INFLUENCE OF ANTHROPOGENIC FACTORS ON THE DISTRIBUTION, DIVERSITY AND CONSERVATION OF MEDICINAL TREE SPECIES IN DUTSE, JIGAWA STATE

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Abstract: Traditional herbal medicine has been a constant source of substances for curing and preventing a variety of ailments. This study determined the diversity, distribution of medicinal plants, and evaluated the effects of human activities on their availability in Federal University Dutse (FUD) and Jigawar Tsada community. 60 questionnaires were administered randomly to household respondents in the two study areas and 6 transect lines of 100 x 100m were laid in the areas to examined the distribution and diversity of the medicinal plants. Data collected on DBH were used to compute Stem Volume (SV), Basal Area (BA) and Number of Trees per hectare (NT). Shannon Weiner index was used to assess species diversity. The result showed that seventeen (17) medicinal plants which are distributed in fourteen families were mostly source from wild found in the study area and Fabaceae family was the dominant with 22% while others having 6%. The diversity (H^i) was 2.65. Availability of medicinal plants were highly affected by building and construction at 93% while farming was 7% in Federal University Dutse. However, respondents from Jigawar tsadar reported that 27% of medicinal plants are lost because of building and construction, 33% due to fuelwood collection; 27% due to collections of charcoal; and 13% due to farming. Major anthropogenic factors identified were building and construction; farming practice; and collection for fuelwood. More also, creation of awareness was the best among the conservation types. Therefore, there is need to create awareness on the effect of the over dependence of fuel wood despite the moderate distribution and diversity of the hotspot.

Keywords: Anthropogenic factors, Conservation, Distribution, Diversity and Medicinal Plants

Introduction

Medicinal plants have been used since the history of mankind (Meaza *et al*., 2015; Odhiambo *et al.,* 2011). Due to the efficacy of traditional herbal medicine, approximately 60-70% of the people in the rural areas depend on plants for their immediate medical care (World Health Organization, 2013). Many people use traditional medicine derived from plants because of poor health facilities and conventional medicinal services especially in the rural areas (Omwenga *et al.,* 2009; Tene *et al.,* 2007). In Africa, people have continued to rely on medicinal plants because of the belief that traditional therapies are the most efficient ways of treating different ailments (Joshi and Joshi, 2000).

In Nigeria, availability of poor healthcare is still generally a problem, and 85-90% of the population has used traditional herbal medicine for the treatment of different diseases (Nagata *et al.,* 2011). Due to lack of knowledge on drivers of medicinal plant species biodiversity and the current status of availability of traditional herbal medicine, many African governments lack a clear policy on use of traditional herbal medicine.

However, the Kenyan government has attempted to sustain and increase the availability of traditional herbal medicine to rural communities. The government through National Environmental Management Authority (NEMA) and other law enforcement agencies has implemented laws that ensure conservation of medicinal plants in their wild habitats and encourage ex situ conservation. Unfortunately, these efforts have not yielded the expected results. In order to develop policies to maintain this valuable resource, research on its current availability and particularly potential causes of a declining availability need to be intensified. The primary medical challenge experienced by most African countries include transferable diseases such as tuberculosis, measles, malaria, pneumonia, gastroenteritis, and diarrhea (Kariuki and Njoroge, 2011).

The distribution of these medicinal plants in the landscape influences the availability of traditional herbal medicine. Currently, biodiversity of medicinal plants has been reported to be on the decline in several studies (Nadembega *et al*., 2011). This is because most medicinal plants are destroyed due to environmental degradation. A crucial point of focus on enhancing availability of traditional herbal medicine might therefore be to conserve biodiversity with particular focus on medicinal plants.

The increased in demand for medicinal plants in Nigeria can be attributed to increasing human population and increasing poverty levels (NCAPD, 2007). This is coupled with observed decreasing availability (Okello `*et al*., 2010; Omwenga *et al*., 2015). Mesfin *et al*., (2013) concurs by asserting that in Northern Ethiopia, pressures from agricultural activities, collection of plants for firewood, grazing of livestock and seasonal drought led to depletion of the medicinal plants and reduction in availability of traditional herbal medicine. Similarly, (Khan *et al*., 2012) reported that in the mountainous regions of Naran Valley in the Western Himalayas, over-exploitation of forests, livestock grazing and continuous collection of plants with medicinal value puts the natural ecosystem at risk thereby leading to decline in traditional herbal medicine. The potential impact of logging in tropical rainforest ecosystem has direct environmental and biological consequences (Nurudeen *et al*., 2017; Salami and Akinyele, 2017; Salami, 2017). The degradation, fragmentation and conversion of the forests to other forms of land uses in Nigeria, are currently progressing at alarming rates. Between 1990 and 2000, Nigeria lost about 2.7% of its natural forests to deforestation which increased to about 18.56% (about

