UMYU Scientifica, Vol. 2 NO. 2, June 2023, Pp 128 – 141
https://doi.org/10.56919/usci.2322.014
ISSN: 2955 – 1145 (print); 2955 – 1153 (online)
A periodical of the Faculty of Natural and Applied Sciences, UMYU, Katsina

ORIGINAL RESEARCH ARTICLE

The Diversity, Composition and Economic Importance of Herbaceous Plants within the Federal Polytechnic Kaura Namoda Campus, Zamfara State, Nigeria.

Bello Bello Musawa*[1], Khalid Tukur[2], Nura Maiakwai Salah[3], Mustapha Sani Muhammad[4] and Mukhtar Lawal Abubakar[5].
[1,2,4,5]Department of Science Laboratory Technology, Federal Polytechnic Kaura-Namoda, P.M.B 1012 Zamfara State, Nigeria.
[3]Department of General Studies, College of Agriculture and Animal Science Wurno, Sokoto State Nigeria.

ABSTRACT
The diversity, composition and economic importance of herbaceous species within the federal polytechnic Kaura Namoda, Zamfara State was studied. The study's objective was to identify, document and evaluate the diversity and abundance of herbaceous species in the study area. The point-centered quarter (PCQ) method was employed in each sampling point. All nearest living herb species encountered were listed. Data obtained were quantitatively analyzed for Relative density (RD) and relative frequency (RF). Species diversity was calculated using Simpson's index and the Shannon-Weiner index. A total of 64 species of herb were identified belonging to 19 Families. Acanthaceae, Aizoaceae, Cleomaceae, Connaraceae, Laminaceae, Oxalidaceae, and Plantaginaceae had (1) species each. Convolvulaceae, Cucurbitaceae and Euphobiaceae had (2) species each. Apocynaceae, Asteraceae, Malvaceae, Pedaliaceae and Poaceae had (3) species each. Solonaceae is the only family with (4) species. Fabaceae is the only family with the highest number of species (32). A total of 494 individuals of herbaceous species were in the study area. Site A has the highest number of individuals (117), followed by Site D (103), Site C (95) and E (82). *Tephrosia pedicellata* has the highest species density of 3.2. *Leptadenia hastata, Centaurea perrottetii, Gynandropsis gynandra, Euphorbia balsamifera, Senna obtusifolia, Abrus precatorius, Desmodium velutinum, Crotalaria goreensis, Crotalaria pallida var.obovata, Tephrosia pedicellata, Indigofera oblongifolia, Tephrosia vogelii, Tephrosia linearis, Biophytum petersianum, Sesamum radiatum, Solanum lycopersicum* has the highest Frequency (100%). *Senna tora* has the highest relative abundance (5), and *Euphorbia balsamifera* has a Relative Density of 3.8. *Euphorbia balsamifera* has the highest relative density of 5, and *Ipomea asarifolia* has an IVI of 7. Shannon Weiner's diversity index for herbaceous species showed a total of 4.0097. Herbaceous plants are of economic importance; they serve as food, fooder, medicine, fuel, and other purposes. We recommended that there is a need for the conservation of herbaceous species within the Polytechnic to avoid harvesting the herbs for medicinal purposes and animals foraging on the grasses.

ARTICLE HISTORY
Received April 04, 2023.
Accepted June 18, 2023.
Published June 30, 2023.

KEYWORDS
Diversity, Composition, Economic importance and herbaceous species.

INTRODUCTION
The global biodiversity crisis has given rise to a growing concern at the prospect of a rapidly accelerating loss of species population, domesticated varieties, medicinal herbs and natural habitats. Currently, biodiversity is declining at an unprecedented rate in response to human-induced changes (Vitousek, 1994; Hooper *et al.*, 2005). The species diversity is one of the most important indices to evaluate ecosystems at different scales (Ardakani, 2004). About 12.9% of Earth's land surface is only protected (Chape, 2008), and with a growing human population, it is highly unlikely that protected areas will ever cover more than a small fraction of Earth's land surface. This is particularly true in the temperate zone (Potapov, 2008).

Nigeria is home to a wide range of habitats, ecosystems, and species diversity (Stuart and Adams, 1990). The number of species within any given location in the country depends partly upon certain factors, including the amount of rainfall received, habitat variation, and anthropogenic activities. There are about 7,895 plants distributed in the four major biomes of the country (Federal Government of Nigeria, FGN, 2001). Some are abundant, while others are rare (Gbile, Ola-Adams, and Soladoye, 1984; David,

Correspondence: Bello Bello Musawa. Department of Science Laboratory Technology, Federal Polytechnic Kaura-Namoda, P.M.B 1012 Zamfara State, Nigeria. ✉ bbmusawa004@gmail.com. Phone Number: +234 803 656 9616.
How to cite: Bello, B. M., Tukur, K., Maiakwai, N. S., Sani, M. M., & Lawal, M. A. (2023). The Diversity, Composition and Economic Importance of Herbaceous Plants within the Federal Polytechnic Kaura Namoda Campus, Zamfara State, Nigeria. *UMYU Scientifica*, 2(2), 128 – 141. https://doi.org/10.56919/usci.2322.014

2008). Several studies have noted that species diversity is greatly depleting in all parts, but more alarming in northern Nigeria (David, 2008).

