ISSN No:-2456-2165

The Woody Vegetation Characterisation of the Classified Forest of Bangui (Department of Madaoua, Niger) in a Demographic and Climate Change Context

Issaka Boubacar Ali1*
University Abdou Moumouni of Niamey, Faculty of Agronomy, Department Animal Production, Laboratory of Animal Productions in Arid and Semiarid Zone (Lapazas) Niamey, Niger;

Amadou Garba[2]
University Abdou Moumouni of Niamey, Faculty of Sciences and Techniques, Biology Department, Laboratory Garba Mounkaila, Niamey, Niger

Chitou Adamou[3]
National Centre of Ecological Surveillance (Cnsee).

Corresponding Author: - Issaka Boubacar Ali1*

Abstract:- Anthropogenic activities and climate change are factors that have led to ecological imbalance in forest formations in the Sahel. The present study conducted in the Bangui classified forest aims to characterise the woody vegetation in a demographic and climate change context. The methodology used consisted of dendrometric measurements and socio-economic surveys. Seventeen (17) woody species were recorded and divided into twelve (12) families, the most important of which are the Fabaceae-Mimosoideae families (29.41%). The biological types are dominated by microphanerophytes (McPh =88.24%) and the phytogeographic types by sudanozambezian species (SZ =52.94%). The diameter structure shows that the woody flora is mostly composed of young individuals of small diameter belonging to the diameter class [2-10 cm [. The woody diversity is average (H= 3.54 bits). The classified forest is in a state of progressive degradation. The factors of this degradation are abusive logging and climate change. Studies on the dynamics of land use must be carried out in order to develop a management plan for this classified forest, for the sustainable management of its resources and for the well-being of its populations.

Keywords:- *Species, Woody, Stand, Forest Inventory, Bangui.*

I. INTRODUCTION

Forest formations are ecosystems that provide ecosystem services, which form the basis of the economy of rural populations. The exploitation of non-timber forest products (NTFPs) from these ecosystems provides substantial income for these populations. Indeed, thousands of rural people depend on the exploitation of these services for food, income and many other functions [1],[2]**.** The contribution of forest-based fruit species to food and income generation, particularly for people south of the Sahara, is well documented [3],[4]. However, for the past three decades, the Sahel has been confronted with numerous difficulties, including the degradation of vegetation cover. In Niger, the demographic rate is 3.9%[5] with an estimated population of 23.3 million. In view of this situation, there is an ever-increasing need for energy resources. To satisfy these needs, the population resorts to forest formations, the disappearance of which is now at the heart of the country's environmental problems. In addition, with climate change causing recurrent droughts, the biological diversity in these environments is undoubtedly subject to an unprecedented process of degradation. It has been noted that in Niger, out of a potential national woody forest resource estimated in 1989 at 16 million ha, including 600,000 ha of classified forests, about 200,000 ha are lost each year due to anthropic factors and climatic variations [6]. This situation does not put Bangui's classified forest on the sidelines, which, faced with the scarcity of pastoral resources, the rapid advance of the agricultural front, the poverty of the population and the effects of climate change, is subject to socio-economic and environmental factors that contribute to the degradation of its occupation units. It is in this context that this study was carried out, with the aim of characterising the woody vegetation of the classified forest in a context of climatic and demographic change.

II. MATERIALS AND METHODS

➢ *Study Area*

The Bangui Classified Forest (FC) (Fig 1) is located in the rural commune of Bangui, between the geographical coordinates latitudes: 13°40' and 14°00' and longitudes: 6°11' and 5°33' and is situated in the department of Madaoua about 60 km east of the main town of the said department, in the south-eastern part of the Tahoua Region and 260 km

ISSN No:-2456-2165

from the region's chief town It covers an area of 1,308 km² with an estimated population of 187,464 inhabitants in 2020, of whom 93,914 are women (50.10%) and 93,550 are men, spread over 1,8608 households, an estimated density of 143.32 habitants/km²[7].

