STRUCTURAL AND ETHNOBOTANICAL CHARACTERIZATION OF VELVET TAMARIND (*Dialium guineense* WILLD), A MULTIPURPOSE TREE SPECIES

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ABSTRACT

The velvet tamarind (*Dialium guineense* Willd) is one of the key species for domestication in Sub-Saharan Africa. In order to help the sustainable management and conservation of this species, its structural characteristics and ethnobotanical traits were studied in the 4 vegetation types (typical dense forest, degraded dense forest, young fallow and old fallow) of the Lama forest reserve. A forest inventory was carried out in 100 randomly selected squared plots of one ha each in the 4 vegetation types. One rectangular plot of 0.15 ha was set up within each 1 ha plot for their structural description. Moreover, 10 squared plots of 10 m side were established on one of the diagonal in each one ha plot in order to estimate regeneration density. An ethnobotanical survey was also carried out among 100 randomly selected people of the *Holli, Fon* and *Adja* sociocultural groups living adjacent to the forest. Results showed that there were significant differences between the 4 vegetation types according dendrometric parameters. Stem diameter structure showed a non-normal shape. Ethnobotanical survey revealed that *D. guineense* is an agroforestry species and most of ethnobotanical knowledge is held by men of *Holli* sociocultural group.

Key-words: Benin, *Dialium guineense*, structure, ethnobotany, Lama forest reserve, vegetation types.

RESUME

*CARACTERISATIONS STRUCTURALE ET ETHNOBOTANIQUE DU TAMARINIER NOIR (*Dialium guineense *WILLD),*
UNE ESPECE A BUT MULTIPLE

*Le tamarinier noir (*Dialium guineense *Willd) est l'une des espèces clés pour la domestication en Afrique Sub-saharienne. Dans le but d'aider à l'aménagement durable des peuplements naturels de cette espèce, les caractéristiques structurales et ethnobotaniques ont été étudiées dans les 4 formations végétales (forêt dense typique, forêt dense dégradée, jeune jachère et vieille jachère) de la forêt classée de la Lama. Un inventaire forestier a été effectué dans 100 placeaux carrés de un ha chacun installés dans les 4 formations végétales. Au sein de chacun des placeaux de un ha a été installé un placeau rectangulaire de 0,15 ha pour la caractérisation structurale. Des quadrats diagonaux de 10 m de côté ont ensuite été installés dans les placeaux de un ha pour évaluer la régénération. Une enquête ethnobotanique a été également effectuée auprès de 100 personnes aléatoirement choisies au sein des populations locales de la forêt. Les résultats ont montré que les paramètres dendrométriques varient significativement d'une formation végétale à l'autre. Les distributions en diamètre présentent globalement des allures non normales. L'enquête sur les utilisations des organes a révélé que* D. guineense *est une espèce agroforestière et qu'une grande partie des connaissances ethnobotaniques est détenue par les hommes* Holli*.*

Mots-clés : Dialium guineense*, structure, ethnobotanique, forêt classée de la Lama, formations végétales.*

INTRODUCTION

Lama forest reserve is the last major relic of natural dense forest in Benin (Djègo *et al.,* 2003). In the reserve, *D. guineense* is the most abundant tree species, representing about 46.25 % of timber potential (60.8 trees ha^{-1}) overall species (Bonou *et al.,* 2009). In most case, common and abundant species are not in immediate threat of extinction and thus are rarely of conservation concern (Gaston and Fuller, 2008). Nonetheless, in terrestrial ecosystems world-wide, a number of common and abundant species are declining as a result of over-harvesting, high intensity logging, irruptions of native pests or introductions and outbreaks of non-indigenous pests and pathogens (Ellison *et al.,* 2010).

The vegetation in the Lama forest has been strongly disturbed by various agricultural activities. Thus, this natural forest has become a mosaic of young and old fallows and undisturbed and degraded forests (Emrich *et al.,* 1999). These past anthropogenic disturbances may leave fingerprints on growing conditions of *D. guineense* (Mwavu and Witkowski, 2008) and particularly modify demographic parameters such as germination, seedling and sapling growth and mortality rates (Guariguata and Pinard, 1998). The effects of human activities on plant species population are often described by changes in demographic structures. In particular, the seedling and the sapling stages represent a demographic bottleneck, as young plants are sensitive to drought, nutrient availability, fire, herbivory and biotic interactions, resulting in fluctuations in population size and age structure (Bond, 2008 ; Prior *et al.,* 2010). All these factors may limit the survival and growth of young individuals of *D. guinenese*, influencing the demographic structure and stability of its populations (Fensham and Bowman, 1992 ; Gurevitch *et al.,* 2006). Therefore, we predicted that populations of *D. guineense* growing in undisturbed forests have demographic structure different from populations in degraded forests and fallows.

