêts sommitales du Cameroun: végétation et flore des collines de Yaoundé. *Bois et Forêts des Tropiques,* 247, 37-52.

Assogbadjo, A.E., Kakaï R. G., Adjallala, F.H., Azihou, A. F., Vodouhê, G.F., Kyndt, T. and Codjia, J.T.C. (2009). Ethnic differences in use value and use patterns of the threatened multipurpose scrambling shrub (*Caesalpinia bonduc* L.) in Benin. *J. Med. Plants Research* 5(9), 1549-1557.

Avohou, H.T. and Sinsin, B. (2009). The effects of topographic factors of aboveground biomass production of grasslands in Atacora Mountains in northwestern in Benin. *Mt Research and Development,* 3(3), 250-254.

Bationo, B.A., Ouedraogo, S.J. and Guinko S. (2001). Longévité des graines et contraintes à la survie des plantules d'*Afzelia africana* Sm. dans une savane boisée du Burkina Faso. *ANN. For. Sci.,* 58(1), 65-75.

Bitariho, R., McNeilage, A., Babaasa, D. and Barigyira, R. (2006). Plant harvest impacts and sustainability in Bwindi impenetrable National Park, S. W. Uganda. . *Afr. J. Ecol*., 44, 14–21.

Boutrais, J. (1984). Le Nord-Cameroun: Des hommes, une région. Edition de l'Office de la Recherche Scientifique et Technique Outre-mer. Collection Memoires n° 102, Paris.

Fowler, J. and Cohen, L. (1988). Statistics for Ornithologists. BTO Guide 22. British trust for Ornithology, Thetford, UK.

Geerling, C. (1987). Guide de terrain des ligneux sahéliens et soudano-guinéen. Université agronomique. Wageningen (NL). Netherlands. 340p.

Griggs, F.T. and Jain, S.T. (1983). Conservation of verni pool plants in California. II. Population Biology of a rare unique grass genus *Orcuttia*. *Biodiv. and Conserv.,* 27, 171-193.

Hall P. and Bawa, K. (1993). Methods to assess the impact of extraction of Non-Timber Tropical Forest Products on plant populations. *Econ. Bot.,* 47, 234-247.

Hamawa, Y., Mapongmetsem, P. M., Nkongmeneck, B. A. and Dongock D. N. (2010). Altitudinal Distribution of *Vepris heterophylla* (Engl.) R. Let. (Rutaceae): a multifunctional plant of sudano-sahelian zone. *Internat. J. Bot.,* 6(3), 243-250.

Lykke, A.M. (1998). Assessment of species composition change in savanna vegetation by means of woody plants size class distributions and local information. *Biodiv. and Conserv*., 7, 1261-1275.

Keita, A. and Ouattara, S. (1995). A propos d'une espèce végétale médicinale en voie de disparition au Mali: le Kinkéliba de Kita. *Pharm. Méd. trad. Afr*. 39-42.

Mapongmetsem, P. M. (2005). Phénologie et apport au sol des substances biogènes par la litière des fruitiers sauvages en zone soudano-guinéenne du Cameroun. Thèse de Doctorat d'Etat. Université de Yaoundé I. 267p.

Mapongmetsem, P.M. (2006). Domestication of *Vitex madiensis* : phenology and propagation. *Akdeniz Üniversitesi Ziraat Fakültesi Dergisi 19*(2), 269-278.

Mapongmetsem, P.M., Nkongmeneck, B.A., Rongoumi, G., Dongock, D.N. and Dongmo, B. (2011). Impact des systèmes d'utilisation des terres sur la conservation de *Vitellaria paradoxa* Gaerten. F. (*Sapotaceae*) dans la région des savanes soudano-guinéennes.

Internat. J. Environ. Studies, 68 (6), 851-872.
Mapongmetsem, P.M., Tsingsabe, O., Keumeze, V. and Damba, A. (2010). Utilisation et commercialization des produits forestiers non ligneux par les communautés locales en zone soudanienne. *In AETFAT*, Antananarivo, Madagascar.
Mapongmetsem, P.M., Duguma, B. and Nkongmeneck, B.A. (1999). Domestication of *Ricinodendron heudelotii* in the humid Lowlands of Cameroon. *Ghana J. Sc.,* 39, 3-8.
Ngamo, L.S.T., Ngassoum, M.B., Jirovertz, L., Ousman A., Nukenine E. and Moukala, O.E. (2001). Protection of stored maize against *Sitophilus zeamais* (Motsch) by essential oils of species from Cameroon. *Med. Fac. Lamboww. Univ. Gent* 66(2a), 473–478.
Ngamo, L.S.T., Goudoum, A., Ngassoum, B.M., Mapongmetsem, P.M., Lognay, G., Malaisse, F. and Hance, T. (2007 a). Chronic toxicity of essential oils of 3 local aromatic plants towards *Sitophilus zeamais* Motsch. (Coleoptera: Curculionidea). *Afr. J. Agr. Research* 2(4), 164-167.
Obiri, J., Lawes, M. and Mukolwe (2002). The dynamic and sustainable use of high-value tree species of the coastal Pondoland forest of the Eastern Cape Province, South Africa. *Forest Ecol. and Manag.,* 166, 131-148.
Tabuti, J.R.S. and Mugula, B.B. (2007). The ethnobotany and ecology status of *Albizia coriaria* Welw. ex Oliv. in Budondo Sub-country, eastern Uganda. . *Afr. J. Ecol*., 45 (Supplement 3), 126-129.
Zammouri, J. Guetet Arbi, G. and Mohamed, N. (2009). Germination responses of *Spartidium saharae* (Coss. & Dur.) Pomel (Fabaceae) to temperature and salinity. *Afr. J. Ecol*., 48, 37–44.