2.06 million ha) between 2000 and 2010 (Salami *et al*, 2016)

Livestock grazing is among the most significant human influences of plant biodiversity and vegetation structure. Light and moderate grazing brings about increased plant biodiversity (Tilman, 1997), whereas low grazing intensity decreases biodiversity (Willoughby and Alexander 2007), according to the intermediate disturbance hypothesis. Noy-Meir, (1995) supports the argument that moderate grazing increases plant species richness and abundance. Grazing has several effects on the ecosystem depending on the intensity of the livestock grazing. Sustainable management of livestock grazing ensures availability of vegetation and litter on the soil which reduces erosion of the top soil, thereby increasing plant diversity (Fakhimi *et al*., 2011). Browsing may lead to an increase in shade tolerant plant species by opening up areas that were previously under shade (Bhattarai *et al*., 2004). Furthermore, browsing pressure may lead to the increase of some browsing tolerant plant species thereby reducing beta diversity of the other plant species (Mouquet and Loreau, 2003). According to Shanley and Luz (2003), fire has also led to the continued decline of plants used for medicinal purposes in Eastern Amazonia. The degree to which fire affected medicinal plant species depends on the characteristics of the plant. Fire tolerant species will not be severely affected by fire. The nomadic pastoralists use fire to burn the old vegetation at the start of the rainy season so as to enable the grass to regenerate as they move to other areas. This will enable healthier grass to re-grow. In case of attacks by the neighboring communities, they also use fire to burn the surrounding vegetation so as to drive away bad omen. Fires in Samburu district are also instigated by honey-hunters during the process harvesting, especially during the dry season (Bussmann *et al*., 2006). Therefore, fire plays a major role in populated savanna ecosystems and its influence on medicinal plants needs to be studied.

Besides grazing and prescribed fires, firewood collection and deforestation are considered to be an important causes of the destruction of medicinal plants used by the Samburu people (Nanyingi *et al*., 2008). The Jigawar tsada people depends on firewood as a source of energy due to absence of an electric supply in the area. However, there is still uncertainty on the impact of anthropogenic activities on availability of traditional herbal medicine. This is because human activities vary in scale and intensity in different areas as a result of differences in technological development and degree of economic activities. This study aimed at assessing the medicinal plants, anthropogenic factors affecting their distribution and, diversity in Federal University Dutse and Jigawar Tsada, Sudan Savannah.

Common medicinal plants in Nigeria

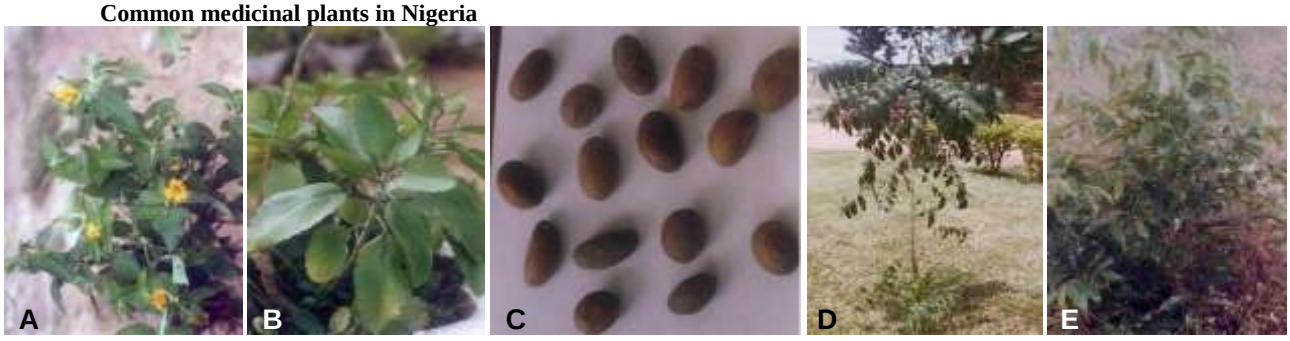

Fig 1 (A) *Aspilia africana*, (B)*Bryophyllum pinnatum* (C)*Garcinia kola*, (D)*Spondias mombin* (E) *Aspilia africana*