D. guineense is also one of food and medicinal plants of Lama forest reserve (Agbani, 2002 ; Eyog-Matig *et al.,* 2002). Fruits, leaves and wood of the species are harvested in the wild by local communities (Eyog-Matig *et al.,* 2002). The ecological impact of harvesting agroforestry species may be greater than those of other species due to the combined effects of harvesting multiple parts. These species may therefore be at higher risk of overexploitation (Gaoué and Ticktin, 2007). Studying the impact of fruit harvest is important as fruits are the species' reproductive organ. Their excessive harvesting may negatively impact species sustainability (Avocèvou-Ayisso *et al.,* 2009). In Benin, earlier studies carried out on local communities' knowledge and use of different multipurpose species such as *Milicia excelsa* (Ouinsavi *et al.,* 2005), *Adansonia digitata* (Assogbadjo *et al.,* 2008) and *Tamarindus indica* (Fandohan *et al.,* 2010) showed significant differences in use values and uses patterns among sociocultural groups and gender. Populations living adjacent to the Lama forest are constituted of «*Fon*», «*Holli*» and «*Adja*» sociocultural groups (Coubéou, 1995). Therefore, we also made the assumption that traditional knowledge on uses of *D. guineense* is function of ethnic group and sex. Until recently, scientific research on *D. guineense* focused mainly on its nutritional potentials (Okegbile and Taiwo, 1990) and seedlings growth (Orhue Ehi *et al.,* 2007).

Overall, this study was then carried out to describe and analyze population structure of *D. guineense,* as well as, to assess its ethno-botanical patterns for a sustainable management of its populations in its natural stands. The study was set up to address the following questions : (1) Did past land uses by local communities negatively impact demographic structure of *D. guineense* in the Lama forest reserve ? (2) What ethnobotanical knowledge do local communities have on *D. guineense* ?

MATERIALS AND METHODS

STUDY AREA AND STUDY SPECIES

The Lama forest reserve, protected by law since 1946, is located in southern Benin in the Dahomey Gap between 6°55' - 7°00' N and 2°04'- 2°12' E (Figure 1). The total area of the forest is estimated at 16,250 ha. The rainfall regime is bimodal from April to June and from September to November, with a mean annual rainfall of 1 200 mm. The mean temperature varies between 25 and 29° C with relative moisture between 69 and 97 %. The vegetation in the forest has been strongly disturbed by various agricultural activities. Thus, this natural forest has become a mosaic of fallows and relic forests. The original vegetation was dense semi-deciduous forest established on 4,777 ha composed of 292 ha of *Tectona grandis* and *Gmelina arborea* plantations, 1,900 ha of dense forest, the remaining area being fallow (Emrich *et al.,* 1999).

Populations living adjacent to the Lama forest are constituted of «*Fon*» sociocultural groups coming from Allada and Abomey, «*Holli*» sociocultural group coming from Pobè and «*Adja*» cultural group coming from Couffo (Coubéou, 1995). Population density is about 120 habitants/km^2 in Zogbodomey (Northern part of the Forest) and 60 habitants/km^2 in Toffo (Southern part of the forest).

D. guineense is found at the border of forest, Guinean and Sudano-guinean gallery forests and at the edge of rivers. It is also found in the meridional part of Sahelian zone and is abundant in the Lama forest reserve (Emrich *et al.,* 1999). It is a shade tolerant species and less resistant to fire (Emrich *et al.,* 1999). In Benin, *D. guineense* tree flowers from October to November and bears fruits from December to February. The species is an important leguminous plant that is widely distributed. Its fruits are consumed raw or fermented in an alcoholic beverage (Orhue Ehi *et al.*, 2007). The twigs are excellent toothpicks (Eyog-Matig *et al.,* 2002) and the fruits are marketed between Benin, Nigeria and Togo during the dry season (Eyog-Matig *et al.,* 2002). The leaves are used to treat fever, asthenia and icterus (Arbonnier, 2002) and wood is a good source of charcoal (Okafor, 1975). Moreover, the species is known to have magical powers (Arbonnier, 2002).