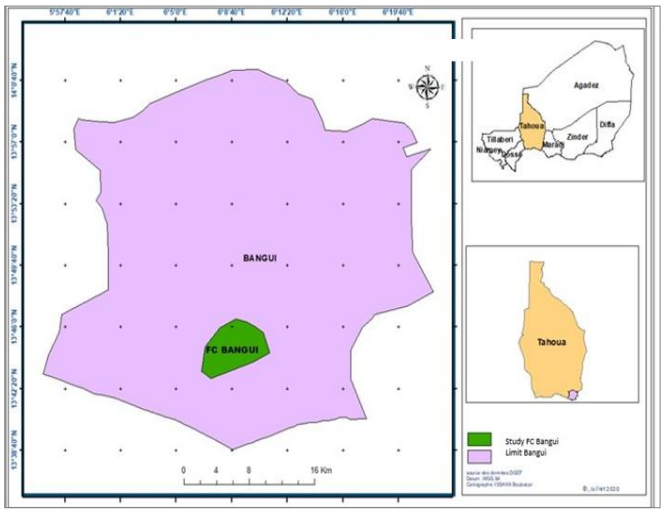

Fig 1 The Study Area

The classified forest covered an area of about 3275 ha according to decree n°2888/S/T/ET of 13 December 1954. In 1999, the Lower Tarkaa Valley Project estimated its area at 3,311.09 ha. The vegetation is characterised by shrubby and wooded savannahs where species such as *Balanites aegyptiaca, piliostigma reticulatum, Annogeisus leocarpa, Combretum glutinosum, Combrethum micrantum, Hyphaene thebaica* are found (Fig 2).

Fig 2 an Overview of the State of Occupation of the Bangui Classified Forest

The relief of the commune of Bangui is characterised by a succession of plateaus in the extreme west and north (Doutchin Kozoro, Doutchi Rouan zafi, Ajaoujaoua) and depressions (Mallélabi, Takorka, Bangui, Nakonawa Sami, Korama-Lamso, Goulbi-Kaba, Tapkin-Godia, Guidan Idi, Guidan-Barmou valleys) In the eastern, central and southern parts, the terrain is flat and consists of plains.

➢ *The Sahelo-Sudanese Climate Is Marked By Two Main Seasons*:

- A dry season lasting 7 to 8 months from November to May. During this period, hot and dry winds blow, the most dominant of which is called the harmattan, with a northeast/southeast direction.
- A relatively short rainy season (June to September); this is the period when a large part of Niger is swept by the monsoons, which are laden with moisture and blow in the opposite direction to the harmattan, south-west/north-east.
- Average temperatures in the area vary between 32° and 12°C in December and between 42° and 28°C in May. The municipality lies between the isohyets of 450 mm and 600 mm.

III. METHODOLOGY

➢ *Sampling and Dendrometric Measures*

To characterise the density of woody vegetation in the forest, sampling units (plots) of varying distances were laid out on 6-7 km transects. These transects were oriented in an east-west and north-south direction to better reflect the state of occupation of the forest and its diversity (Fig 3). Plot sizes on each transect were 50m×50m (2500m2) in agrosystems (fields) and 50m×20m (1000 m²) in pastoral areas. Within these plots, all woody species were recorded and reported on biophysical data collection sheets. The materials in Fig 4 were used to record the following dendrometric parameters:

- *Diameter at 20cm from the ground for shrubs and at 1.30m for trees;*
- *The height of shrubs and trees;*
- *The average diameter of the crown;*

And the numbers of stems with a diameter less than 2cm were counted.

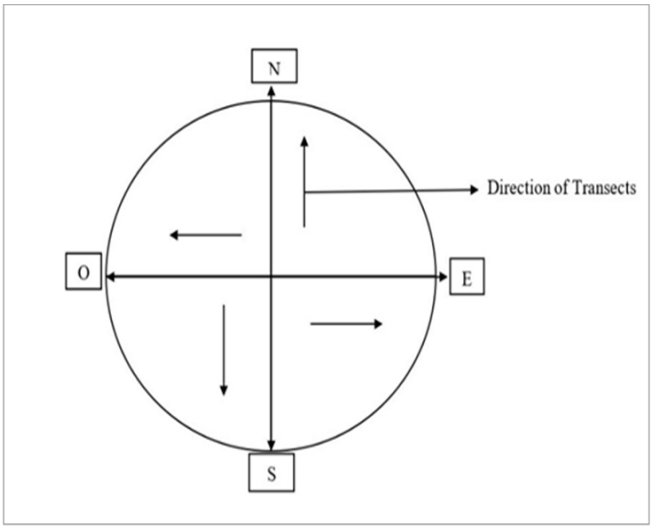

Fig 3 Schematic of the Sampling Scheme for Woody Vegetation Surveys

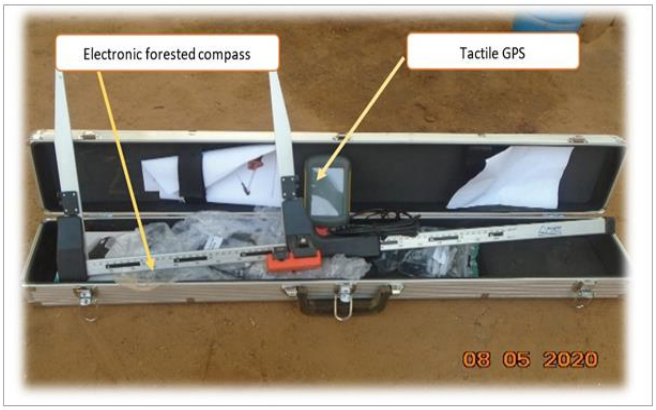

Fig 4 Materials for Dendrometric Measurement

➢ *Ethnobotanical Surveys*

In order to assess the state of the Bangui classified forest, ethnobotanical surveys were conducted in focus groups of 30-40 people in the villages surrounding the forest. The criteria for choosing the villages were based on accessibility and population size. The respondents were men and women who all use the forest.