Materials and Method

Study area

Dutse is a city located in Northern Nigeria, it is the capital city of Jigawa state. The study area has a coordinate of latitude $11^{0}42'04"$ N $9^{0}20'31"$ E and longitude $11^{0}70'11^{0}$N $9.3^{0}41'94"$ E. It has a little rainfall throughout the year with a precipitation of 734mm falls annually the mean daily minimum and maximum temperatures of 19oC and 35oC respectively (Lawal *et al.*, 2020) Soil well known to be fertile ranging from sandy-loamy, pH ranges from 6.07-6.72, nitrogen content ranges from 0.63-1.64g/kg, phosphorus 6.25 to 12.04mg/kg and potassium ranges from 0.18-0.63cmol/kg respectively (Salami *et al.*, 2022; Aminu, 2021). Sunshine hours showed that the town 10-11 hours of sunshine depending on the season (Salami *et al.*, 2019). Study area is known with population estimated of 153000 (Ilu *et al.*, 2020). Duste is currently the largest city in Jigawa state followed by Hadejia (111,000) Gumel (43,000) and Birnin kudu (27,000) (Ilu *et al.*, 2020). The study area is well known with rocks which spread across town and its environment are well known for date trees for different varieties, the area is characterized with un diluting topography and hilly walls the Jigawa (from Jigayi) is attributed to such topology. Dutse is predominately farmers; other occupations typical to rural area are also available among the populace. Soil tends to be fertile ranging from sandy-loam (Jibo *et al.*, 2022; Jibo *et al.*, 2021).

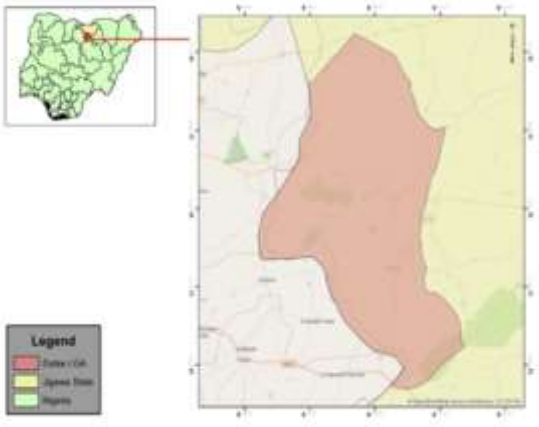

Figure 2: showing the map of the study area
Adopted from: Salami *et al.*, (2023)

Data collection

Primary and secondary data were sourced for the study. The medicinal plants found were identified and recorded. Additionally, skilled herbalists from an established list provided by the District Medical Officer were involved in identification. The skilled herbalists sampled

comprised of three old women and two young men. Unknown specimens were also deposited at the Bayero University Kano for identification. Thirty (30) questionnaires were randomly administered to the members of the target groups in each study area which make the sample size of sixty (60).

Experimental design and layout

Three areas were selected purposively to cover larger percentage of medicinal plants which were chosen based on their environmental, social and economic attributes especially variation in vegetation types, availability of health care facilities and level of income. Two transects of 100 x 100m resulting to six transects from three areas were laid in an open vegetation to identify the abundance, richness and diversity. The number of medicinal plants within transect was used to categorize the availability and abundance of the medicinal plant species. This was done with the aid of specialized herbalists who helped in the identification of the medicinal plant species.

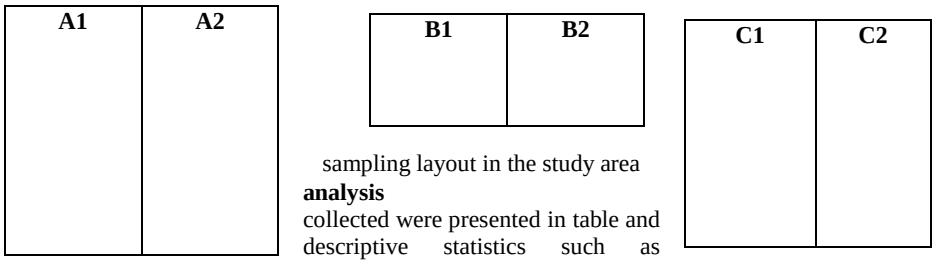

Figure 3: showing the sampling layout in the study area

Data analysis

Data collected were presented in table and subjected to descriptive statistics such as percentage and frequency.

$$\textbf{Percentage distribution} = \frac{\text{Number of single plant}}{\text{!Total number of the whole plant}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{ eqn 1}$$

The following indices were employed in determining species diversity and richness:

Shannon-Weiner index (H), which is the measure of diversity within a site according to (Shannon and Wiener, 1949; Salami and Akinyele, 2017).

