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TREE SPECIES DIVERSITY AND COMPOSITION IN THE ORCHARD OF FEDERAL UNIVERSITY DUTSE, JIGAWA STATE

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ABSTRACT

The effect of anthropogenic activities caused by poverty, ignorance, unemployment and inadequate of management in savannah zone is the main concern. There is need to determine the plant diversity and composition of a biological hotspot which will serve as a yardstick for proper management in the savannah, orchard and related biological hotspots. Five plots of 20m x 20m were located using random sampling techniques. Within each selected plot, information on total number of tree species, relative density and abundance of each individual species were recorded for all living trees. A total of 650 trees of 18 different species belonging to 13 families and 17 genera were identified. *Citrus sinensis* had highest density and *Paupartia birrea, Adansonia digitata and Acacia senegal* had the lowest density (1.0). Rutaceae had the highest abundance of (91) while Potaceae, Malvaceae and Rhinnaceae had the lowest value of one. Shannon wiener diversity index of the Orchard (1.35) indicated low species richness and evenness was estimated to be 0.21. The low number of tree species revealed poor management and planning which significantly affected species composition and diversity in the orchard. There is need to introduce new species which will improve biodiversity hotspot as well as aid the protection of the other components of the ecosystem.

Keywords: Orchard, Diversity, Composition**,** Random sampling, Fruit trees.

INTRODUCTION

An orchard is an intentional planting of trees or shrubs that is maintained for food production or that comprise fruit or nuts producing trees which are generally grown for commercial production (Oxford and Edmund, 1989). A fruit garden is generally synonymous with orchard, although it is set on a smaller non-commercial scale and may emphasize shrubs in preference to fruits trees. Most temperate zone orchards are laid out in a regular grid with a grazed or mown grass or bane soil base that makes maintenance and fruit gathering easy. Orchards are sometimes concentrated near bodies of water where climatic extremes are moderated and blossom tree is retarded until frost danger is past. An orchards layout is the techniques of planting the crop in a proper system (Dave, 2011). In addition to diversity in plant levels, the urban Eco-orchard features a diversity of plant choices within each level. For examples instead of just planting apples in the low free level, the orchard might feature plants like: pears, charmers and more unusual choices like fig, persimmons and services berries. If one crop fails in a particular year, this diversity ensures that the orchard will still be productive. One of the most important aspects of creating functioning orchard ecology is creating healthy living soil organisms: worms, insets, fungi, bacteria and many micro-organisms which have vital roles in supporting productive plants (Chisholm hugh, 1911).

Pressures of forests, especially in the tropical world are to provide economic resources have been increasing rapidly as a result of geometric increase of human population in the region (Salami, 2006). Groombridge (1992) observed significant pressures on biodiversity of forest reserves through anthropogenic activities such as over exploitation of forest resources, grazing in forest reserve and conversation of forest areas to other forms of use such as residential, schools, industries, road construction and unstable climate conditions. This has led to unabated deforestation, which has been recognized as one of the major drivers of biodiversity loss (Ojonigu *et al.*, 2010). According to FAO (2005), each year about 13 million hectares of world's forest are lost due to deforestation. The overall impacts are reduction, fragmentation and impaired natural ecosystem functions. Forest conversion may have far reaching environmental, economic and social effects. Environmental consequence can include the disruption of natural hydrological process. Soil erosion and degradation, nutrient depletion, loss of biological

diversity, increased susceptibility to fires and changes in local distribution and rainfall (Ehrich and Wilson, 1991). The economic consequences include the loss of production potential, as soil is degraded. The loss of biological resources such as forest s or pharmaceuticals from primary forest; destabilization of watershed with the attendant downstream effects of flooding and siltation; and at the global levels, the long run impacts of deforestation on global climate changes (Norgard, 1989; Randall, 1988; Rapeto and Gillis, 1988).

Forest reserves play significant role in the socio-economics of rural dwellers around the reserve as well as ecological benefits. Plant like *Aciobateri* and *Pterocarpus santolinoides* over centuries have been included in the farming system for the purpose of soil fertility improvement. Their inclusion allowing farmers to shorten the fallow period in highly populated area and exhausted soils of Eastern Nigeria (Faje *et al.*, 2011). Trees and other orchard plants provide many environmental benefits, including absorbing carbon and other pollution, reducing, storm water runoff and providing neighborhood cooling. Beauty in flowers, foliage and fruit is another important function of eco-orchard (Chisholm, 1911). Floristic inventory of forest helps to present accurate data on the vegetation composition which is desirable for issues of planning and the restoration of the degraded and disturbed forest areas. The objective of this study is to assess plant species diversity and investigate tree composition in Orchard of Federal University Dutse, Jigawa State, with a view to ensuring its sustainable management.

