

# Composition and Abundance of Woody Species in Falgore Game Reserve, Kano State, Nigeria

Maishanu, H.M.<sup>1</sup> Bello, U. B<sup>1</sup>. \*Mainasara M. M<sup>1</sup>

<sup>1</sup>Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto

## Abstract

The study was conducted at Falgore Game Reserve in Kano state, Nigeria with the objective of making inventory woody species diversity, and to determine the vegetation structure of woody plants in terms of richness. The survey was carried out between the months of March to November, 2016. Total of 12km<sup>2</sup> was used for the Site Selection and six plots were utilized from the three sites selected for the study. Growth parameters (Species Height, Stem diameter and Canopy Crown), Soil pH and Soil bulk density were studied. 49 different plant species belonging to (20) families, while the total of (549) Woody Species Vegetation where enumerated. The data collected were analyzed using Shannon – Weiner's diversity index, and species richness was calculated using Menhinik's index. Results from the diversity, richness and plant growth parameters (Plant height), Site 1A had more species diversity and species richness compare to the others. Site 3B had the highest density moisture of 1.89g/cm<sup>2</sup> and site 3A is more acidic (soil pH of 5.96).

**Keywords** - Woody species, Abundance, Falgore, Composition

## I. INTRODUCTION

The world and Africa in particular are facing serious challenges in the area of environmental degradation [1]. The most important and prominent challenge in Africa today is desertification and climate change. The rate at which forest is being depleted today due to population growth, indiscriminate logging, construction purposes and farming is alarming [2]. Nigerian rain forest zones and savannah areas have potentials of providing for human needs in terms of economy, leisure, food and drugs among others [3]. Nigeria as a geographic entity has been blessed with rich and unique array of ecosystem and great variety. North to South gradation of ecological formation which in turn has a direct bearing on the diversity of flora and fauna in Nigeria. Supporting more than 1340 species of animals, about 4600 species of plants [4]. Presently, Nigeria has 7 national parks, 994 forest reserves and 32 game reserves. These include state owned and those managed by communities [1]. Vegetation refers to the total mass

of plants life that occupies space of a given area [5]. In general terms, the distribution of forest vegetation and other vegetation types follow closely the pattern of rainfall with adjustments in biotic factors and drainage conditions of the area [6]. The organization in space for mass of vegetation confers a particular appearance or physiognomy [5].

According to Agbogidi and Ofuoku environment is the closest neighbor of man [7]. Among the major biotic components of the environment are forest and other vegetation and the wise management of the environment depends on a better understanding of its components. It is generally accepted that conservation of Biodiversity at the level of ecosystem, landscapes, species, individuals and genes is essential to sustain the health and vitality of forest ecosystem thereby safeguarding their production and protective functions [8]. Vegetation cover is recognized as element of biodiversity, which needs to be identified and monitored. Vegetation analysis using internationally standardized method has been recognized as an essential tool for identification, monitoring and conservation of ecosystem [9]. In recent times, overgrazing and changes in land use pattern are taking heavy toll on wild species diversity, especially in Nigeria. Urbanization and changing lifestyles, globalization and market economics are also contributing indirectly to the loss of biodiversity which has serious implications for food security in long term [10]. Forest reserves are areas of forest designated by the government for the protection of trees grown or planted for the purpose of their ecological benefit [11]. Forest reserves are areas of land that are protected and managed in order to preserve a particular type of habitat and its flora and fauna which are often considered rare or endangered [12]. Forests are plants communities consisting predominantly of trees and other woody vegetation occupying an extensive area of land. In its natural state, forest remains in a relatively fixed self-regulated condition over a long period of time [13].

Game reserve is a large area of land where wild animals live safely, or are hunted in a controlled way for sport. These include valley bushveld, savanna grassland, fynbos to riverine forest and acacia

woodland (Hoven 2015). Woody plants are such vital components of the ecosystem that have productive, protective and recreational purpose. They control soil erosion, stabilize regional and global climate and provide carbon sinks [4]. Trees and shrubs contribute to food security directly in form of fruits or seeds and indirectly through restoring soil fertility and water resource which subsequently increase agricultural production [15]. Plants have continued to serve the needs of man and eternally continue to do so. According to Akinsoji, the wild animals and other inhabitants living in the environment are able to survive by using the vegetation components to serve their needs [16]. Several studies conducted in protected area have focused on ecotourism or nature tourism as a form of sustainable tourism [17].