$H = -\Sigma^{s}_{i=1} p_i \ln(p_i)$……..……..eqn 2

Results and Discussion

Results

Table 1: Availability and percentage distribution of medicinal plants

S/N	Medicinal plants	Family	Common name	FUD	% Distribution	Jigawa tsada	% Distribution
1	*Azadirachta indica*	Meliaceae	Neem	+	57.6	+	8.1%
2	*Adansonia digitata*	Bombacaceae	Baobab	-	-	+	6.8%
3	*Anogeissus leiocarpus*	Combretaceae	African birch	+	0.8	-	-
4	*Balanites aegyptiaca*	Zygophyllaceae	Desert date	+	9.9	-	-
5	*Calotropis procera*	Asclepiadaceae	Apple of Sodom	+	7.8	+	1.7%
6	*Diospyros mespiliformis*	Ebenaceae	Ebony tree	+	2.5	-	-
7	*Eucalyptus globulus*	Myrtaceae	River red gum	+	5	-	-
8	*Phoenix dactylifera*	Aracaceae	Date palm	+	1.2	+	1.7%
9	*Piliostigma thonningii*	Fabaceae	Monkey bread	+	10.3	+	4.2%
10	*Tamarindus indica*	Fabaceae	Tamarin	+	2.1%	+	0.2%

11	*Vitellaria paradoxa*	Sapotaceae	Shea butter	+	0.8%	-	-
12	*Citrus limon*	Rutaceae	Lemon	-	-	+	0.3%
13	*Senna siamea*	Fabaceae	Kassod tree	+	2.1%	-	-
14	*Leucas aspera*	Lamiaceae	Thumbai	-	-	+	0.3%
15	*Cassia tora*	Fabaceae	Sickle senna	-	-	+	8.6%
16	*Euphobia hirta*	Euphorbiaceae	Asthma Plant	-	-	+	64.7%
17	*Lawsonia inermis*	Lythraceae	Henna tree	-	-	+	4.4%

Source: Field Survey, (2022)

Table 2: Number of people who use plant extract to cure

Statement	Frequency of Respondents in FUD (%)	Frequency of Respondents in Jigawar Tsada (%)
Yes	28 (93.33)	30 (100)
No	2 (6.67)	-
Total	**30(100)**	**30(100)**

Source: Field Survey, (2022).

Table 3: Showing the number the users of the plants

Common Illness	Frequency of Respondents in FUD (%)	Frequency of Respondents in Jigawar Tsada (%)
Malaria	16 (53.33)	16 (53.33)
Leprosy	-	4 (13.33)
Diarrhea	6 (20.00)	4 (13.33)
Fever	8 (26.67)	4 (13.33)
Stomach ache	-	2 (6.67)
Total	**30 (100)**	**30 (100)**

Source: Field Survey, (2022).

Table 4: Showing the location of the plants

Areas	Frequency of Respondents in FUD (%)	Frequency of Respondents in Jigawar Tsada (%)
FUD	26 (86.67)	-
Jigawar Tsada	-	28 (93.33)
Neighboring Community	-	-
Market	4 (13.33)	2 (6.67)
Total	**30(100)**	**30(100)**

Source: Field Survey, (2022).

Table 5 revealed that the highest destruction was found in FUD with Building and construction activities (93.33%) followed by fuel wood collection with 33% from Jigawar tsada. Building construction and charcoal production form a major threat in Jigawar tsada after Firewood Collection (26.67%)

Table 5: Showing the threat to Medicinal plants

Threats To Medicinal Plants	Frequency of Respondents In FUD (%)	Frequency of Respondents In Jigawar Tsada (%)
Building and Construction	28 (93.33)	8 (26.67)
Grazing and livestock	-	-
Fire	-	-
Farming activities	2 (6.67)	4 (13.33)
Firewood Collection	-	10 (33.33)
Charcoal Production	-	8 (26.67)

Total	**30(100)**	**30(100)**

Source: Field Survey, (2022).

Table 6 shows that awareness on the threat of plants had the highest frequency from Jigawar tsadar and FUD with 73.33 and 66.67 % respectively. Tree planting followed awareness with values of 33.33 and 26.67 from Jigawar tsadar and FUD respectively.

Table 6: Showing the way of conserving the medicinal plants

Threats To Medicinal Plants	Frequency of Respondents In FUD (%)	Frequency Of Respondents In Jigawar Tsada (%)
Awareness	20 (66.67)	22 (73.33)
Tree planting	10 (33.33)	8 (26.67)
Promoting herbal plantation and conservation	-	-
Total	**30(100)**	**30(100)**

Source: Field Survey, (2022).