According to Hornby (2001) and Mongkhonsin *et al.*, (2019), herbs are usually small tender plants lacking woody stems above ground. They occur in a wide variety of forms and leaf structures, including annuals, biennials and perennials, and broad-leaved plants (forbs) as well as grasses. Herbaceous species also constitute an important vegetative component of the environment due to their diverse ecological importance, including maintaining the structure and function of forests (Iwara *et al.*, 2014; Mohammed *et al.*, 2015). In particular, they are a habitat for wild animals, the base for a complex food web, stabilizing the soil and preventing soil erosion. Furthermore, they have economic relevance, such as sources of fodder, food, fuel and medicines, and aesthetic and cultural values for a vast number of people throughout the world (Abdullahi, 2011). Some herbaceous species in Federal Polytechnic Kaura-Namoda, such as *Euphorbia hirta*, *Acanthospernum hispidium*, and *Physallis angulata*, are used for medicinal purposes. Both human and animal ailments are treated through the use of these local vegetables. In most instances, these plant species are considered specific for a particular illness but have occasionally mixed usages. Herbaceous species, however, play a major role in improving water penetration into soils and adding organic matter that improves moisture-holding capacity and plant growth. It plays important productivity and environmental health functions by reducing runoff velocity (Department of Environment and Resource Management, (DERM, 2010). However, its small stature, herbaceous species has huge ecological significance in mediating carbon dynamics and energy flow and influencing the cycling rates of essential nutrients, including N, P, K and Mg (Gilliam, 2007). The herb community of tropical savannas is very little known, with few studies addressing its structure quantitatively. Even with this scarce body of information, it is clear that the herbs are a rich group, comprising 14 to 40% of the species found in total species counts in tropical forests. This stratum remains an underappreciated aspect of savanna ecosystems (Gilliam, 2007). The quantitative plant diversity inventories are the fundamental tool for conserving and managing tropical savannas (Campbell, 1994).

Human anthropogenic activities have been restructuring natural plant communities for over a decade, increasing and decreasing plant diversity across landscapes (Flinn and Vellend, 2005; Maezumi *et al.*, 2018). However, in the last few decades, human activities' direct and indirect effects have become the dominant driving force behind community turnover, population decline, and increased extinction risk in forests (Ellis *et al.*, 2012). Herbaceous communities often appear to have different, and at times opposing, responses to human disturbance compared to trees, but the consequences of anthropogenic pressures on herb diversity are still poorly recognized (Decocq *et al.*, 2014). The main chronic and acute threats to herbaceous plant diversity in forest ecosystems include land-use legacies, overgrazing, invasive species, climate change, logging, nutrient deposition, expansion of farming land, urbanization, industrialization and infrastructural development and fuel wood, bush burning, overgrazing, mining, forest and other plantations (Gilliam 2007, 2014; Duguid and Ashton 2013) hence the need for the conservation of herbaceous plants in the study area. Here, we carried out a quantitative inventory of understory species of the Federal Polytechnic Kaura-Namoda. The documentation and classification of this unique and often neglected vegetation community may enable efforts to be made for biological conservation (Jennings *et al.*, 2009; Ahmad and Ehsan, 2012).

MATERIALS AND METHOD

Study Area

This study was conducted at the Federal Polytechnic Kaura-Namoda main campus (long 12°35' N and latitude 6° 36' E). The permanent site of 1000 hectares land area is located on the northern periphery of Kaura-Namoda town at a distance of approximately 3 kilometres from the existing temporary site. The site is bounded by the Gusau-Katsina highway in the East, farmlands in the north, River Gajere in the west, Yankaba village in the northwest and farmlands, Government Low-Cost Housing Estate and Government secondary school in the south.

Kaura-Namoda lies within the hot/dry semi-desert climate type. It has two distinct seasons, the wet and dry, with two interfacing minor seasons. The dry season between November and March is characterized by very hot/dry conditions, during which rain may not fall with afternoon temperatures ranging between 30° C and 40°. At night, the temperature drops to between 14° and 20° due to rapid radiation resulting from cloudless skies. This gives the characteristics wide diurnal range typical of this climate. Most of the Kaura-Namoda lies in the Sudan savanna zone, extending its southern portion into the Northern Guinea Savanna zone. Sudan Savanna vegetation zone, under the natural conditions, as in the forest reserves, consists predominantly of grasses and scattered trees, including shrubs and scrubs.

Sampling Procedure and Methodology

The point-centered quarter (PCQ) method was employed (Cottam and Curtis, 1956; Dix, 1971; Abdullahi, 2010). Three transects (1, 2, and 3) of 100m long each were laid per site. There were 5 sampling points per transect, giving 15 sampling points. On each sampling point, four quarters were demarcated, and the nearest herb plant in terms of distance from the point to the centre of the herb plant. Readings were recorded within each quarter. This was done for all the sampling points on each transect.