➢ *Data Processing and Analysis*

Excel and Minitab 14 software were used to process and analyse the data collected. The identification of species and the determination of their origin (endogenous or exogenous) was carried out using the analytical flora of Benin [8] and Arbres et arbustes du Sahel [9]. The different parameters calculated are:

- *Diversity Indices*

Diversity indices provide information on the quality of stands, their viability or their evolution [10]. Among the most commonly used indices in ecology and phytosociology are: species richness, the Shannon and Weaver index (1949) and Piélou's equitability (1966).

- *Species Richness*

The species richness (S) of a community or stand is the number of species that the community or stand contains;

- *Shannon and Weaver index (H'***)**

The Shannon diversity index (H') expressed in bits is determined from the following formula

$$\boldsymbol{H'} = -\sum_{i=1}^{S} \text{Pilog2Pi} \qquad (1)$$

Where pi (relative frequencies of species) = ni/N with ni =number of individuals of species i and N =total number of individuals of all species; S = species richness (total number of species).

✓ H∈ [0;2.5], it is assumed to be low;
✓ H∈ [2.6;3.9], then it can be assumed to be medium;
✓ H∈ [4;6], then H can be assumed high.

- *Equitability of Piélou R*

It is calculated from the Shannon-Weaver index (H')

$$\mathbf{R} = H' / \log 2\,(S) \qquad (2)$$

✓ R [0 - 1], If R∈ [0; 0,6] then Pielou equitability is low (dominance phenomenon existing in the community);
✓ R∈ [0.7; 0.8] [then Pielou equitability is medium.
✓ R∈ [0.8; 01] then Pielou equitability is assumed to be high

- *The Density*

The density which is determined by expression

$$\boldsymbol{N} = \frac{n}{s} \qquad (3)$$

Where N is the medium number of individuals by hectare; n the number of trees in the plot and **s** the area in hectares.

- *The Ground Surfaces*

The ground surface determined by expression:

$$\mathbf{G}(\mathbf{m}^2/\mathbf{ha}) = \frac{л}{40000S} \sum_{i=1}^{n} \text{di}^2 \qquad (4)$$

Where di is the diameter (in cm) of tree in the plot and s is the area of the plot (in ha)

➢ *Diameter and Height Structure of Woody Stands*

Minitatab 14 software was used to establish the diameter and height structures. These structures were then compared to the theoretical three-parameter Weibull distribution (a,b,c) [9]. This distribution, which is based on the probability density function, is defined as follows:

$$\mathbf{f}(\mathbf{x}) = \frac{c}{b} + \frac{(x-a)^{C-1}}{b}\, e^{x}\left[-\left(\frac{x-a}{b}\right)^{c}\right] \qquad (5)$$

Where x is the diameter of the trees and f(x) its value; a is the position parameter; b is the scale or size parameter and c is the shape parameter related to the diameter or height structure considered. In this study the position parameter is equal to five (5). The main Weibull distribution shapes according to the values of the parameter C are detailed below:

- C < 1: Inverted J distribution, characteristic of multispecies or unequal stands;
- C = 1: Exponentially decreasing distribution, characteristic of extinct populations;
- 1<C<3.6: Positive asymmetric or straight asymmetric distribution, characteristic of monospecific stands with a predominance of young or small diameter individuals;
- C = 3.6: Symmetrical distribution; normal structure, characteristic of even-aged or monospecific stands of the same cohort;
- C > 3: Negative or left-symmetric distribution, characteristic of monospecific stands with a predominance of old individuals.

In order to check the fit of the observed distribution to the Weibull distribution, the Kolmogorov Smirov test was used . A probability P≥ 0.05 at the 5% level indicates a fit of the structure

IV. RESULTS

➢ *Composition Floristique of the Forest*

The inventory of woody stands in the forest identified seventeen (17) woody species, belonging to two (12) families, the most important of which are the Fabaceae-Mimosoideae family (29.41%), followed by the Fabaceae-Ceasalpinoideae and Asclepiadacea families, each with 11.7%. The other families, which are no less important, each represent 5.88% (Table 1).