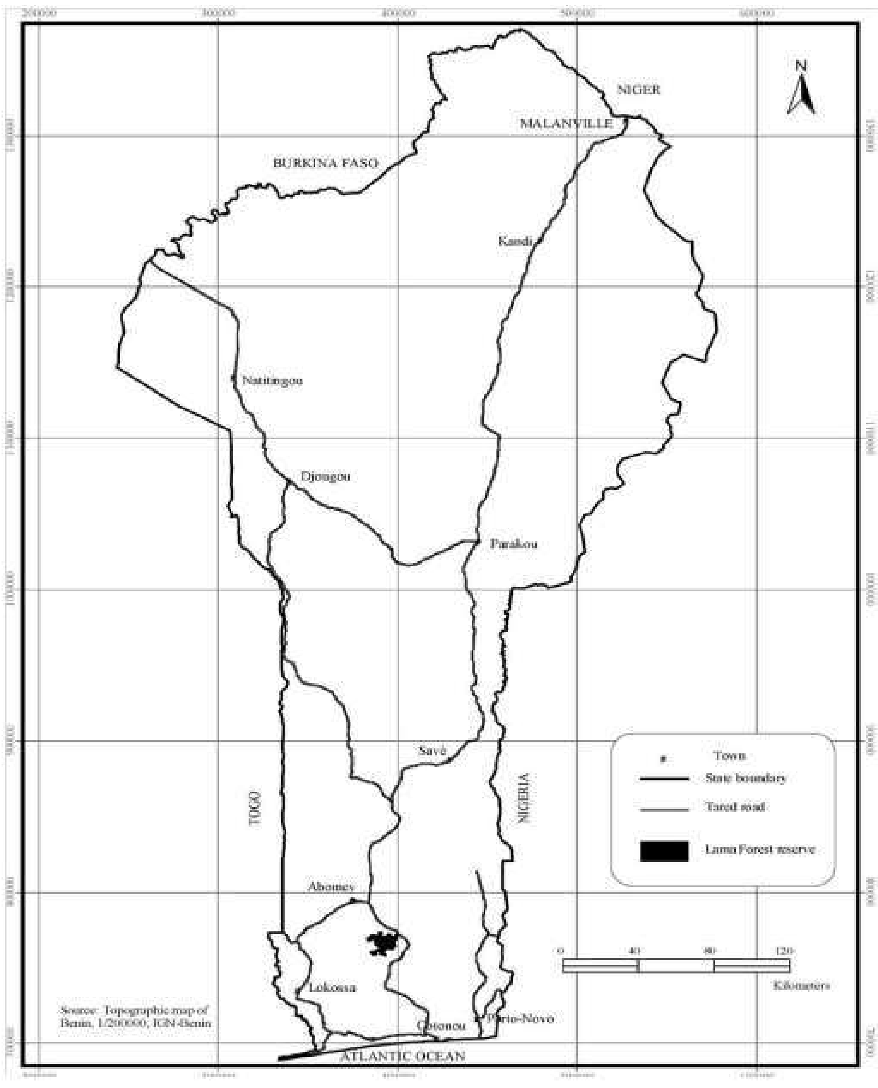

Figure 1 : Location of the Lama forest reserve in Benin.

Localisation de la forêt classée de la Lama au Bénin.

Source : Bonou *et al.,* 2009

SAMPLING DESIGN AND DATA COLLECTION

Forest inventory was conducted in 100 permanent square plots of 1 ha each randomly distributed. Forty-six plots were set up in typical dense forest, 12 in degraded dense forest, 13 in old fallows and 29 in young fallows according to the area of each vegetation type.

Within each square plot, one rectangular subplot of 50 x 30 m was designed in order to record dendrometric data related to *D. guineense* trees that had at least 10 cm as diameter at breast height (dbh). Moreover, 10 adjacent diagonal square subplots of 10 m of side were set up in each plot for natural regeneration study (Figure 2). Within each plot, all individuals of *D. guineense* were counted and their diameters (dbh $\geq$ 10 cm) and total heights measured within subplots. Young trees (dbh less than 10 cm) were also counted within the diagonal subplots (Figure 2).

Ethnobotanical survey was also carried out on 100 randomly people selected from local populations living adjacent to the Forest. Interviews were conducted on use values of different organs (roots, bark, stems, leaves, flowers and fruits) and any other knowledge on *D. guineense* products.