Data Collection and Analysis

In each sampling point, all nearest living herb species encountered were listed. In each site, all nearest living herb plants were measured with measuring tape in each

quarter and recorded. Species encountered were identified on-site with the help of field guides and floras and texts (Blair, 1976; Lowe and Stanfield, 1974; Akobundu and Agyakwa, 1998). Also, morphological characteristics involving fruits, flowers, leaves and stems were used for identification. The specimens obtained were carried to the Biology Department, Umaru Musa Yaradua University and compared with herbarium specimens to validate the names. Nomenclature of the species follows Hutchinson and Dalzeil (1972).

Data obtained were quantitatively analyzed for Relative density (RD) and relative frequency (RF) following the procedure of Curtis (1959), and the relative values were summed up to obtain the Importance Value Index (IVI) (Misra 1968, Dallmier, 1992; Sabogal, 1992; Abdullahi, 2010). The formulae used to calculate RD, RF and (IVI) are as follows:-

RD = (number of individuals of a species)/ (total number of individuals of all species) x 100.

RF= (frequency of one species)/ (sum of all frequencies) x 100

IVI = sum of (RF+ RD+ RDo)

Species diversity was calculated using Simpson's index (Simpson, 1949) with this formula:

D = [N (N-1)] / [summation of n (n-1)], where D is the diversity index, N is the total number of individuals of all plant species found, and n is the number of individuals of a particular species.

Species diversity index was also calculated using the Shannon-Weiner index (Shannon, 1948) = $-\sum$ Pi In Pi, Where H' is the = Shannon –Weiner diversity index Pi= is the proportion of each species in the sample.

RESULTS

A total of 64 herb species were identified belonging to 19 Families, of which Family Fabaceae recorded the highest number of herbs (31) in the study area. Acantaceae, Aizoaceae, Cleomaceae, Connaraceaae Lamiaceae, Oxalidaceae and Plantaginaceae recorded the least number of species (1 each). The majority of the herbs are of high economic value to humans and other animals (Table 1).

Table 1: Family, Botanical name, local name, common name, voucher specimen number and economic value of herbaceous plant found in the study area.

Family	Botanical name	Local name	Common name	Voucher specimen number	Economic value
Acanthaceae	*Hygrophila schulli* (Buch.-Ham.) M. R. Almeida & S. M. Almeida	Kayar rakumma		BBM 61	The plant is used as a vegetable and traditional medicine.
Aizoaceae	*Zaleya pentandra* (L.) C. Jeffrey	Gadon maciji		BBM 52	General well being
Apocynaceae	*Anisopus mannii*	Karan masallaci		BBM 43	Ease pain
Apocynaceae	*Leptadenia hastata* (Pers) Decne	Yadiya		BBM 11	General well-being, serve food as podder
Apocynaceae	*Ceropegia adscendens* (Roxb.) Bruyns	Karan masallaci	Mosque reed	BBM 01	General well being
Asteraceae	*Vernonia strummambigum*	Tattaba		BBM 05	Fever
Asteraceae	*Baccharoides adoensis* (Sch. Bip. ex Walp.) H. Rob.			BBM 15	Vomiting
Asteraceae	*Centaurea perrottetii DC*	Surandi	Star thistle	BBM 19	Postpartum hemorrhage
Cleomaceae	*Gynandropsis gynandra* (L.) Briq.	Gasaya	White massambee	BBM 44	The leaves are eaten, boiled or stewed.
Connaraceae	*Rourea coccinea* subsp. *coccinea*	Tsamiyar Kasa	Tamarind of the valley	BBM 57	Breast milk enhancement
Convolvulaceae	*Evolvulu salsinoides* L.	Kafimalam	Morning glory	BBM 38	General well being
Convolvulaceae	*Ipomea asarifolia* (Desr.) Roem & Schult.	Duman kada	Balsam spurge	BBM 59	General well being
Cucurbitaceae	*Citrullus colocynthis* (L.) Schrader	Guna		BBM 02	It can be eaten or elaborated for further medical and energy use.
Cucurbitaceae	*Citrullus lanatus* (Thunb.) Matsum. & Nakai	Kankana	Water melon	BBM 09	It serves as a fruit.