Table 7: Showing the Abundance of medicinal plants

Availability/accessibility	Frequency of respondents in FUD (%)	Frequency of respondents in Jigawar tsada (%)
Available	378 (90.00)	184(43.81)
Scarce	42 (10.00)	236 (56.19)
Extinct	-	-
Total	**420 (100)**	**420 (100)**

Source: Field Survey, (2022).

Discussion

Floristic composition, distribution and forms of the medicinal plant species

Eleven (11) medicinal plant species were encountered in each of the study area and seventeen (17) plant species found from both study areas. The encountered medicinal plants include: *Azadirachta indica, Adansonia digitata, Anogeissus leiocarpus, Balanites aegyptiaca Calotropis procera, Diospyros mespiliformis, Eucalyptus spp, Phoenix dactylifera, Piliostigma thonningii, Tamarindus indica, Vitellaria paradoxa, Citrus limon, Senna siamea, Leucas aspera, Cassia tora, Euphobia hirta, and Lawsonia inermis.* The fourteen families of medicinal plants encountered within the six transects were: Aracaceae, Asclepiadaceae, Ebenaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Lythraceae, Myrtaceae, Meliaceae, Bombacaceae, Combretaceae, Rutaceae, Sapotaceae, and Zygophyllaceae where Fabaceae showed its dominance having 22% followed by other species with 6%. Most of the medicinal plants found in Dutse were trees (64.7%), shrubs with 23.5% and 11.8% of herbs. Majority of the medicinal plants were trees; this implies that tree as a life form could do better with the environmental conditions in the study area. In Federal University Dutse (FUD), *Azadirachta indica* is the most dominating medicinal plant species with 57.6% while *Anogeissus leiocarpus* and *Vitellaria paradoxa* were the lowest occurring medicinal plants species with 0.8%. In Jigawar tsada, *Euphobia hirta* is the most dominating medicinal plant species with 64.7% while *Tamarindus indica* is the lowest occurring medicinal plant species with 0.2%. The study conducted by Salami *et al.,* (2023) also observed close number of plant species and family in Dutse (26 plant species and 15 families) and which Fabaceae appeared to be most frequent after Combretacae.

Effect of Anthropogenic activities

The main causes of threat to medicinal plants in the tropics are logging, grazing, and urbanization which is known globally (Rowe *et al.*, 1992; Salami *et al.*, 2018; Salami *et al.*, 2020). Urbanization, fuel wood collection and farming practice are the major threat to plant diversity in among Dutse metropolis; as a main threat, over-exploitation and land use change have been identified. The challenges caused by deforestation in the country today is being intensified by desertification especially in Northern Nigeria. Human activities have been widely reported to contribute more to this problem compared to natural factors (Putz *et al.*, 2000). Habitat loss, fragmentation, and degradation are currently the most important threats to biodiversity conservation worldwide (Cannon *et al.*, 1998; Salami *et al.*, 2020). Similarly, Khan *et al*., (2012) reported that in the mountainous regions of Naran Valley in the Western Himalayas, over-exploitation through clearing of forests, livestock grazing and continuous collection of plants with medicinal value puts the natural ecosystem at risk thereby leading to decline in traditional herbal medicine. Mesfin *et al*., (2013) concurs by asserting that in Northern Ethiopia, pressures from agricultural activities, collection of plants for firewood, grazing of livestock and seasonal drought led to depletion of the medicinal plants and reduction in availability of traditional herbal medicine. In recent times, medicinal plants have been variously demanded and exploited for many reasons. Plant users collect these plants to satisfy their need and preference of the people on herbal preparations used in solving their primary health care problems. Natural disasters such as floods, gully erosions destroy millions of medicinal plants and their ecosystem in an instant, bringing to naught any prior conservation effort.

Diversity and Conservation status

Shannon-Wiener diversity index examined put as 2.65. This agrees with the value obtained for temperate forest which ranges from 1.16 and 3.40 (Salami and Akinyele, 2018; Salami, 2017; Pande *et al*., 1996). The Shannon Wiener diversity index obtained is lower than the tree species diversity values in tropical forests of Kalakad Forest Reserve in Western Ghats which was reported to

be between 3.31 and 3.69 (Parthasaranthy *et al.,* 1992). The diversity index obtained is higher than the tree species diversity values in Kurba Forest Reserve in Bauchi state which was reported to be between 1.94 and 2.21 (Salami *et al.,* 2022). Findings from the study on conservation showed that creating awareness on the conservation of medicinal trees had the highest frequency out of the three methods. Tree planting method followed the awareness. There was a wide gap among the best methods. Garba *et al.,* (2021) supported the study by his observation that environmental education is the best method of conserving threating plant species while other methods proved better after education is re-introduction. Garba *et al.,* (2021), Popoola *et al.,* (2009) showed that mankind make use of many species for economic benefits which results in serious reduction in biodiversity and many species becoming extinct more rapidly than researchers can study them. However, despite the fact that, these native trees have slow growth rate and long gestation period, they are generally noted as good sources of medicinal products used in the treatments of certain ailments that are difficult to cure by using the conventional drugs.