METHODOLOGY

Study was conducted in Orchard of Department of Forestry and Wildlife Management, Federal University Dutse, Jigawa State. The orchard has a total area of 2.4 hectares. It is located within the University farm, situated in the North- Western geopolitical zone of the town. It lies between latitudes 11.00^{o}N to 13.00^{o}N and longitudes of 8.00^{o}E to 10.15^{o}E. The study area covered by Sudan savannah, also area characterized by hot wet summer and cool dry winter with average raining season of 3 - 5 months (644mm) (Jigawa State Ministry of Agriculture and Natural Resources (JARDA), 2016). Sunshine hours indicate that the town enjoys 10 - 11 hours of sunshine depending on the season (JARDA Metrological data, 2016)

Sampling Techniques and Data Collection

Five plots (5) of 20m by 20m were located using simple random sampling technique. All trees in each plot were identified with their local, common and scientific namesWithin each selected plots, information on total number of species per plot and relative abundance of all living trees were recorded

Data Analysis

Species Diversity

Orchard species diversity was analyzed using Shannon wiener**.**

$$H^1 = -\sum_{i=1}^{S}(p_i Lnp_i) \quad \text{.....(1)}$$

Where H^1 is the Shannon diversity index, S is the total number of species in the community, p_i is the proportion of a species to the total number of plants in the community and Ln is the natural logarithm

Species Evenness (E)

Species evenness (E) measures the distribution of the number of individual in each species. It was determined using Shannon's equitability (E_H) as stated by Kent and Coker (1992):

$$E = \frac{H^1}{Ln(S)} \quad \text{.....(2)}$$

Where S is the total number of species in each community.

Orchard Structure Analysis

The following community assessment variables were determined in an attempt to analyse the orchard structure.

$$\textbf{Density} = \frac{\text{Total number of individuals of a species in all subplots}}{\text{Total number of species in subplots}} \quad \ldots\ldots\ldots\ldots\ldots eqn\ 3$$

$$\textbf{Relative density} = \frac{\text{(Number of individuals of species)}}{\text{Total number of all individual tree}} X\ 100\% \ldots.eqn\ 4$$

$$\textbf{Abundance} = \frac{\text{Total number of individuals of a species in all transects}}{\text{Total number of transects in which species occurred}} \ldots.eqn\ 5$$

$$\textbf{Relative Density} = \frac{n_i}{N}\ x\ 100 \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots eqn\ 6$$

Where:

ni = Density of a particular species

N = Density of all species.

RESULTS AND DISCUSSION

Floristic composition

A checklist of the tree species in Federal University Dutse orchard, their families, densities in the Orchard of Federal University Dutse, Jigawa State are presented in Tables 1 and 2 respectively. A total of 18 species were distributed into 13 families and 17 genera in the orchard. The family of Fabaceae had the highest diversity (3) families while 2 families were represented by only one species (Potaceae and Malvaceae) respectively. Salami, (2017) reported the dominance of Fabaceae and Meliaceae in Omo Forest Reserve because of easy wind dispersal which enhanced their spread in the study location. *Paupartia birrea*, *Adansonia digitata* and *Acacia nilotica* had the lowest frequency occurrences in the study area due to its low suppression effects of arid- zone trees on plant stand and growth of crops rate in the climatic region and its structural anatomical development of the tree does not strikes well in the geographical zone of the study area.

Density, Frequency and Abundance

The results showed that the orchard had one species with large numbers of individual and many species with few numbers of individual. *Citrus sinensis* had the highest density (91) followed by *Moringa oleifera* (9.0), *Mangifera indica* (8.0), *Eucalptus camadulensis* (5.4), *Anacardium occidentale* (5.4), while *Acacia seyal* (0.2), *Adansonia digitata* (0.2) and *Paupartia birrea* (0.2). Eighteen plants species in the Orchard were fruit trees, revealing the biologically diverse nature of the mature ecosystem. Therefore, attention is needed to be given to introduction of fruit trees

species. The occurrence and high abundance of plant species in the families of Rutaceae and Fabaceae could be attributed to the susceptible ability of these species to withstand extreme environmental conditions, their nature, high seed germination and growth rate, seedlings or saplings proliferations, seeds source from the Orchard's soil and seed bank (Damgard, 2001). Potaceae, Malvaceae and Rhinnaceae had the lowest occurrence and abundance. This may occurred as a result of anthropogenic factors in the orchard.

Relative Density

Relative density of each individual species was estimated (Table 2). *Citrus sinensis* had the highest relative density of 68.94% followed by *Moringa oleifera* with the value of 6.82%. The species with lowest density were *Paupatia birrea*, *Adansonia digitata* and *Acacia seyal* (0.15%). Lowest density of the orchard could be attributed to inadequacy of technical know-how in terms of large spacing, financial implication and policy within the University.

Species diversity and Evenness

Species diversity of the reserve was found to be 1.35. This is in agreement with the value obtained in Dabagi Forest Reserve where value was 1.45 (Shamaki *et al.*, 2015) and temperate forest which ranges from 1.16 - 3.40 (Pande *et al.*, 1996). This value of the diversity index for this study closes within the general limit of diversity index of 1.5-3.5 (Kent and Coker, 1992). The relative low diversity might be due to large spacing and anthropogenic forces ravaging the orchard. Some important orchard species which are usually found in the Sudan savannah were conspicuously absent in the study site. More beneficial species needed to be introduced into Orchard and adequate spacing must be recommended. Evenness was calculated to be 0.21 and considered to be poorly distributed due to the less number of species within the orchard. This could be attributed to soil physio-chemical properties influencing tree species richness and distribution within the forest.