Euphorbiaceae	*Ricinus comminis* L.	Castor bean	Zurma	BBM 12	Castor oil has many uses in medicine and other applications
Euphorbiaceae	*Euphorbia balsamifera Aiton, Hort*	Aliyara	Balsam spurge	BBM 24	General well being
Fabacea	*Indigofera astragalina* Dc.	Kai kai koma kan mashekiya	Silky indigo	BBM 26	General well being
Fabaceae	*Senna obtusifolia* (L.) Roxb	Tafasa	Sickle pod	BBM 29	1. The plant and seeds are edible. Young leaves can be cooked as vegetables. 2. The seeds and leaves are used to treat skin disease 3. Cassia tora is made into tea
Fabaceae	*Abrus precatorius* L.	Idon zakara		BBM 60	1. The seeds are used as beads and percussion instruments 2. Used as ornamental. 3. The root, leaves and seeds are used for different medicinal purposes
Fabaceae	*Vigna membranaceae* A.Rich.	Waken gajan gajan	Hog-peanut	BBM 36	The leaves are eaten after frying or boiling and are said to taste like cowpea leaves.
Fabaceae	*Desmodium velutinum* (Wild.) Dc.	Dan kadafi	Velvet-Leaf Desmodium	BBM 33	1. It is used by native people from a wide variety of conditions, including hepatitis and prevention of the liver from cirrhosis
Fabaceae	*Senna italica* Mill	Filasko	Italian senna	BBM 17	1. The leaves, pods and seeds of the plant are used in traditional medicine 2. In Malawi, root infusion is used to treat diarrhea in infants
Fabaceae	*Crotalaria goreensis* Guill. & Perr.	Gyadar awaki	Rattle pod	BBM 18	It is used as green manure.
Fabaceae	*Crotalaria pallida var.obovata* (G.Don) Polhil	Bakar bi rana	Smooth rattlebox	BBM 20	1. Several species of crotalaria are cultivated as a crop to be consumed by humans 2. They are also selected for resistance to disease yield and nutrient Quality
Fabaceae	*Crotalaria pallida alton*	Farar bi rana	Smooth rattlepod	BBM 22	Its wide consumption is due to its nutritional value as a rich source of B-carotene.
Fabaceae	*Vigna vexillata* (L.) A. Rich.	Waken damo	Wild pea	BBM 23	Very important food crops.
Fabaceae	*Mimosa pudica* L.	Karka tabani	Sensitive plant	BBM 03	1. Possesses antibacterial, antivenom, antifertility and anticonvulsant activities. 2. Also used traditionally in treating urogenital disorders, piles, dysentery, and sinus, and also applied on wounds.
Fabaceae	*Tephrosia pedicellata* Baker	Kunnen kusu	Hoarypea	BBM 08	General well being
Fabaceae	*Indogofera pilosa* Poir	Kasa kaifi	Softhairy indigo	BBM 50	Medicine
Fabaceae	*Uraria picta* (Jacq.) Dc.	Kini	Dabra	BBM 42	The roots are used as a sedative and to invigorate the liver and spleen. The plant is said to be an antidote to the bites of phursa snakes in India. Pounded leaves are used in the treatment of gonorrhea.
Fabaceae	*Tephrosia bracteolata* Guill. Perr.	Faskara toyi	Fish poison bean	BBM 41	1. The pounded leaves are used to stupefy and catch fish 2. Used as insecticide
Fabaceae	*Indigofera oblongifolia* Forssk.		Indigo blue	BBM 48	It is used for medicinal purposes like analgesic and anti-inflammatory effects.
Fabaceae	*Indigofera polyphylla* DC.			BBM 53	1. They are used as an analgesic with inflammatory activity 2. They are used as a dye
Fabaceae	*Indgofera conferta* J.B. Gillett		True indigo	BBM 56	1. The decoction of the leaves is used to treat sore feet 2. The leaves have anti-microbial properties
Fabaceae	*Crotalaria macrocalyx* Benth.		Rattlepod	BBM 58	It serves as food
Fabaceae	*Tephrosia vogelii* Hook. f.			BBM 31	1. Igbo people grind up the patched leaves in Nigeria to treat sores of yaws.
Fabaceae	*Crotalaria senegalensis* (Pers.) Dc.			BBM 32	1. The leaves serve as food 2. Use as fodder
Fabaceae	*Mucuna pruriens* Linn.		Velvet bean	BBM 40	Used as an important forage, fallow and green manure crop. It fixes nitrogen and fertilizes the soil.