Protection of local ethnicity can be achieved without impacting on life of local people by linking social life and environmental protection [18]. Proper management of natural resources provides nation project and good image for strength of the country's economy, forest or any sizable community of trees. Wood Vegetation play an indispensable role in creating and preserving a quality environment [19]. The study of wild plants used for food, medicine, and other purposes is the oldest and widest domain within Botany. There is evidence that increasing number of people across various parts of the world depend on traditional herbal remedies for their health care [20]. Economically speaking, plants can be classified as food, medicinal, fiber, wood, ornamental or industrial plants. Fruits may be edible or non-edible by humans and some are medicinal [21]. Variety of plants species has significant uses such as food, fuel wood, timber, conservation of land and soil fertility, medicine and so on [22]. Recently, research has focused sprouting is an adaptation to fire that is a common attribute of hardwoods and shrubs. Grasses are usually well adapted to fire, mostly by having their survival buds at or below the soil surface [23].

This work was aimed at studying the composition and abundance woody species in the Falgore Game Reserve, to make an inventory of woody species of the vegetation, to determine the species composition and richness in the reserve. and determine the difference in species vegetation.

## **II. MATERIALS AND METHODS**

### **III. Study Area**

The study was conducted at Falgore Game Reserve between March, 2016 to November, 2016 in Kano. The

reserve occupied parts of the boundaries of Tudan Wada, Doguwa, and Sumaila local government in the north, South and North East respectively, covering an area of about 920 km<sup>2</sup> of Kano state [9]. It shares boundaries with Lame – Burra forest reserve, Ningi local government area, Bauchi state on south east; Also It borders Saminaka local government area, Kaduna state in the extreme South East. The Reserve is located in the Northern Guinea Savanna zone of Nigeria and covers a total area of about 920 km<sup>2</sup>. It lies between latitudes 10° 50' N – 11°20' N and longitude 8° 45' E – 9°32' E. It is situated about 140km south of Kano city at altitude of 508 m (1669 feet) above sea level [23].

## **IV. RECONNAISSANCE SURVEY**

Reconnaissance survey involved moving several times round the reserve on access roads as well as tracks within the reserve. The vegetation composition, structure, general geography of the reserve and nature of the soil were observed and noted. Frequent halts were made during the drive for closer observation, especially where changes in new species were observed [24].

## **V. SAMPLING PROCEDURE**

### **Site Selection**

The map of the area was obtained to show the dimension and size of the area, Figure 1. The map was used to identify "hot-spots" within the reserve. The area was divided into six (6) plots areas, with each plot measuring 2km<sup>2</sup>. Total of 12km<sup>2</sup> was used for the study area. The plots were selected using a stratified based on purposely sampling method more especially the area that unites them together to serve as representative of the larger study area of Tudan Wada, Sumaila and Doguwa Local Government Area of Kano that covers the reserves study area [25].

Site one, comprise of 2 Plots, measuring 4km<sup>2</sup>. To the North Central of the reserve is Tudun Wada Local Government Area where Marmara community is located closer to the river Marmara that cut across area reserve which is characterized by flood plains. The vegetation for these area where mostly compacted, with dense and thick canopy cover. The texture of the soil is reddish brown, sandy loam soil.

Site two, comprise of 2 plots, measuring 4km<sup>2</sup>. To the North East of the reserve is the Sumaila Local Government Area where the Sitti community is located. The area slightly sloped and hill at some areas of the Reserve. This area is dry and hard soil forming small sedimentation. The vegetation is scattered in the area. The soil is reddish brown and sandy loam.

Site three, comprise of 2 plots, measuring 4km<sup>2</sup>. To the North West of the reserve is Doguwa Local Government Area in where Yaryasa community is located. It has a moderate weather condition neither too wet nor too dry.