Table 1: Floristic composition of Orchard species in Federal University Dutse, Jigawa State

Species	Common name	Local name	Family	Frequency	Abundance
Citrus sinensis (L) osbeck	Sweet Orange	Osan, Lemon Tsami	Rutaceae	445	91
Paupartia birrea		Dinya	Potaceae	1	1.0
Adansonia digitata (Bahobab) L.	Baobab	Kuka	Malvaceae	1	1.0
Frangula alnus L.	Christ's thorn	Kurna	Rhinnaceae	2	2.0
Vachelliani lotica (L.) Delile		Bagaruwa	Fabaceae	5	2.5
Syzygium guineense (willd) DC	Water pear	Malmo	Myrtaceae	5	2.5
Azadirachta indica Adr. Juss	Neem	Darbejiya	Meliaceae	18	6.0
Phoenix dactylifera Linn.	Date palm	Dabino	Arecaceae	8	4.0
Moringa oleifera Lam.	Drum stick	Zogale	Fabaceae	45	15.0
Acacia senegal	Gum Arabic	Dakwara	Rhinnaceae	1	1.0
Parkia biglobosa (Jacq) R.Br.G.Don	Locust Bean	Dorawa	Fabaceae	3	3.0
Eucalyptus camadulensis Dehnh	Red gum	Turare	Myrtaceae	27	9.0
Acacia seyal Delile	Red acacia	Farar Kaya	Fabaceae	3	1.5
Faidherbia albida (Del) A.Chev	Apple ring	Gao	Magnoliopsida	5	2.5
Anarchadium occidentale L.	Cashew	Fisa	Anacardiaceae	27	9.0
Balanite segytiaca (L.) Delile	Desert date	Aduwa	Zygophyllaceae	4	2.0
Diospyrous mespiliformis Hochst ex A. DC	Jack berry fruit	Kanya	Ebenaceae	10	5.0
Mangifera indica Linn.	Mango	Mangwaro	Anacardiaceae	40	13.3

Table 2: Tree species diversity indices of Orchard species in Federal University Dutse, Jigawa State

Species names	Density= (n/N) =P	Relative Density (%)	Frequency	Relative Frequency (%)	P_i	Shannon Wiener index (H^i)
Citrus sinensis (L) osbeck	91	68.94	100	12.82	0.690	-0.260
Paupartia birrea	0.2	0.15	20	2.56	0.002	-0.013
Adansonia digitata (Bahobab) L.	0.2	0.15	20	2.56	0.002	-0.013
Frangula alnus L.	0.4	0.30	20	2.56	0.003	-0.017
Vachellia nilotica (L.) Delile	1.0	0.76	40	5.13	0.008	-0.039
Syzygium guineense (willd) DC	1.0	0.76	40	5.13	0.008	-0.039
Azadirachta indica Adr. Juss	3.6	2.73	60	7.69	0.027	-0.100
Phoenix dactylifera Linn.	1.6	1.21	40	5.13	0.012	-0.053
Moringa oleifera Lam.	9.0	6.82	60	7.69	0.068	-0.183
Acacia senegal	0.2	0.15	20	2.56	0.002	-0.013
Parkia biglobosa (Jacq) R.Br.G.Don	0.6	0.46	20	2.56	0.005	-0.027
Eucalyptus camadulensis Dehnh	5.4	4.09	60	7.69	0.041	-0.131
Acacia seyal Del.	0.6	0.46	40	5.13	0.005	-0.025
Faidherbia albida (Del) A.Chev	1.0	0.76	40	5.13	0.008	-0.039
Anarchadium occidentale L.	5.4	4.09	60	7.69	0.041	-0.131
Balanite segytiaca (L.) Delile	0.8	0.61	40	5.13	0.006	-0.031
Diospyrous mespiliformis Hochst ex A. DC	2.0	1.52	40	5.13	0.015	-0.063
Mangifera indica Linn.	8.0	6.06	60	7.69	0.061	-0.171

Fig 1: Showing the abundance status of families in Orchard

CONCLUSION AND RECOMMENDATIONS

Orchard species diversity of Federal University Dutse, Jigawa State has been investigated. It was discovered that tree species diversity and composition in this orchard compared favorably with other reserves in the same ecosystems. Inadequate management plans and inefficient execution have negative impacts on the orchard species diversity. This calls for an urgent solution so as not to drive some of this tree species particularly those already threatened into extinction. It is therefore suggested that University orchard must be protected from pathogenic agents and plans must be drawn up to improve the quality of the orchard. Also, adequate spacing is encouraged. More importantly, the results of the study will serve as reference point for any research institute who wishes to establish Orchard as guide, students and homes for personal and educational purposes.

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