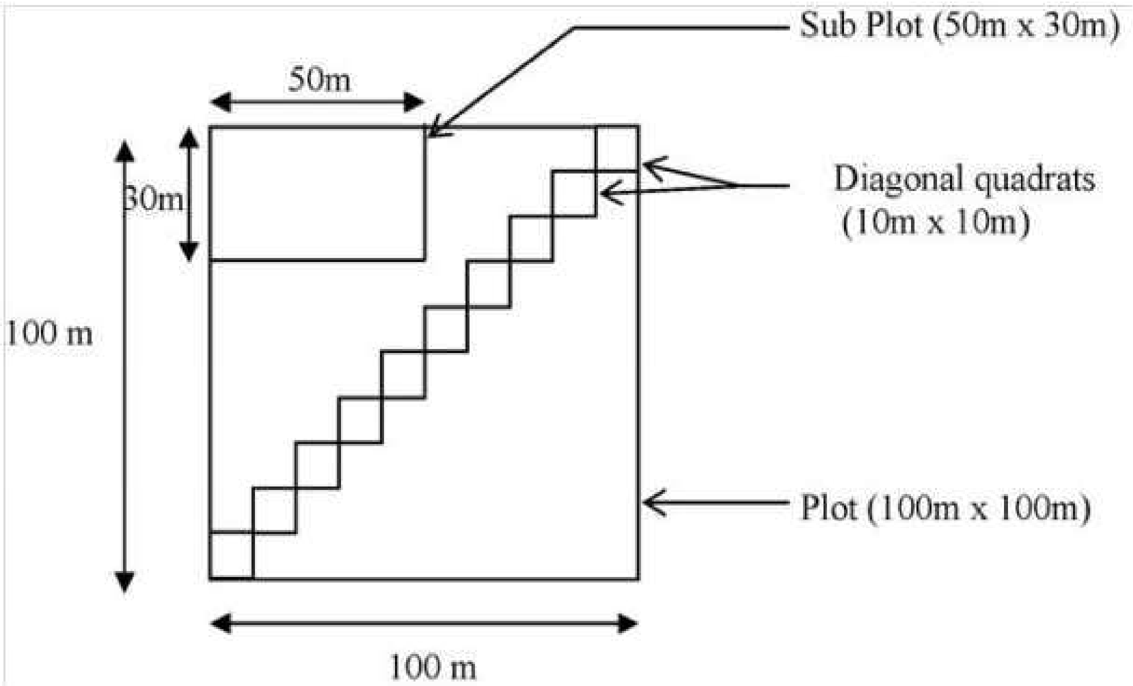

Figure 2 : Sample unit of forest inventory.

Unité d'inventaire forestier

Source : Bonou *et al.* (2009).

DATA ANALYSIS

Assessing dendrometric parameters of *D. guineense*

The following dendrometric parameters were computed for each inventory plot.

The tree-density of the stands (*N*), i.e. the average number of *D. guineense* trees per plot expressed in trees/ha.

The mean diameters of the trees (Dg , in cm), i.e. the diameter of the tree with the mean basal areas in the stand :

$$D_g = \sqrt{\frac{1}{n}\sum_{i=1}^{n} d_i^2} \quad (1)$$

where n is the number of trees found on the plot, and d_i the diameter (cm) of the ith tree.

The basal area of the stand (G), i.e. the sum of the cross-sectional area at 1.3 m above the ground level of all trees on a plot, expressed in $m^2\ ha^{-1}$:

$$G = \frac{\pi}{40000\ s} \sum_{i=1}^{n} d_i^2 \qquad (2)$$

d_i is the diameter (in cm) of the i-th tree of the plot ; s = 0.15 ha.

The Lorey's mean height (H_L, in meters), i.e. the average height of all trees found in the plot, weighted by their basal area (Philip, 2002), was computed as follows :

$$H_L = \frac{\sum_{i=1}^{n} g_i h_i}{\sum_{i=1}^{n} g_i} \quad \text{with} \quad g_i = \frac{\pi}{4} d_i^2 , \qquad (3)$$

g_i and h_i are the basal area (in m²/ha) and the total height (in m) of tree i.

The density of *D. guineense* regeneration : to compute density of young plants of the species, the four vegetation groups were considered as strata. Regeneration density of the *D. guineense* population, Ng, was computed as indicated below (Dessard and Bar-Hen, 2004) :

$$Ng = \frac{\sum_{l=1}^{k} N_l \overline{N}_{rl}}{N} \quad \text{with} \quad \overline{N}_{rl} = \frac{1}{n_l} \sum_{i=1}^{n_l} y_{li} \qquad (4)$$

$\overline{N}_{rl}$ = mean density of *D. guineense* regeneration within group l (l = 1, 2, 3, 4) ; N = total number of plots within the global sampling ; y_{li}= regeneration density of *D. guineense* within the ith plot of group l of the stand.

Data on dendrometric parameters in the four vegetation types were subjected to one-way analysis of variance (ANOVA). Logarithmic transformation was applied to tree-density and basal area to normalize their values and stabilize variances before performing the analysis. The Student-Newman-Keuls test was applied after the ANOVA test to classify the vegetation types according to the mean value of the parameters. All analyses were implemented using SAS 9.1 software.

Stem diameter structures of *D. guineense* trees

To establish the stem diameter structure of *D. guineense* stands, all individuals of the species were grouped into diameter classes of 5 cm. Tree-density was computed for each diameter class. The observed diameter structures were adjusted to the 3-parameter-Weibull distribution, which density function, f is expressed as follows (Bonou *et al.,* 2009) :

$$f(x) = \frac{c}{b}\left(\frac{x-a}{b}\right)^{c-1} \exp\left[-\left(\frac{x-a}{b}\right)^{c}\right] \qquad (5)$$

where x = tree diameter ; a = 5 cm when the diameter is considered ; b = scale parameter linked to the central values of diameter ; c = shape parameter. For each group, values of tree diameter were used to estimate parameters b and c based on the maximum likelihood method.