Table 1 Floristic List of Woody Species Inventoried in the Forest

Species	Families	TB	TP
Acacia nilotica (L.) Willd. ex Del. subsp. Nilotica	Fabaceae-Mimosoideae	McPh	SZ
Acacia radiana savi	Fabaceae-Mimosoideae	McPh	S
Senegalia senegal (L.) Willd.	Fabaceae-Mimosoideae	McPh	Pal
Azadirachta indica A. Juss.	Meliaceae	McPh	i
Balanites aegyptiaca (L.) Del.	Balanitaceae	McPh	SZ
Bauhinia rufescens Lam.	Fabaceae-Ceasalpinoideae	McPh	SZ
Calotropis procera (Ait.) R. Br.	Asclepediaceae	McPh	Pal
Comiphora africana (A.Rich.) Engl.	Burseraceae	McPh	SZ
Faidherbia albida Guill. Et Perr.	Fabaceae-Mimosoideae	McPh	PA
Guiera senegalensis J.F. Gmel.	Combretaceae	NnPh	SZ
Hyphaene thebaica (L.) Mart.	Arecaceae	McPh	SZ
Leptadenia hastata (Pers.) Decne	Asclepediaceae	McPh	SZ
Maerua crassifolia Forsk.	Caparidaceae	McPh	SZ
Piliostigma reticulatum (DC.) Hochst.	Fabaceae-Ceasalpinoideae	McPh	SZ
Prosopis juliflora (Sw.) DC.	Fabaceae-Mimosoideae	McPh	i
Sclerocarya birrea (A. Rich.) Hochst.	Anacardiaceae	MsPh	S
Ziziphus mauritiana Willd	Rhamnaceae	McPh	Pal
Total = 17			

➢ *Abundance, Densities and Diversity of the Woody Populations of the Classified Forest*

The results in Table 2 illustrate the density of woody species inventoried. From these results, it appears that the most abundant spontaneous woody species in the forest are : Balanites aegyptiaca, Faidherbia albida, Piliostigma reticulatum and Hyphaene thebaica. Introduced species include Prosopis juliflora and Acacia senegal. The diversity of the woody stands was characterised through the determination of the Schannon diversity index (H' = 3.55) and the Piélou equitability (R = 0.87). The value of the Shannon index indicates that the diversity of the stand is average, while the Piélou equitability is high. The mean diameter and mean height of the woody plants are 15.75±14.13 cm and 3.14±3.59 m respectively (Table 3).

Table 2 Species Numbers and Densities

Species	Workforce	densities (ha)
Acacia nilotica (L.) Willd. ex Del. subsp. Nilotica	11	5,37
Acacia radiana savi	3	1,46
Senegalia senegal (L.) Willd.	16	7,8
Azadirachta indica A.Juss	2	0,98
Balanites aegyptiaca (L.) Del.	28	13,66
Bauhinia rufescens Lam.	14	6,83
Calotropis procera (Ait.) R. Br.	6	2,93
Comiphora africana (A.Rich.) Engl.	5	2,44
Faidherbia albida Guill. Et Perr.	25	12,2
Guiera senegalensis J.F. Gmel.	1	0,49
Hyphaene thebaica (L.) Mart.	19	9,27
Leptadenia hastata (Pers.) Decne	6	2,93
Maerua crassifolia Forsk.	5	2,44
Piliostigma reticulatum (DC.) Hochst.	22	10,73
Prosopis juliflora (Sw.) DC.	3	1,46
Sclerocarya birrea (A. Rich.) Hochst.	4	1,95
Ziziphus mauritiana Willd	1	0,49
Total = 17	171	83,41

Table 3 Structural Parameters and Species Diversity Indices

Biological indicators	Values
Species richness (S)	17 species
Schannon Index (H')	3,54 bits
Piélou equitability R	0,87bits
Basal area (G)	4,55m^2/ha
Average diameters (cm	15,75±14,13
verage heights (m)	3,14±3,59

➢ *Biological and Phytogeographical Types of Woody Stands*

- *Bilogical Types*

The biological types of woody stands in the forest are still dominated by microphanerophyte species (McPh = 88.24%), followed by nanophanerophyte and mesophanerophyte species (NnPh = 5.88% and MsPh = 5.88% respectively) (Fig 5).