Number of the users and location of the plants

The medicinal plants encountered were commonly used for curing disease such as malaria; leprosy; fever; liver problem; anemia; diarrhea; tuberculosis; asthma; epilepsy; stomach ache; headache; diabetes; hypertension etc. Study showed that higher number of people do use medicinal plants to cure malaria followed by fever while diarrhea and leprosy seems to had least means of treatment by medicinal plant. It is worthy to note that most the plants use for curing disease were sourced from the wide (FUD and Jigawar sadar). This supports the observation of Salami *et al*., (2023) who's discovered that most the plants use for curing gonorrhea and other STD are were sourcing from the wide.

Conclusion

The study revealed the diversity of medicinal plants and anthropogenic threats to the use of traditional medicine among the two communities in Jigawa State. Majority of medicinal plant species in the selected communities in Jigawa State grew in the wild. Due to poor soil fertility, attempts of cultivation failed indicating that people will have to rely on their occurrence in the wild in the near future. Anthropogenic factors affecting medicinal plants diversity and distribution which include building and construction; farming practices; Firewood Collection; and Charcoal production. Despite the effect of anthropogenic activities, the diversity in the study area is still moderate; this study found out that the commonly used medicinal plant is *Azadirachta indica.* Federal University Dutse is richer in Medicinal plant than Jigawar tsada. There is need to create awareness and also plant more trees so as to increase medicinal plant occurrence in the area of study.

References

Aminu, M. (2021). Evaluation of Stem Volume, Litterfall, and Soil Fertility of Azadirachta indica (A. Juss) and *Eucalyptus camaldulensis* (Dehnh) at Shelterbelts in Kiyawa, Jigawa State, Nigeria. An unpublished project submitted to the Department of Forestry and Wildlife Management, Federal University Dutse, Jigawa State.

Bhattarai, K. R., Vetaas, O. R., and Grytnes, J. A. (2004). Relationship between plant species richness and biomass in an arid sub-alpine grassland of the central Himalayas, Nepal. Folia Geo-botanica, 39(1): 57–71.

Bussmann, R. W. (2006). Ethnobotany of the Samburu of Mt. Nyiru, South Turkana, Kenya. *Journal Ethnobiol Ethnomed*., 2(1): 1-10.

Cannon, C. H, Peart D.R and Leighton, M (1998). Tree species diversity in commercially logged Bornean rainforest. Science, 281(5381): 1366–1368.

Fakhimi, E., Mesdaghi, M., Dianati Tilaki, G. A., and Tavan, M. (2011). Relationships among forage and litter production in three grazing intensities in Nodooshan Rangeland (Yazd, Iran). *Journal of Rangeland Science* 1(3): 217–223.

Garba, A., Salami K. D. and Akanbi WB (2021) Assessment of Endangered economic tree species and conservation Techniques in Jigawa *state FUDMA journal of Agriculture and Agricultural Technology* V7(2):116-123

Ilu, K. J., Salami, K. D., Gidado, A. H., Muhammad, Y. K. and Bello Ahmed (2020) Household's Responses to the Roles of Trees as Wind Breaker in Dutse Local Government Area of Jigawa State, Nigeria. *FUDMA Journal of science* 4(3)162-168

Jibo, A. U., Mohammad, K. Y., Salami, K. D., Ilu, K. J. and Lana, H. M. (2022) Effect of Scarification Methods on Germination and Early Seedlings Growth Performance Of *Delonix regia* (Bojer)*Nigerian Journal of Agriculture and Forestry* 8(1):64-76

Jibo, A. U., Salami, K. D., Kareem Akeem, A. Muhammad, Y. K. and Musa, F. Y.(2021) Impact of Provenances on Seed Germination, Early Growth Performance and Survival Rate of *Tamarindus indica* (L) in North Western Nigeria. *Nigerian Journal of Horticultural Science (NJHS)* V26 (1 and 2):87-104

Joshi, A. R., and Joshi, K. (2000). Indigenous knowledge and uses of medicinal plants by local communities of the Kali Gandaki Watershed Area, Nepal. *J Ethnopharmacol.,* 73(1): 175–183.