Analysis of ethnobotanical data

Quantitative ethnobotanical parameters were computed as below :

- The overall use value of the species, UVt , i.e. number of uses listed for the species ;

- The specific use value, UV*org* , i.e. number of uses listed for each organ; it was computed for stem, leaves, bark, roots and fruits of the species.

The intraspecific use value, IU, i.e. ratio between UV*org* and UVt.

Moreover, specific use value was computed for each organ of the species according to sex and each of the 3 main sociocultural groups in the region (*Holli, Fon* and *Adja*). The data matrix was subjected to Principal Component Analysis (PCA) in order to describe the relationship between organs use value and socio-cultural groups.

RESULTS

STRUCTURAL CHARACTERIZATION OF *D. guineense* ACCORDING TO VEGETATION TYPES

High significant differences (P = 0.000) were noticed for tree-density, mean diameter and basal area between vegetation types (Table 1). There were also significant differences ($P \geq 0.05$) between vegetation types on the basis of the regeneration density and Lorey's height. The mean of tree-density and regeneration density were 60.8 stems/ha and 173 plants/ha respectively. The highest values (115.6 stems/ ha ; 284.8 plants/ha) were recorded in the typical dense forest and the smallest (8.8 stems/ha ; 37.2 plants/ha) in the young fallow. It means that the typical dense forest had the highest tree cover and potential for recruitment. The mean diameter in the whole forest was 25.9 cm. The highest value (25.4 cm) was obtained in the old fallow and the smallest one (22.9 cm) in the young fallow. The Lorey's mean height in the whole forest was 17.4 m. The highest value (18.8 m) was obtained in the old fallow and the smallest (15.5 m) in the young fallow. So, old fallows had mainly big and tall trees without new recruits. The average basal area was 3.4 m²/ha. The highest value (4.9 m^2 ha^{-1}) was found in the typical dense forest and the smallest one (0.8 m^2 ha^{-1}) in the young fallow. It means that typical dense forest had the highest potential for timber production. The SNK test confirmed these differences obtained between the different vegetation types.

Stem diameter structures (Figure 3) in the 4 vegetation groups were non-normal and positively asymmetric ($1 < c < 3.6$). The asymmetry is strong in the typical dense forest and the young fallows. These values of the shape parameter of Weibull distribution characterized a monospecific stand with relatively more young individuals (Husch *et al.,* 2003). Trees with 20 - 25 and 30 - 35 cm dbh classes were the most represented in degraded dense forest while trees with 20 - 25 cm dbh were the most represented in old fallow. Young trees (10 - 15 cm dbh) were the most represented in typical dense forest and young fallow.

ETHNOBOTANICAL CHARACTERIZATION OF *D. guineense*

The overall ethnobotanical use value (UVt) of *D. guineense* was equal to 27 (Table 2). The leaves had the highest specific use value ($UVorg$ =11) while the stems and fruits had the least specific use values (6 and 2, respectively).

Results of PCA performed on ethnobotanical use values of organs according to sociocultural groups and sex indicated that the first two axes explain 89.6 % of the observed variations. The correlation coefficients between different use categories and the axes are presented in Table 3. The first axis shows positive link between leaves, fruits, barks and roots whereas the second axis shows opposite link between stems and fruits.

Sociocultural groups were projected into system axis 1 and 2 and revealed that *Adja* men had more knowledge on the use of *D. guineense* stems than on other organs while *Holli* men had more knowledge on the use of the leaves, fruits, roots and barks (Figure 4). However, *Holli* and *Fon* women had more knowledge of the fruits, while the stems are more used by the *Fon* men but less than *Adja* men. The other groups had little knowledge of the use of *D. guineense*.

Table 1 : Dendrometric characteristics of *D. guineense* in the four vegetation types in Lama forest reserve.

Caractéristiques dendrométriques du D. guineense *dans les 4 formations végétales de la réserve de Lama*