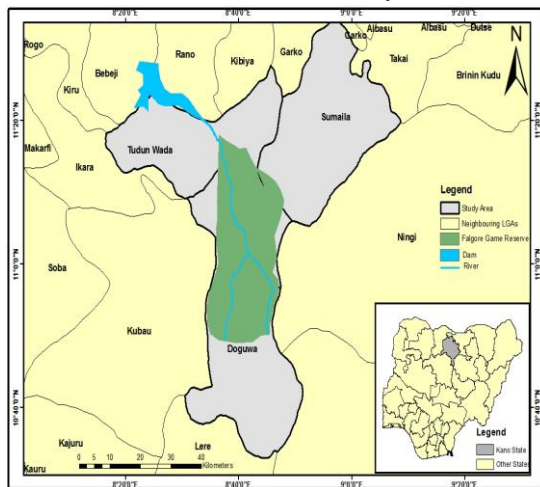


Figure 1: Map of Study Area Showing Falgore Game Reserve

## VI. Measurement of Plant Growth Parameter

### Species Height

In forestry, tree height is defined as the vertical distance from the ground level to the highest point on the tree which is the tip [26]. The angle from the tip to the base of the tree was measured using hand-held clinometers. The clinometers were observed at closer range at initial point, so that the tip of the tree is kept visible. Moving away from the tree and keeping the top of the tree in sight. Readings from the clinometers was observed at intervals. The point at which the weight string lines up at 45°, the movement was stopped. The distance covered from the tree was measured at 45°. A tape was used to measure the distance from the observer to the centre of the base tree [26,27].

Calculating tree height using trigonometric method:

If angle at eye level = 45°

Then, base of the tree = B

Distance from tree to x = H + h

Therefore, angle from the horizontal tip of the tree = (H+h), B+h [26,27].

### Stem Diameter

The stem diameter was measured at its girth, at breast height of an adult that is 4.5 feet using a simple tape measure, known as a diameter tape. They were calibrated in units with mathematical constant  $p_i = (3.14)$ . A diameter tape was correctly wrapped firmly around the stem to its axis. Any loose bark was brushed

gently off the stem before making the measurement [27,28]. The results were then multiplied by the constant  $p_i$ .

### Canopy Crown Measurement

The Canopy area was determined by using the crown diameter measuring method (CDMM). A tape was laid down from one end of the crown shadow to the other end of the crown parameter, diameter of the crown ( $D_1$ ). Another crown diameter was measured perpendicular to the axis of the first measurement ( $D_2$ ). Canopy area was calculated using the formula [29].

Where:  $D_1$  = Diameter 1,

$D_2$  = Diameter 2

$$= \frac{D_1 + D_2}{2} \times \pi r^2 = 3.14 \text{ (Constant), [30].}$$

### Soil Bulk Density

The soil density was collected for determination using a Core sampler, a Helper and Hammer. The soil surface was cleared and then the metal core sampler was knocked into the ground with the help of a hammer, to obtain the wet soil from each sub-plot. The moist sample was placed in a bag and sealed for laboratory analysis [25]. The soil was not allowed to dry out or loses moisture. In total, six soil samples were taken two samples per site. The soil samples were weighed fresh and recorded. After oven dried at 105°C for two hours, the soil samples were weighed and then recorded finally [31].

$$\text{Bulk density} = \frac{\text{Mass of oven dry weight}}{\text{Total volume of the soil}}$$

$$\text{soil (g)} = \frac{\text{Mass of fresh soil} - \text{Mass of oven dry soil}}{\text{Volume}}$$

$$\text{Percentage moisture (\%)} = \frac{\text{Mass of oven dried soil (g)} = W_2 - W_1}{W_1} \times 100 \text{ [25].}$$

### Soil pH

Soil pH was determined using electrode pH meter (Hanna digital portable pH meter model no. H199121). Beakers of 100 ml were used in mixing soil and water in 1:1 soil – water mixture. The mixture was stirred well with a glass rod. The pH meter was placed into the soil water mixture. The second beaker containing distilled water. The pH value was displayed automatically and results readings were recorded [32].

### Data Collection

Forest inventory was conducted as a procedure for obtaining information on the quantity and quality of woodland resources and other characteristics of which trees and shrubs are growing [33,34]. Systematic sampling design was adapted in this study. This sampling design ensured an even spread of samples throughout areas and thus increase the chances of including other vegetation types in the woodland [35]. The data was collected within the selected area.