Fabaceae	*Crotalaria retusa* L.			BBM 28	It is occasionally grown purely as an ornamental, though it is sometimes considered a weed.
Fabaceae	*Indigofera hirsuta* L.			BBM 10	The leaves are used as medicine, painkillers (Whole plants), and eye treatments (leaf, root).
Fabaceae	*Tephrosia purpurea* (L.) Pers.		Fish poison	BBM 16	The seeds are used as a substitute for coffee. All parts of the plant have tonic and laxative properties.
Fabaceae	*Tephrosia paniculata* Welw. Ex Baker			BBM 25	1. Used as poisons, cover crops and as ornamentals 2. It is also used as an insecticide and for medicine.
Fabaceae	*Tephrosia linearis* (Wild.) Pers			BBM 04	All livestock in Senegal grazes it. Pulped-up Fulanis use the leaves to add to milk, millet or guinea corn pap as seasoning. 2. In northwestern Nigeria, the plant is given as postnatal medicine
Fabaceae	*Indigofera conferta* J.B. Gillett			BBM 07	
Fabaceae	*Indigofera nummulariifolia* (L.) Alston			BBM 06	Recipes as well as dye for commercial purposes.
Fabaceae	*Crotalaria arenaria* Benth.			BBM 13	1. cultivated as crops to be consumed by humans 2. They have a very potential and important role in soil fertility as a green manure
Fabaceae	*Centrosema molle* Mart. Ex Benth.	Sakayau	Butterfly pea	BBM 14	As plantation ground cover, also in grazed pastures in a mixture of grasses.
Lamiaceae	*Ocimum gratissimum* L	Daddoya	Sweet basil	BBM 21	Leaves-cooked and eaten as a potherb. Clove basil is an aromatic, stimulant, antispasmodic, antiseptic herb that repels insects and lower fever.
Malvaceae	*Melochia corchorifolia* L.		Chocolate weed.	BBM 27	It is used as a source of fibre for making dilly bags and other objects. The leaves are consumed as a potherb.
Malvaceae	*Hibiscus safdarifa* L.	Roselle	Yakuwa	BBM 47	The red calyces of the plant are used as food coloring, and it is processed as juices.
Malvaceae	*Sida ovata* Forssk.	Miyar tsanya		BBM 34	Medicine: dropsy, swellings, oedema
Oxalidaceae	*Biophytum petersianum* Klotzsch	Kabude ka noke	Sensitive plant	BBM 39	It's used as medicine
Pedaliaceae	*Sesamum radiatum* Schumach.	Karkashi	Benniseed, black benniseed	BBM 37	It is used as leafy vegetables; the seed are eaten whole or as a paste
Pedaliaceae	*Sesamum orientale* L.	Karkashi		BBM 35	It's used as traditional medicine. The leaves are astringent, used in the treatment of infant, cholera, diarrhea and dysentery.
Pedaliaceae	*Sesamum alatum* P.Thonn.	Ridin barewa	Winged seed sesame	BBM 49	Leaves and young shoots are cooked and eaten as a vegetable. Mucilaginous fruits are eaten and used for oil production.
Plantaginaceae	*Scoparia dulcis* L.	Rumafada	Sweet broom weed	BBM46	General well being
Poaceae	*Cenchrus biflorus* Roxb.	Karangiya	Bur grass	BBM 45	As food
Poaceae	*Eleusine indica (*L.) Gaertn	Tuji	Goose grass	BBM 55	Uses as podder
Poaceae	*Cynodon dactylon* (L.) Pers.	Tsarkiyar zomo	Bermuda grass	BBM 54	The plant is alterative, antipruritic, and antiseptic, aperient. A decoction of the whole plant treats conditions such as anasarca, anuria, convulsions, etc.
Solanaceae	*Physalis angulate* L.		Angular winter cherry, ballon cherry.	BBM 62	Edible fruit – raw or cooked. Young leaves – raw or cooked as a potherb. The plant is a diuretic, expectorant, febrifuge.
Solonaceae	*Datura stramonium* L.	Zakami	Jimson weed	BBM 53	It has been used in various treatments of traditional medicine or drug abuse as well as hallucinogen.
Solonaceae	*Solonum americanum* Mill.	Gautan kaji	Bird pepper	BBM 63	Young shoots and leaves cooked.
Solonaceae	*Solanum lycopersicum* L.	Tumatir	Tomato	BBM 64	It is used as food, stew.