	Tree-density, N (stem/ha)		Mean diameter Dg (cm)		Basal area G (m²/ha)		Lorey's mean height (HL, m)		Density of young plants (Ng, plants/ha)	
	m	cv(%)	m	cv(%)	m	cv(%)	m	cv(%)	m	cv(%)
WF	60.8	91.3	25.9	30.4	3.4	82.1	17.4	20.3	173.0	118.6
TDF	115.6a	27.7	25.4b	23.1	4.9a	53.1	18.0a	16.5	284.8a	87.6
DDF	26.7b	57.3	29.3b	20.9	3.0b	65.0	17.8a	12.1	158.3b	81.1
OF	14.8c	67.4	32.0a	24.0	1.1c	62.0	18.8a	15.0	93.8b	67.9
YF	8.8d	63.6	22.9c	43.1	0.8d	105.1	15.5b	19.4	37.2c	84.6
Prob.	0.000		0.000		0.000		0.015		0.006	

m : Mean ; cv : coefficient of variation ; P : probability values ; WF : whole forest ; TDF : typical dense forest ; DDF : degraded dense forest ; OF : Old Fallow ; YF : Young fallow ; Prob. : Probability values. Means followed by the same letter on the same line are not significantly different at Prob. = 0.05 (Student Newman and Keuls test).

m : Moyenne ; cv : coefficient de variation P : probabilité ; WF : valeur globale de la forêt ; TDF : forêt dense typique ; DDF : forêt dense dégradée ; OF : vieille jachère ; YF : jeune jachère ; Prob. : Probabilité. Dans une même colonne, les valeurs de même lettre ne sont pas significativement différentes au seuil de 5 % (test de Student Newman et Keuls).

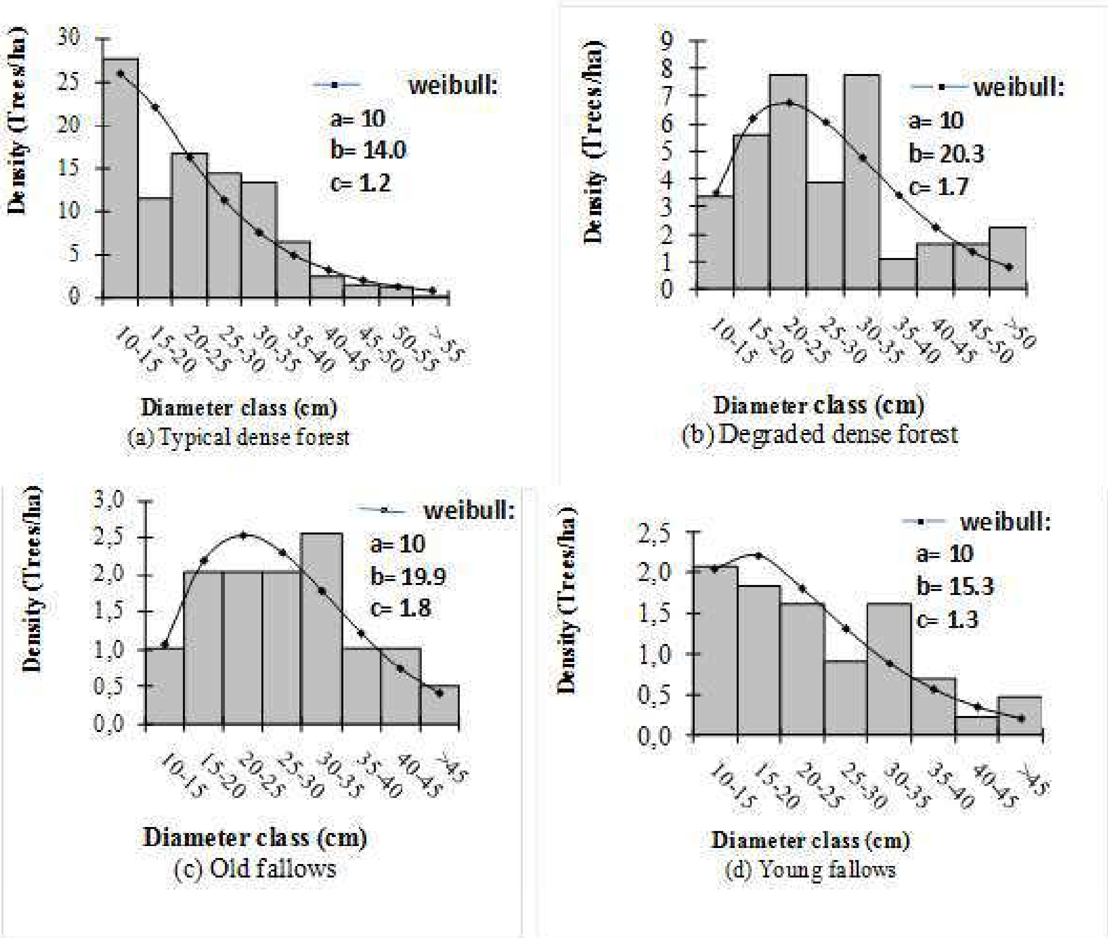

Figure 3 : Stem diameter structures of *D. guineense* in the four vegetation types in Lama reserve forest.