### Data Analysis

The species diversity data was computed using Shannon's diversity index. Shannon's diversity index is a mathematical measure of species diversity in a given community [36].

$$\text{Shannon and Weiner's Index (H)} = - \sum P_i \ln P_i$$

Where;

$P_i$  = proportion of each species

$\ln$  = natural log

$\sum$  = sum of calculations

While, the species richness is the number of species found in a sample, since the larger the sample, the more the species would be expected to find, the number of species was divided by the square root of the number of individual in a sample. Using the Menhinick's index known as D, the richness was computed.

$$D = \frac{\sqrt{N}}{s}$$

Where  $s$  = number of different species represented in a sample

$N$  = the total number of individual in a sample (Heyer,2014).

From the results obtained, the mean value was calculated.

## VII. DISCUSSIONS

Due to the diversity of habitats in Nigeria and the tropical climate, there is a great diversity of plant species found in the country. From the results observed site1A and B had the highest number plant species of one hundred and forty-nine (149) and one hundred and twenty-four (124). This may be due to less number of human activities taking place in the area and the closeness to river cutting across the study area. According to a study by USAID, more than 848 studies on algae carried out in the marine and fresh water habitats [37]. In addition, more than 5103 higher plant species have so far been identified, and less than 200 lower plant species have also been identified, although

the number of these plants is definitely higher. This result is similar to the research conducted by Assoka and Abubakar in Falgore Game Reserve, who also reported that, the Savanna is characterized by woody vegetation that forms a fairly scanty canopy [38]. The trees are usually short and ranges from 12 to 30m or above in height, common species include *Daniellia oliveri*, *Lophiralance olata*, *Terminalia glaucescens*, *Hymenocardia acida*, *Detarium microcarpum*, *Azelia africana*.

From the results observed in 2A and 2B there were total of ninety-five (95) and one hundred and four (104) plant species stands. This result was recorded as the least with plant species present in the study area. Danladi, stated that the high demand for energy and other human needs made people go beyond the limit of reasonable exploitation of forest resources [37]. This consequently exposes the environment to agent of denudation like strong winds and running water which further degrade the environment and increase the chances of desertification. [38], carried out a study on Gele Gele forest reserve, Edo state and the result shows that there is a steady growth of population of the communities around the reserve which leads to the rapid decline and depletion of the rich biodiversity and biological resources in the reserve due to overdependence on the forest resources. Similarly, in another different study by Forest Research Institute of Nigeria out of 85 endangered tree species, many are endemic, found only in the region of North [37]. From the results observed in 3A and 3B there were total of one hundred and eighteen (118) and one hundred twenty-nine (129) species respectively. This result shows a higher number of plant species were observed in the study area, undisturbed nature of the vegetation. The plant species were allowed to grow due to the presence of forest guard patrolling this part of the reserved area. This is similar to the work of Akinsoja, who 'carried out a vegetation analysis of Ngel Nyaki Forest Reserve on the Mambilla Plateau Nigeria [16]. The result indicated that the vegetation of Ngel Nyaki reserve is stable and self-sustaining. However, Falgore Game Reserve is located in the Sudan savanna zone of Nigeria. This area has the highest number of communities around the study area, as farming activities is taking place. The result changes may be as a result of the topography of the area, hills and slopes or as result of little moisture present in the soil or different ranges in the soil pH or presence of human activities within and around the study area.



## VIII. CONCLUSION

In conclusion, the Falgore Game Reserve is blessed with different vegetation composition that supports the life of people. The inventory of woody species vegetation provides the most basic needs such as fruits, fuel wood, herbs, fodder and timber. Therefore, the need to protect and manage the forest and its resources cannot be overemphasized. The Future of this reserve lies on emphasis of the Government and local communities around the game reserve should be actively involved in the effort towards reforestation, utilization and conservation effort of natural resources. The woody plant species was stable in Falgore Game Reserve. The rate at which human activities is going on at Falgore Game Reserve was seriously monitored. Human activities affect the dynamics of ecosystem especially natural vegetation cover and earth system, over exploitation of woody vegetation which is a major kingpin in any forest existence. These may have long time impact on sustainable food production, fresh water and forest resources, climate and human welfare.