Kariuki, A. C., and Njoroge, G. N. (2011). Ethnobotanical and Antimicrobial Studies of Some Plants Used in Kibwezi (Kenya) for Management of Lower Respiratory Tract Infections. *African Journal Traditional Complement Alternative Medine.* 8(2): 144–149.

Khan, S. M., Page, S., Ahmad, H., and Harper, D. M. (2012). Anthropogenic influences on the natural ecosystem of the Naran Valley in the Western Himalayas. *Pak J Bot.,* 44: 231–238.

Lawal, A. A., Jibo A.U., Salami K.D., Ilu, K.J., Muhammad, Y.K., Amina, G.H., and Saidu M. (2020) Assessment of Indigenous Fodder Tree Species from Different Land-Use Types In Dutse, Jigawa, Nigeria V12(3):32-38.

Meaza, G., Tadesse, B., Maria, A. S., Piero, B., and Gidey, Y. (2015). Traditional medicinal plants used by Kunama ethnic group in Northern

Ethiopia. *Journal of Medicinal Plants Res*., 9(15): 494–509.

Mesfin, K., Tekle, G., and Tesfay, T. (2013). Assessment of threatening factors of medicinal plant species in Samre district, south-eastern Tigray, northern Ethiopia. *Journal Medicinal Plants.* 1(4):135-145.

Mouquet, N., and Loreau, M. (2003). Community Patterns in Source-Sink Meta communities. *The American Naturalist*., 162(5): 544–557.

Nadembega, P., Boussim, J. I., Nikiema, J. B., Poli, F., & Antognoni, F. (2011). Medicinal plants in Baskoure, Kourittenga Province, Burkina Faso: An ethnobotanical study. *Journal of Ethnopharmacol*.,133(2): 378–395.

Nagata, J. M., Jew, A. R., Kimeu, J. M., Salmen, C. R., Bukusi, E. A., and Cohen, C. R. (2011). Medical pluralism on Mfangano Island: Use of medicinal plants among persons living with HIV/AIDS in Suba District, Kenya. *Journal of Ethnopharmacol.*, 135(2): 501–509.

NCAPD. (2007). Draft Policy on Traditional Medicine and Medicinal Plants (p. 32). Nairobi: National Coordinating Agency for Population and Development.

Noy-Meir, I. (1995). Interactive effects of fire and grazing on structure and diversity of Mediterranean grasslands. *Journal of Vegetation Science*. 6(5): 701–710.

Nurudeen, T A., Aina-Oduntan., Awotedu, B. F and Salami, K. D. (2017) Structure and Tree Species Diversity pattern of Gambari Forest Reserve Southern Nigeria. *International Journal of Applied Research and Technology*, V6(6), June 2017

Odhiambo, J. A., Lukhoba, C. W., and Dossaji, S. F. (2011). Evaluation of Herbs as Potential Drugs/Medicines. *African Journal for Traditional Complement Alternative Medicine.*, 8(5): 144–151.

Okello, S. V., Nyunja, R. O., Netondo, G. W., and Onyango, J. C. (2010). Ethnobotanical study of medicinal plants used by Sabaots of Mt. Elgon Kenya. *African Journal of Traditional Complement Alternative Medicine*., 7(1): 1–10.

Omwenga, E. O., Hensel, A., Shitandi, A., and Goycoolea, F. M. (2015). Ethnobotanical survey of traditionally used medicinal plants for infections of skin, gastrointestinal tract, urinary tract and the oral cavity in Borabu sub-county, Nyamira county, Kenya. *J Ethnopharmacol.*, 176: 508–514.

Omwenga, E., Okemo, P., Mbugua, P., and Ogol, C. K. (2009). Ethnobotanical Survey and Antimicrobial Evaluation of Medicinal Plants used by the Samburu Community (Kenya) for treatment of Diarrhorea. - Pharmacogn Mag. 5(18): 165-172.

Pande, P. K., Negi., J. D and Sharma, S.C. (1996). Plant species diversity and vegetation Analysis in Most Temperate Himalayan Forests. Abstracted in first Indian Ecological congress. New Delhi .

Parthasaranthy, N Kinbal , V., Kumar L P (1992). Plant species Diversity and Human impact in the Tropical Wet evergreen forests of Southern Western Ghats.Indo –French Workshop on Tropical Ecology, 15-23.