Color Photographs of some Selected Herbaceous Plants

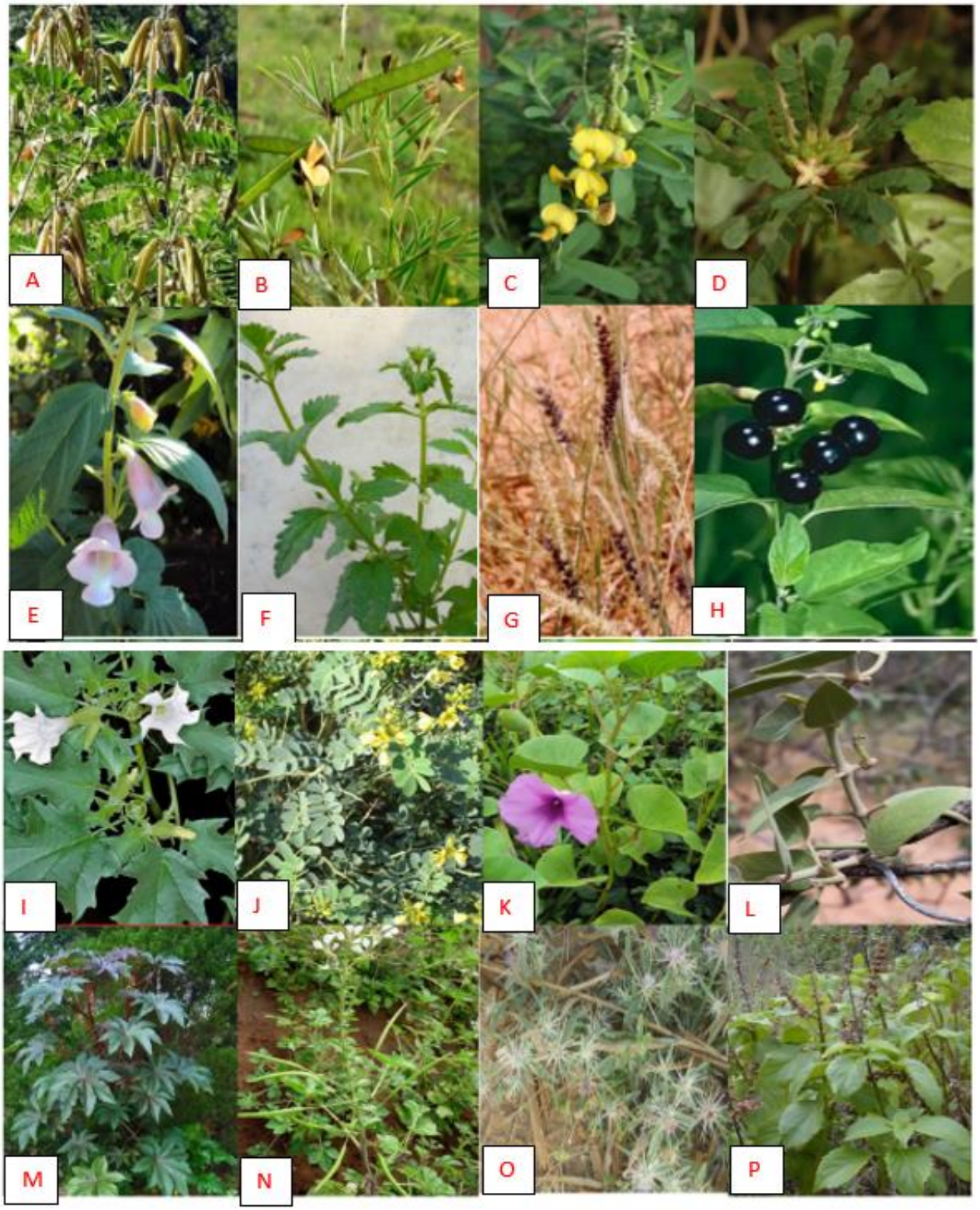

Figure 1a: A = *Teprosia vogelli*, B = *Teprosia linearis*, C = *Crotalaria retusa*, D = *Biophytum petersianum*, E = *Sesamum radiatum*, F = *Scoparia dulcis*, G = *Cenchrus biflorus*, H = *Solanum americanum*, I = *Datura stramonium*, J = *Senna italica*, K = *Ipomoea asarifolia*, L = *Leptadenia hastata,* M = *Ricinus communis*, N = *Gynandropis gynandra*, O = *Centauria perrottetii*, P = *Ocimum gratissimum.*