## REFERENCES

- [1] Nigerian Conservation Foundation, NCF (2011). Stakeholders Decried loss of Biodiversity. <http://www.ncfnigeria.org/index.php>. Retrieved on 13th march, 2016.
- [2] A., Ayanlade, & N. Drake. Forest loss in different ecological zones of the Niger Delta, Nigeria: evidence from remote sensing. *GeoJournal*, 81(5), 2016, 717-735.
- [3] B.N. Ejidike. Biodiversity in Nigeria: Non-Consumptive Values Perspective. *Journal on Food, Agriculture and Environment, Finland*. 8(3&4): 2010, 1394–1396.
- [4] S., Soliveres, F., Van Der Plas, P., Manning., D., Prati, M. M., Gossner, & K., Renner. Biodiversity at multiple trophic levels is needed for ecosystem multi functionality. *Nature*, 536(7617), 2016, 456.
- [5] S. R. Eyre, *Vegetation and soils: a world picture*. Routledge. 2017
- [6] WCMC (World Conservation Monitoring Centre). *Global Biodiversity: State of the Earth's Living Resources*. Chapman and Hall, London. 1992 Pp. 280 – 285.
- [7] O.M. Agbogidi, and A.U. Ofuoku, Promoting Environmental Protection in Nigeria, Through Environmental Education: The Role of Women. *J. Environ. Extension*. 6: 2007, 28-33.
- [8] P. A., Sandifer, A. E., Sutton-Grier, & B. P. Ward. Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: Opportunities to enhance health and biodiversity conservation. *Ecosystem services*, 2015, 12, 1-15.
- [9] I.L. Suleiman. Forest and Forest Reserve as Security Threats in Northern Nigeria. *European Science Journal* December, 2014 Edition. Vol. 10, No. 35. IBSN; 2014, 1857-7881.
- [10] B A., Usman, and, L. L Adefalu. "An Appraisal of Nigeria National Policy of Forestry Wildlife and Protected Area" *Environment issue* 3(1) 2010, 50-63.
- [11] G. S., Cumming, C.R., Allen, N.C. Ban, D., Biggs, H. C., Biggs, D. H., Cumming, & R. Mathevet. Understanding protected area resilience: a multi- scale, social- ecological approach. *Ecological Applications*, 25(2), 2015, 299-319.
- [12] B. Oludotun. Forest and its Services to Nigeria and Nigerians. [Olawasomidotun.blogspot.com/2011/05/forest-and-its/resources](http://Olawasomidotun.blogspot.com/2011/05/forest-and-its/resources) Retrieved on 13<sup>th</sup> march, 2016. 2011
- [13] W. van Hoven. Private game reserves in southern Africa. In *Institutional arrangements for conservation, development and tourism in eastern and southern Africa 2015*, (pp. 101-118). Springer, Dordrecht.
- [14] M. Atiku, A. G. Bello, and J. S. Alao. Study of some trees characteristic at Tangaza north Forest Reserve in Sokoto state Nigeria. *Agricultural science research journal* 13 (10): 2013, 318-323
- [15] E. H., Sene. Forest and food security in African. The place of forestry in FAO's special programme for food security, Rome, Italy. 2000
- [16] A. Akinsoji. *Vegetation types and ethno – botanical Studies of Gashaka Gumti National Parks, Nigeria*. Technical Report NCF, WWF; UK. 2000, Pp. 52.
- [17] L., Daniel, R. Manning, and D. Krymkowski. Relationship Between Visitor-Based Standard of Quality and Existing Condition in Parks and Outdoor Recreation, *Leisure Science*, 2005, 27:157-173.
- [18] M., Lockwood. Good governance for terrestrial protected areas: A framework, principles and performance outcomes. *Journal of environmental management*, 91(3), 2010, 754-766.
- [19] G. J. Martínez. Use of fauna in the traditional medicine of native Toba (qom) from the Argentine Gran Chaco region: an ethnozoological and conservationist approach. *Ethnobiology and conservation*, 2013, 2.
- [20] R. A., Noe, J. R., Hollenbeck, B., Gerhart, & M. P., Wright. *Human resource management: Gaining a competitive advantage*. New York, NY: McGraw-Hill Education. 2017
- [21] I., Abdurashid & M., Rabi'u. Indigenous trees inventory and their multipurpose uses in Dutsin-Ma area Katsina State. *European Scientific Journal, ESJ*, 2013, 9(11).
- [22] E., Knapp. Ecological effects of prescribed fire season: a literature review and synthesis for managers. *DIANE Publishing*. 2010
- [23] I., John. *Africans: The History of a Continent*. Cambridge, University Press. 2007 Pp. 75. ISBN 0-521-86438-0.
- [24] O. D., Akinyemi, O. A., Ugbogu, and A. B., Oguntola. The Dynamics of Natural Vegetation of Savanna Trees Species in Ribako Wetland Reserve .*Conference Proceeding of Forestry Association of Nigeria*. Abuja, Nigeria. 2001 Pp, 45-55.
- [25] H. H., Zakari. *Vegetation Composition and Conservation Status of Baturiya Wetland, Jigawa State, Nigeria*. A Dissertation Submitted to School Postgraduate Studies, Ahmadu Bello University Zaria. 1992
- [26] P., Raunonen, M., Åkerblom, M., Kaasalainen, E., Casella, K., Calders, & S., Murphy. (2015). Massive-scale tree modelling from TLS data. *ISPRS Annals of Photogrammetry, Remote Sensing & Spatial Information Sciences*, 2015, 2.
- [27] P. W., West. *Tree and Forest Measurement*, 2<sup>nd</sup> edition DOI: 10.1007/978-3-540-95966-3-3 Springer – Verlag, Berlin Heidelberg. 2009
- [28] P. W., West. Stem Diameter. In *Tree and Forest Measurement* (pp. 11-18). Springer, Cham. 2015
- [29] D. Batcher. How to Measure Tree Canopy. .how Contributor Available @ <http://www.e.how.com> Retrieved 26<sup>th</sup> February, 2016.
- [30] M. B., Abdullahi, S. S., Sanusi, S. D., Abdul, B. J. and Sawa. An assessment of the herbaceous species vegetation of Yankari game reserve, Bauchi, Nigeria. *Journal of Agriculture and Environmental Science*. 6: 2009, 20 – 25.
- [31] A. D., Isah, M. Audu, and B. Ahmad. Soil Status of Kalgo Forest Reserve in North-Western Nigeria. *International Journal*