Popoola, L. A., Adejumo, B. O. and Solomon, A. A. (2009). Review of Millenium Development Goal (MDG) In Relation to Forest in Nigeria. *Proceeding of Forestry Association of Nigeria.* 2009. 1: 114-120

Putz FE, Redif KH and Robinson, J.G. (2000). Biodiversity Conservation in the Context of Tropical Forest Management. The World Bank Environmental Department, Washington DC, USA.

Rowe, W. B, Del-Genio AD and Eichler, T (1992). Cloud-tracked winds from pioneer Venus OCPP images. *Journal of the Atmospheric Sci.*, 47(17): 2053–2084. Bib code: 1990JAtS.47.2053R. Doi: 10.1175/15200469(1990)047<2053: CTWFVO>2.0.CO; 2.

Salami K. D., Nurudeen TA and Ringim, A.S (2018). Status of Forest Ecosystem and It's Conservation in Nigeria. World Environmental Conservation Conference held Theodore Idibiye Francis Auditorium, The Federal University of Technology, Akure, Ondo State, Nigeria, pp. 93-99.

Salami K. D., Akinyele, A.O., Adekola P. J and Odewale, M. A. (2016). Tree species Composition and Regeneration potential of Onigambari Forest Reserve, Oyo State, Nigeria. *Direct Research Journal of Agriculture and Food Science* (DRJAFS).V4 (3), Pp.39-47, March 2016 ISSN 2354-4147 Article Number: DRJA25309587

Salami, K. D., Alao, J. S. Abubakar, U. and Fatima Adam (2023) Ethno-botanical Survey of Plants Applied for the Treatment of Sexually Transmitted Diseases in the Sudan Savannah Region of Nigeria *Journal of Advances in Biology and Biotechnology Volume* 25, Issue 11-12, Page 55-63, 2022

Salami, K. D, Ibeh K.G and Jibo A. U. (2020). The impact of Human activities on Litterfall production, tree diversity and structural changes in tropical rain forest. *FUW Trend in science and Technology*. V5(3):705-710

Salami, K. D. and Akinyele, A .O. (2018) Floristic composition, Structure and Diversity distribution in Omo Biosphere Reserve, Ogun State, Nigeria. https://dx.doi.org/10.4314/ijs.v 20i3.17 *Ife Journal of Science* Vol 20 (3):639-647.

Salami, K. D. (2017): Tree species Diversity and Soil status of Omo Biosphere and Gambari Forest Reserves in South western Nigeria. Ph.D Thesis, Department of Forest Resources Management, University of Ibadan, Nigeria

Salami, K. D., Odewale, M. A., Gidado, A. H and Adam, Z. A. (2019): Pre-germination Treatments on Seeds of *Balanites aegyptiaca* (L) Delile and Influence of Potting Mixtures on the Early Growth. *Journal of Forestry Research and Management.* Vol. 16(1).107-117; 2019, ISSN 0189-8418. www.Jfrm.org.ng IBADAN

Salami, K. D. and Akinyele, A.O. (2017). Tree species Diversity Abundance in Degraded Gambari forest reserve, Southwest Nigeria. Translating Research findings into policy in developing countries. Contributions from Humbolt Kolleg Osogbo-2017. Lambert Academic Publishing. Pp 276-287 GERMANY

Salami, K. D., Aminu, M., Ilu K. J. Lawal A. A. and Folohunsho, W. O. (2022) Evaluation of stem volume, litter fall, Soil fertility of *Azardirachta indica A. JUSS and Eucalyptus camadulensis* Dehnh at Shelterbelt in Kiyawa , Jigawa state , Nigeria. *International Journal of Agricultural Research, Sustainability and food Sufficient*. V9(01): 560 -569

Shanley, P., and Luz, L. (2003). The Impacts of Forest Degradation on Medicinal Plant Use and Implications for Health Care in Eastern Amazonia. BioScience. 53(6): 573.

Tene, V., Malagón, O., Finzi, P. V., Vidari, G., Armijos, C., and Zaragoza, T. (2007) An ethno-botanical survey of medicinal plants used in Loja and Zamora-Chinchipe, *Ecuador. J Ethnopharmacol*., 111(1): 63–81.

Tilman, D. (1997). Community invasibility, recruitment limitation, and grassland biodiversity. Ecol., 78(1): 81–92.

Willoughby, M, and Alexander, M. (2007). Rangeland health for native modified plant communities in Rough Ecological Site of Montane Sub-region. ASRDLD.

World Health Organisation (Ed.). (2013). WHO traditional medicine strategy. 2014-2023. Geneva: World Health Organization.