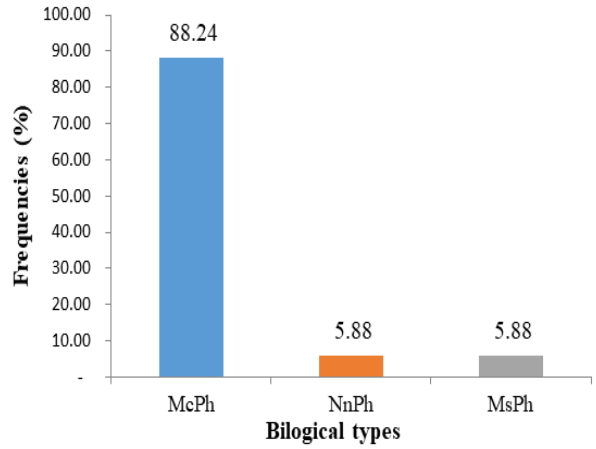

Fig 5 Proportions of Biological Types of Woody Species

➢ *Phytogeographic Types*

The phytogeographic types are dominated by sudanozambezian species (SZ = 52.94%), followed by palaeotropical species (Pal = 17.5%) and sudanian and introduced species (S = 11.7% and i = 11.76%). The least represented species are the multi-regional ones (PA = 5.88%) (Fig 6).

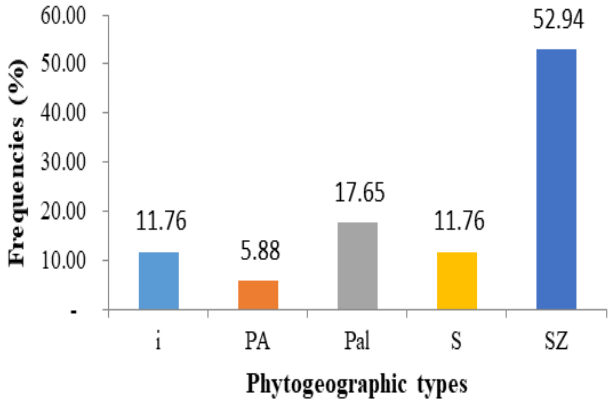

Fig 6 Proportions of Phytogeographic Types of Woody Species

➢ *Structures of Woody Stands in the Classified Forest*

- *Diameter Structure*

The diameter structure of the forest's woody stands is represented by the results in Figure 7. The trend that emerges from the analysis of the curve results indicates that the woody stands of the forest are still dominated by small-diameter individuals, belonging to the diameter class [2-10 cm[. Large-diameter individuals are almost absent in the forest. The diameter class distribution of the woody species shows an inverted 'J' distribution. The observed class distribution fits the theoretical weibull distribution with the shape parameter C = 1.0385, ranging from 1 to 3.6 (1<C< 3.6). This indicates that the stand distribution is of the positive asymmetric or right asymmetric type. It is characteristic of monospecific stands with a predominance of young or small diameter individuals. This type of structure results from the consequence of repeated cutting of plant species for charcoal production. This activity occurs through the selection of large-diameter individuals in the different ecosystems, leaving the small-diameter individuals behind. It can also be due to the recovery of young shoots through the practice of assisted natural regeneration (ANR), practiced in the fields by farmers.

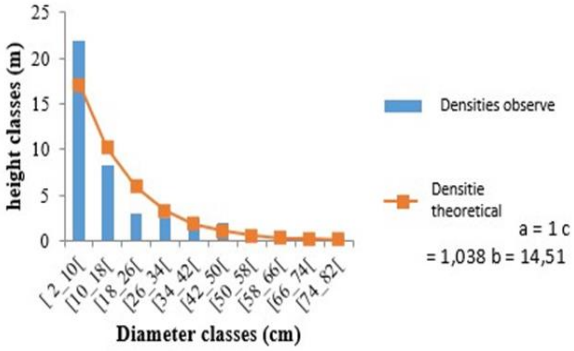

Fig 7 Diameter Structure of Woody Species

➢ *Height Structure of Woody Stands in the Forest*

The height structure of the woody species is shown in figure 8. The height class distribution of the woody species shows an inverted "J" distribution. The observed class distribution fits the theoretical weibull distribution with the shape parameter C with a value between 1 and 3.6 (1<C<33.6). This indicates that the distribution of the stand is of the positive asymmetric or right asymmetric type. It is characteristic of monospecific stands with a predominance of young or low height individuals. The majority of the woody plants are between the height class [1_5m]. The woody stand of the forest is mostly composed of shrubs, with very few trees of 7m height or more. The reasons for this current trend in the forest are due to anthropic pressures on natural resources, in particular, the abusive cutting of plant species for agriculture, the successive pruning of fodder species for animals, etc. It is also important to note the natural deaths of species due to the aridity of the climate, repeated droughts, high temperatures, etc.