Structures en diamètre de D. guineense *dans les quatre formations végétales de la forêt classée de la Lama.*

Table 2 : Specific and Intraspecific Use Values (UVorg and IU) of the different organs in *D. guineense.*

Valeurs d'utilisation spécifique et intraspécifique (UVorg et IU) des différents organes chez D. guineense.

Organs	UVorg	IU (%)	Use value
leaves	11	40.7	memory^{+}, malaria, anemia, tonic for newborn^{+}, heart aches^{+}, contraception^{+}, cough, cold, condiment, tonic for women who gave birth and wound.
barks	9	33.3	memory^{+}, cough, tonic for newborn^{+}, contraception^{+}, anemia^{+}, menstruation regulation $^{+}$, wound on the tongue, dysentery and measles^{+}.
Roots	8	29.6	memory^{+}, contraception^{+}, measles^{+}, oligospermia^{+}, swelling of feet, difficulty to defecate, edible fungus and intestinal worms.
stems	6	22.2	House building, toothpick, firewood, tool handle, carbon and granary.
Fruits	2	7.4	Raw consumption and malaria^{+}.

Legend

UVorg : Specific Use Values ; IU : Interspecific Use Values / + : the treatment of the given disease needs moreover the use of parts from other plants.

UVorg : Valeur d'utilisation spécifique ; IU : Valeur d'utilisation interspécifique / + : le traitement du mal exige en plus l'utilisation d'autres organes de plantes.

Table 3 : Correlation coefficients between parts of *D. guineense* and PCA axes.

Coefficients de corrélation entre les organes de D. guineense *et les axes de l'ACP.*

Organs	Axis 1	Axis 2
leaves	0.99	-0.03
Fruits	0.58	-0.64
stems	0.28	0.87
barks	0.99	0.07
Roots	0.96	0.10

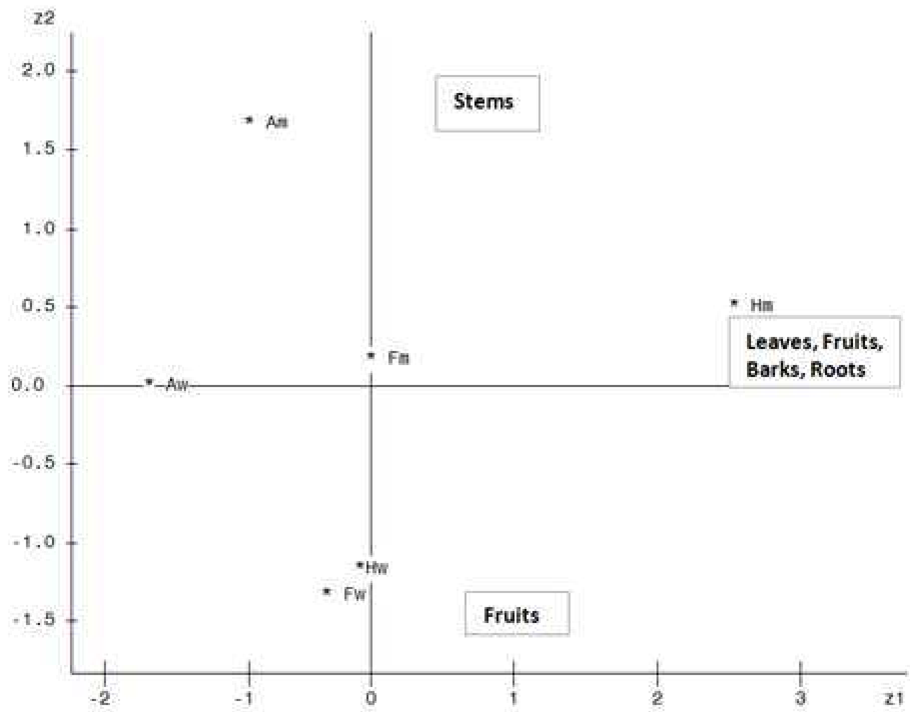

Figure 4 : Projection of ethnic groups in the system axis defined by the different organs of *D. guineense.*

Projection des groupes ethniques dans le système d'axes défini par les organes de D. guineense.

Aw = Adja women ; Am = Adja men; Fw = Fon women ; Fm = Fon men ; Hw = Holli women ; Hm = Holli men.

Aw = femme adja ; Am = homme adja; Fw = femme fon ; Fm = homme fon ; Hw = femme holli ; Hm = homme holli.

DISCUSSION

The study provides evidence of the influence of past land use on demographic parameters of *D. guineense* populations, especially for density of regeneration, density of adult trees and basal area which had highest values in typical dense forest. It confirms that both adult and juvenile life stages of *D. guineense* are influenced by past land uses. Such evidence is however lacking for mean diameter which was higher in old fallows. Likewise, Lorey's mean height also had similar values in typical dense forest, degraded forest and old fallows.