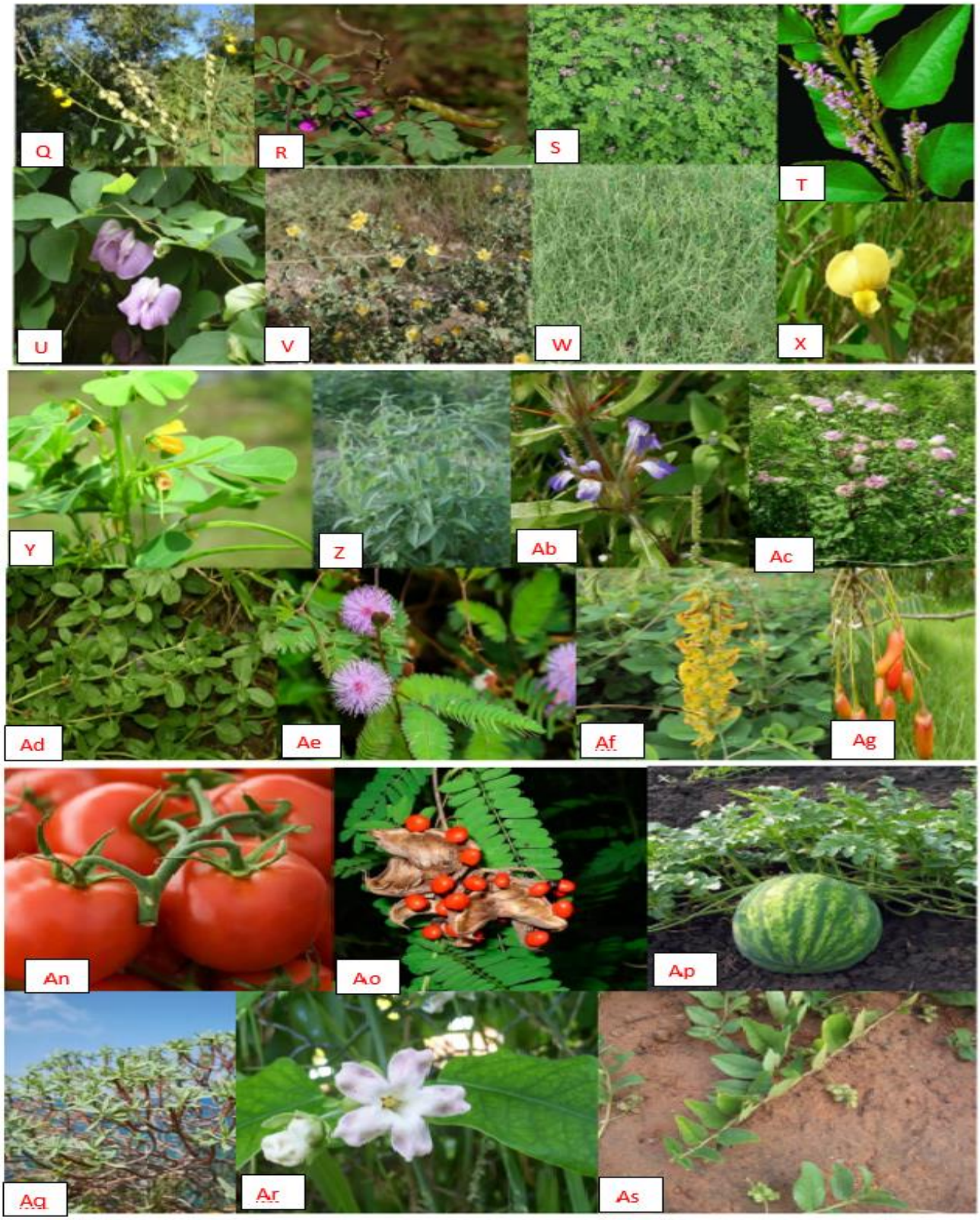

Figure 1b: Q = *Crotalaria senegalensis,* R = *Tephrosia purpurea,* S = *Indigofera astragalinaI*, T = *Desmodium velutinum,* U = Centrocema molle, V = *Sida ovate,* W = *Eleusine indica,* X = *Vigna membranacea,* Y = *Senna obtusifolia,* Z = *Melochia corchorifolia,* Ab = *Hygrophila schulli,* Ad = *Zaleya pentandra,* Ae = *Mimosa pudica,* Af = *Crotallaria pallida*, Ag = R*ourea coccinea.* An = *Solanum lycopersicum,* Ao = *Abrus precatorious*, Ap = *Citrullus lanatus*, Aq = *Euphorbia balsamifera,* Ar = *Anisopus mannii,* As = *Indigofera nummulariifolia*

The Table 2 below gives the total number of the herbaceous plants found in each of the five sites designated for the sampling in the study area. A total of 494 individuals werefound in the study area.Site A has the highest number of individuals (117) followed by site D (103), Site C (95) and E (82)

Table 2: Total count of herbaceous species within the study area

Herbaceous species	Site A	Site B	Site C	Site D	Site E	Total
Hygrophila schulli	2	1	3	-	1	7
Zaleya pentandra	-	2	4	-	3	9
Anisopus mannii	3	1	1	1	-	6
Leptadenia hastata	4	3	2	3	1	13
Caralumma dalziella	2	1	-	2	-	5
Mimosa pudica	1	3	1	1	-	6
Vernonia strummambigum	-	-	-	-	4	4
Baccharoides adoensis	2	1	-	4	1	8
Physalis angulate	-	-	-	2	1	3
centaurea perrottetii	2	1	2	1	1	7
Gynandropsis gynandra	2	4	5	2	1	14
Rourea coccinea	-	-	2	-	1	3
Evolvulu salsinoides	2	3	2	1	-	8
Ipomea asarifolia	4	3	5	2	-	14
Citrullus colocynthis	-	2	-	3	2	7
Citrullus lanatus	-	-	-	3	-	3
Ricinus comminis.	4	-	-	3	1	8
Euphorbia balsamifera	3	4	5	2	4	18
Indigofera astragalina	1	-	2	3	2	8
Senna tora	4	5	6	6	4	25
Abrus precatorius	2	3	-	-	-	5
Vigna membranaceae	3	2	4	2	1	12
Desmodium velutinum	1	-	-	3	2	6
Senna italica	4	3	5	3	5	20
Crotalaria goreensis	3	3	4	2	1	13
Crotalaria pallida var.obovata	2	3	1	2	-	8
Crotalaria pallida alton	2	3	1	-	-	6
Vigna vexillata	3	2	1	2	-	8
Melochia corchorifolia	-	-	-	3	1	4
Ocimum gratissimum	5	3	2	2	4	16
Tephrosia pedicellata	2	3	4	1	-	10
Indogofera pilosa	-	-	-	3	2	5
Uraria picta	2	-	1	2	-	5
Tephrosia bracteolate.	2	2	1	3	1	9
Indigofera oblongifolia	3	-	-	-	2	5
Indigofera polyphylla	-	2	-	-	-	2
Indgofera conferta	-	-	-	3	1	4
Crotalaria macrocalyx	2	4	3	1	3	13
Tephrosia vogelii	1	-	-	3	3	7
Crotalaria senegalensis	2	-	3	2	4	11
Mucuna pruriens	2	-	-	-	2	4
Crotalaria retusa	1	-	-	2	1	4
Indigofera hirsute	2	3	2	3	-	10
Tephrosia purpurea	1	2	-	-	-	3
Tephrosia paniculata	-	-	-	-	3	3
Tephrosia linearis	1	1	2	1	2	7