ISSN No:-2456-2165

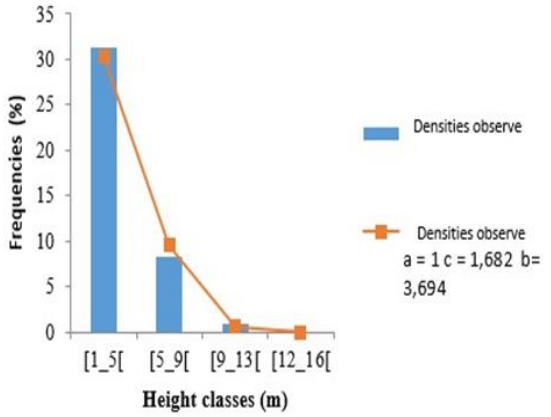

Fig 8 Height Structure of Woody Species

➢ *Assessment of the State of the Classified Forest by the Population and the Causes*

The results in Figure 9 below show that 74% of Bangui's classified forest is in a degradable situation. Several factors contribute to this degradation (Fig 10). The analysis of this figure shows that the most cited degradation factors are abusive logging, climate change and cultivation, in proportions equal to 28%, 25% and 19% respectively.

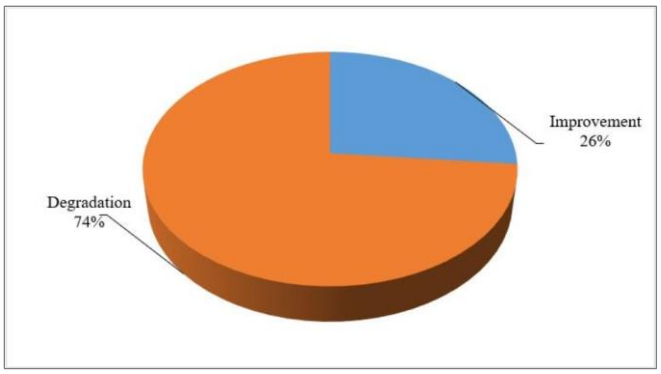

Fig 9 State of the Forest Classified by Bangui

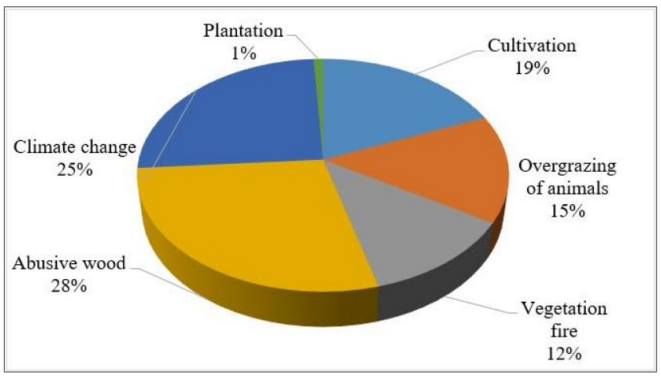

Fig 10 Degradation Factors of the Classified Forest

➢ *Woody Species Of Socio-Economic Importance*

Field observations allowed the list of extinct species obtained through the ethnobotanical surveys to be verified. The result in Table 4 shows that a total of twenty-four (24) woody species of socio-economic importance have completely disappeared in the Bangui classified forest, leaving other woody species without economic value.

Table 4 Extinct Woody Species in the Classified Forest

Species	Status
Adansonia digitata L.	Missing
Albizia chevalieri Harms.	Missing
Bombax costatum Pellegr. & Vuillet	Missing
Boswellia dalzielii Hutch. = B. odorata Hutch.	Missing
Cadaba farinosa Auct.	Missing
Ceiba pentandra (L.) Gaertn.	Missing
Cocculus pendulus (J.R. et G.Forsk.) Diels.	Missing
Commiphora africana (A.Rich.) Engl.	Missing
Danielia oliveri (Rolf.) Hutch. et Dalz.	Missing
Detarium microcarpum Guill. et Perr.	Missing
Dichrostachys cinerea (L.) Wight et Arn.	Missing
Diospyros mespiliformis Hochst. ex. A. DC.	Missing
Ficus platyphylla Del.	Missing
Grewia bicolor Juss	Missing
Grewia tenax (Forsk.) Firiori.	Missing
Hyphaene thebaica (L.) Mart.	Missing
Khaya senegalensis (L)	Missing
Lannea microcarpa Engl. et K. Krauze	Missing
Parkia biglobosa (Jacq.) Benth.	Missing
Prosopis africana (Guil, Et Per.) Taub	Missing
Pterocarpus erinaceus Poir.	Missing
Sterculia setigera (Del)	Missing
Tamarindus indica (L)	Missing
Vitex doniana Sweet.	Missing
Ziziphus spina-cristi(L) Desf	Missing
Total = 25	25