Populations of *D. guineense* growing in typical dense forest had never experienced harvesting of timber or non timber organs and their demographic parameters are largely an outcome of natural processes of birth, growth and death. The low density of adult trees in old and young fallows could be explained by the tendency of farmers to destroy trees before establishing field of annual crops. These trees recorded in fallows may reflect agroforestry practices in which farmers conserve some trees in agroforestry fields (Vodouhe *et al.,* 2011). Contrary to fallows, low density of *D. guineense,* in degraded forest, may come from illegal timber harvesting in the reserve. The previously mentioned factors may also explain the observed trends in values of basal area among vegetation types. The same factors partially explained the variation in density of regeneration due to the availability of mother trees and seed production. All else things been equal, it could be expected that typical dense forest have higher recruitment which may exert a negative effect on the value of mean diameter. Therefore, the high mean diameter value observed in old fallows may indicate a recruitment failure and persistence of long-lived individuals despite unfavorable conditions (McCauley *et al.,* 2013). This factor may also explain the high value of Lorey's mean height observed in old fallows. The mean height obtained (17.4 m) confirms that *D. guineense* could be classed in the codominant floor of the forest as described by Coubéou (1995) and Emrich *et al.* (1999). Therefore, competition for light may explain the height of trees in typical dense and degraded forests (Murphy and Bowman, 2012).

Diameter distributions in this study showed positive asymmetry as revealed by the shape parameter in all vegetation types. It seems to indicate that past anthropogenic disturbance does not negatively affected the structure populations of *D. guineense*. But this structure did not take into account small trees (less than 10 cm of dbh). Similar observations were made on Isoberlinia stands in Wari-Maro Forest Reserve (Glèlè Kakaï and Sinsin, 2009).

Our findings also support the hypothesis that local knowledge on *D. guineense* varies not only according to different ethnic groups but also according to the sex of individuals interviewed. The study also revealed the importance of *D. guineense* to local communities' livelihoods in rural Benin. In fact, *D. guineense* is used by local people in different ways, including edible fruit, timber, medicine, magic, and others. Recorded uses overlap with those mentioned in other West African countries (Arbonnier, 2002).

The diversity of traditional uses and knowledge should be considered when designing regional management strategies. For example, as Holli men assigned a high ethnobotanical use value to leaves, fruits, roots and barks and use these organs in medicine, social, cultural purposes, they should be involved in strategies aiming to improve genetic selection of this species. In the same way, Adja and Fon men should be involved in identifying timber potential of the species. Based on these uses, leaves, barks and roots are most used organs principally to treat different diseases. Moreover, stems and fruits assumed food functions. Similar results were found within the people living close to Pobè protected forest in Benin (Vihotogbé, 2001). The same results were also found in Burkina Faso, where the forest species *D. guineense* were kept in field mainly for food and medicinal purposes (Yaméogo, 2005).

Due to the socio-cultural importance of *D. guineense*, its populations are declining in Benin (Eyog-Matig *et al.,* 2002). Therefore, there is high risk of a substantial decrease of the genetic diversity within the population of the species. All interviewees said that the species distribution areas are declining around the forest. This is confirmed by Floquet and Mongbo (1998) who argued that agriculture causes short or medium term degradation of land and ecosystems. Past anthropogenic activities, namely the collection of woods for constuction, mutilation of organs and fields work in the forest, well justified the diameter structures of *D. guineense*. Threats are due to collecting intensity, mutilation, uncontrolled deforestation and inappropriate agricultural practices (de Souza, 1999).

Bark, leaves and roots mutilations have a negative effect on young trees especially during the dry season when water content in the soil decreases. Moreover, fruits harvestings negatively affects regeneration densities since they are most of the time carried at home where embryos of the seeds are damaged and compromising, by this fact, germination (Degrande *et al.,* 2007).

CONCLUSION

Results from this study showed the influence of past land use on dendrometric characteristics of *D. guineense* populations in Lama forest reserve in Benin. Fruit harvesting in the wild could hinder population recovery in old and young fallows. Increased harvesting pressure on timber and non timber organs of *D. guineense* could lead to the shortage of this valuable species as noticed in Benin for *Afzelia africana* and *Khaya senegalensis*, two multipurpose tree species which were well represented in forests in the past (Sinsin *et al.,* 2004 ; Bonou *et al.,* 2009 ; Glèlè Kakaï and Sinsin, 2009). The negative effects of mutilations and irrational uses on trees needs to be raised up in order to inform local communities living around the forest on conservation strategies for *D. guineense* preservation in Benin targeting their knowledge and activities using results obtained. Moreover, molecular techniques related to genetic variation and genetic diversity encountered in *D. guineense* population in Lama forest reserve will be useful for a better assessment of trees studied.

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