- of Engineering and Science. Vol. (3) Pp, 29-34. 2014, 2319-1813.
- [32] Giliba, R. A., Boon, E. K., Kayombo, C. J., Musamba, E. B., Kashindy, A. M., & Shayo, P. F. (2011). Species composition, richness and diversity in Miombo woodland of Bereku Forest Reserve, Tanzania. *Journal of Biodiversity*, 2(1), 1-7.
- [33] C. Fischer, C. Kleinn, L. Fehrmann, H. Fuchs, & O. Panferov. A national level forest resource assessment for Burkina Faso—A field based forest inventory in a semiarid environment combining small sample size with large observation plots. *Forest Ecology and Management*, 262(8), 2011, 1532-1540.
- [34] R. Heyer, M. A., Donnelly, M. Foster, & R. Mcdiarmid, (Eds.). *Measuring and monitoring biological diversity: standard methods for amphibians*. Smithsonian Institution. 2014
- [35] C. D., Shannon, and W., Weinner. *The Mathematical Theory of Communication*; In: Imam, T.S. (2012) *Application of Biological Diversity Indexing in the Water Quality Monitoring and Pollution Assessment. A Review of Biology and Environmental Science Journal for Tropics*. 2012, 9(2):252:257.
- [36] USAID. *Nigeria Biodiversity and Tropical Forestry Assessment*. Review by United State Agency for International Development. Published by Chemonics International Inc., 2008. Pp. 14.
- [37] P.A., Assoka, and S. M., Abubakar. *Deforestation in Government Protected Area A Case Falgore Game Reserve* *Global Journal of Pure And Applied Science*. 11(2); 2005, 257-263
- [38] D. U., Danladi. *Day to Press Release to Mark World Combat Desertification, 17<sup>th</sup> June, 2008*. African Desertification Control Initiative, South Africa. Available @ <http://www.nomej:desertification.org> Retrieved on 17<sup>th</sup>, March, 2014. 2008
- [39] P. C., Mmom, and M. D., Mbee. “Population Pressure and Forest Resource Depletion in Gele Gele Forest Reserve of Edo State Nigeria” *International Journal of Physical and Human Geography*. 2 (1): 2014, 10-21.