V. DISCUSION

Semi-arid environments are characterised by the precariousness of their environmental conditions, which weaken the ecosystems. The tree stratum is subject to increasing pressure linked to the demand for firewood and construction wood and the expansion of cultivated areas. The herbaceous layer is subject to overgrazing and burning. [11],[12]. Species richness is a biological indicator that explains the state of plant communities in an ecosystem. The floristic composition of the Bangui classified forest in this study counts seventeen (17) species, which is lower than the results obtained by [12] in the classified forest of Dan Kada Dodo - Dan Gado where he recorded 31 woody species, divided into 23 genera and 15 families. This same result is well below the 106 species recorded by [13] in the classified forest of Baban Raffi in the south of the Maradi region. This situation reflects the multiple anthropic pressures to which the forest's resources are subjected, in particular the abusive cutting of wood and the advance of the agricultural front. In the absence of income-generating activities, the populations have no other source of income than the exploitation of forest resources. In other words, despite climate change, this flora is subject to repeated droughts that cause the natural death of species.

The dominance of the Fabacea-Mimosoideae families in this floristic composition generally reflects the arid climate of the area. *Acacia nilotica* is the most visible in the ecosystem. These families generally adapt to hostile environments characterised by a dry and arid climate.

During their evolution, they have developed physiological behaviours such as the loss of leaves during periods of high temperature, allowing them to avoid water loss through transpiration.

Biological vegetation in the forest is still dominated by micro-phanerophyte species. This situation characterises the ecosystems of shrubby formations [13]. Dendrometric parameters such as the average diameter and height of the species, which are very low, confirm this assertion. Similar results were obtained in Tamarindus indica parks in the southwest of the country by [14]. Anthropogenic factors are the predominant factors in the conversion from stable to unstable environments in these ecosystems.

The phytogeographic types are dominated by sudanozambezian (SZ) species followed by paleotropical (Pal) species. These species are biological indicators that provide information on the stability of the ecosystem [15]. The low density of these species notes the effect of increasing anthropisation in the environment. Thus, land grabbing through the system of contracting crops into the forest has become commonplace. The diameter structure of the woody stands is marked by the dominance of small-diameter individuals and the absence of large-diameter individuals. This situation is the result of the effect of abusive logging for the supply of large cities. This activity is most often carried out by selecting large-diameter trees. These results are also similar to those of authors such as [6],[16],[17]. Low species diversity is the result of the consequences of these anthropogenic activities, which continue to shape the physiognomy of the vegetation. These factors, coupled with the aridity of the climate, prevent the regeneration of the species by seed in the natural environment, the consequences of which usually led to the depletion of the gene pool. The significant demographic growth in the commune has resulted in the occupation of forest units in the area to meet the ever-increasing needs of the population. As reported by [18] The imbalance of the ecosystem results from this phenomenon and the factors of degradation of the classified forest, of which the most cited by the populations are the abusive cutting of firewood, confirm this situation. The cumulative effect of these events has led to the complete disappearance of twenty-five (25) plant species of socio-economic importance in the Bangui classified forest. However, the exploitation of the ecosystem services of these plants provides substantial income to the various communities that exploit the forest. The non-timber forest products of these species constitute food relays that increase the resilience of populations to climate change. As noted by [19], [20],[21] in addition their interest in the socio economic life of the populations, these forest species participate in the ecological, such as the maintenance of the fertility of soil, the struggle against the wind and water effects of erosion, favour the infiltration of runoff and the development of biological diversity.

VI. CONCLUSION

The characterisation of the woody vegetation made it possible to situate the current state of the Bangui classified forest through its floristic composition, species diversity, dendrometric parameters and the establishment of the structure in diameter and height. These biological indicators showed the state of degradation of this forest formation, the main factors of which are the abusive cutting of trees for agriculture and the effects of climate change (repeated droughts, high temperatures, etc.). The consequences have led to the disappearance of several plant species of economic value to the population, leaving some species such as thorny plants. Studies on the dynamics of land use must be carried out in order to draw up a management plan for this classified forest, for sustainable management and for the good of the people.

➢ *Acknowledgements*

At the end of this study, we would like to thank all the people of the villages surrounding the forest, in particular their chiefs, who allowed us to have access to the forest. The hospitality they showed us and their sense of welcome will forever be remembered.

REFERENCES

[1]. F. Akinnifesi *and al.*, “Towards the development of miombo fruit trees commercial ace tree crops in southern Africa,” For. *Trees Livelihoods*, flight. 16, N. 1, pp. 103-121, 2006.

[2]. W. Atakpama, K. Batawila, In. Gnamkoulaba, and K. Akpagana, “Quantitative approach of Sterculia setigera Del. (Sterculiaceae) ethnobotanical employ rural communities in Togo (West Africa), ”*Ethnobot. Res. Appl.*, flight. 14, pp. 063-080, 2015.

[3]. S. Bourou, “eco-physiological Study of the tamarind (Tamarindus indica L.) in arid tropical environment, ” 2012.

[4]. A. Garba, In. Amani, In. Laouali, and A. Mahamane, “socioéconomiques Perception and manners of the tamarind (Tamarindus indica L.) in the Southwest of Niger: Involvements for a domestication and a lasting conservation, ”*J. Anim. Young plant Investment company.*, flight. 40, N. 2, pp. 6584-6602, 2019.

[5]. I.N. S, “Study National of Valuation of Indicators Socioeconomic and Demographic. Pp133 Retrieved one 2019-09-16 from http://www.stat-niger.org/statistique/file/ENISED/Rapport_ENISED_ .pdf,.” on 2016.

[6]. H. Abdourhamane, B. Morou, H. Rabiou, and A. Amhamane, “floristiques Characteristics, diversity and structure of woody vegetation in the South Centre of Niger: case of the complex of forests classified by Dan kada Dodo-Dan Gado, ”*Int. J. Biol. Chem. Investment company.*, flight. 7, N. 3, pp. On 1048-1068, on 2013.

[7]. "I.N.S., Chip on the Evolution of the Main Indicators Sociodémographiques and Macroeconomic Aggregates of Niger, Pp6. Retrieved 2019-09-16 from one http://www.stat-niger.org/statistique/file /DSEDS/FSPI_Niger_Decembre_2018.pdf, 2018.
[8]. G. Paradise, "Akoègninou A., van der Burg WJ, VAN DER MAESEN LJG (chief editors), a 2006 – analytical flora of the Benin. Backhuys Publishers. XXII, "*J. Club foot.* flight. 45, N. 1, pp. 81-82, 2009.
[9]. Mr Arbonnier, "Trees and bushes of Sahel, "*Leurs Caractér. Leurs Util. Trees Shrubs Sahel Their Charact. Their Uses Verl. Josef Margraf Paris*, 1990.
[10]. "Ramade F. - From ecology Eléments : fundamental ecology. 2nd edition. Ediscience international.579 579 p, 1994.
[11]. Y.-C. H. Hountondji, "environmental Dynamics in Sahelian and Sudanese zones of Western Africa: Analysis of modifications and valuation of the deterioration of plant place setting, "*Belg. Univ. Liege*, 2008.
[12]. Abdourhamane. Y., "floristique study, ecological, phytogéographique and ethnobotanique of forests classified by Dan Kaada Dodo-Dan Gado in Niger." 209p 2014.
[13]. I. D. Guimbo, K. Ambouta, In. Mahamane, and Mr Larwanou, "Germination and initial growth of Neocarya macrophylla (Sabine) Prance, an oleaginous kind of Niger, "*Tropicultura*, flight. 29, N. 2, pp. 88-93, 2011.
[14]. A. Mahamane, S. Mahamane, B. Yacoubou, In. Issaka, In. Ichaou, and K. Saley, "diachronic Analysis of the occupation of lands and characteristics of vegetation in the village of Gabi (region of Maradi, Niger), "*Investment company. Chang. PlanétairesSécheresse*, flight. 18, N. 4, pp. 296-304, 2007.
[15]. A. B. Sinsin, "Phytosociologie, ecology, pastoral value, production and capacity of load of the natural pasture of perimetre Nikki-Kalalé in the North-Benin, " 1993.
[16]. A. Garba, In. Amani, S. Douma, In. K.S. Sina, and A. Mahamane, "Structure of the populations of Tamarindus indica L. in the zone Southwest of Niger, "*Int. J. Biol. Chem. Investment company.*, flight. 14, N. 1, pp. 126-142, 2020.
[17]. I. D. Guimbo, In. Mahamane, and K.J. Mr Ambouta, "Population of parks in Neocarya macrophylla (Sabine) Prance and in Vitellaria paradoxa (Gaertn. CF) in the southwest of Niger: diversity, structure and regeneration, "*Int. J. Biol. Chem. Investment company.*, flight. 4, N. 5, on 2010.
[18]. Sounon B. B., Sinsin B., and Goura S. B., "Effects of the dynamics of occupation of the soil on structure and diversity floristique savannahs of clear forests and in the Benin. In Tropicultura, "*Surplus.*, flight. 25 (4), N. 221-227, on 2007.
[19]. L. Akpo, "Effect of the tree on herbaceous vegetation in some phytocénoses in the Senegal. Variation according to a climatic gradient, " 1998.
[20]. E. Delabre, "Characterisation and evolution of anthropisés Sahelian ecosystems: circles post - culturaux southwest of Niger, "1998.
[21]. S. Douma, "Study ethnobotanique and ecological of food woody plants of soldering of systems southwest agroforestiers of Niger: diversity, importance, structure and threat level, "2016.