Indigofera conferta	-	-	1	-	-	1
Indigofera nummulariifolia	3	2	-	-	2	7
Crotalaria arenaria	2	1	-	2	2	7
Centrosema molle	1	-	-	-	2	3
Melochia corchorifolia	-	-	2	2	-	4
Hibiscus safdarifa	4	5	2	-	-	11
Sida ovata	-	2	3	1	2	8
Biophytum petersianum	2	1	3	1	2	8
Sesamum radiatum	1	1	2	1	2	7
Sesamum orientale	2	3	1	2	-	8
Sesamum alatum	4	3	2	1	1	11
Scoparia dulcis	-	-	-	2	-	2
Cenchrus biflorus	-	1	-	-	-	1
Eleusine indica	5	2	1	3	1	12
Cynoidon dactylon	1	-	-	-	-	1
Datura stramonium	3	2	1	2	-	8
Solonum americanum	4	3	1	-	-	8
Solanum lycopersicum	3	1	2	3	2	11
Total	**117**	**100**	**95**	**103**	**82**	**494**

Table 3 below shows that *Tephrosia pedicellata* has the highest density of 3.2, *Leptadenia hastata, Physalis angulata, Vigna membranaceae, Senna italica, Crotalaria goreensis*, *Cynodondactylon* has the highest relative frequency of 1.01. *Senna tora* has the highest relative abundance (5), *Euphorbia balsamifera* has a Relative Density of 3.8. *Euphorbia balsamifera* has the highest relative density of 5, and *Ipomea asarifolia* has an IVI of 7.

Table 3: Density (Den), Relative Frequency (RF), Abundance (Abu), Relative density (RD%), Relative dominance (R.Dom. %) and Importance Value Index (IVI) of Herbaceous species in the study area

Herbaceous species	Den.	RF.	Abu.	RD (%)	R.Dom (%)	IVI
Hygrophila schulli	1.4	0.81	1.75	1.4	1.4	3.61
Zaleya pentandra	1.8	0.60	3	1.8	1.8	4.2
Anisopus mannii	1.2	0.81	1.3	1.2	1.2	3.21
Leptadenia hastate	2.6	1.01	2.6	2.6	2.6	3.87
Caralumma dalziella	1	0.60	1.6	1	1.2	2.8
Mimosa pudica	1.2	0.02	1.5	1.2	0.8	2.02
Vernonia strummambigum	0.8	0.81	1	0.8	1.6	3.21
Baccharoides adoensis	1.6	0.40	2	1.6	0.6	2.6
Physalis angulata	0.6	1.01	1.5	0.6	1.4	3.01
Centaurea perrottetii	1.4	0.81	1.4	1.4	2.8	5.1
Gynandropsis gynandra	2.8	0.81	2.8	2.8	1.4	5.1
Rourea coccinea	1.4	0.81	1.5	0.6	0.6	2.01
Evolvulu salsinoides	0.6	0.60	2	1.6	1.4	3.6
Ipomea asarifolia	1.6	0.60	3.5	2.8	3.6	7
Citrullus colocynthis	2.8	0.60	2.3	1.4	1.4	3.4
Citrullus lanatus	1.4	0.02	1	0.6	5.1	5.72
Ricinus comminis.	0.6	0.40	2.6	1.6	1	3
Euphorbia balsamifera	1.6	1.01	3.6	3.8	5	9.81
Indigofera astragalina	3.6	0.81	2	1.6	1.2	3.61
Senna tora	1.6	1.01	5	5	4	10.01
Abrus precatorius	5	0.40	2.5	1	2.6	4
Vigna membranaceae	1	1.01	2.4	2.4	1.4	4.81
Desmodium velutinum	2.4	0.60	2	1.2	1.2	2.8
Senna italica	1.2	1.01	4	4	1.4	5.41
Crotalaria goreensis	4	1.01	2.6	2.6	0.8	4.41
Crotalaria pallida var.obovata	2.6	0.81	2	1.6	3.2	5.51
Crotalaria pallida alton	1.6	0.60	2	1.2	2	3.8
Vigna vexillata	1.2	0.81	2	1.6	1	3.41
Leucas martinensis	1.6	0.81	2	0.8	1	2.61

Ocimum gratissimum	0.8	0.40	3.2	3.2	1.8	5.40
Tephrosia pedicellata	3.2	1.01	2.5	2	0.4	3.41
Indogofera pilosa	2	0.81	2.5	1	0.8	2.61
Uraria picta	1	0.40	1.6	1	2.6	4
Tephrosia bracteolate.	1	0.6	1.8	1.8	1.4	3.8
Indigofera oblongifolia	1.8	1.01	2.5	1	2.2	4.21
Indigofera polyphylla	1	0.4	1	0.4	0.8	1.6
Indgofera conferta	0.4	0.02	2	0.8	2.6	3.42
Crotalaria macrocalyx	0.8	0.40	2.6	2.6	1.4	4.40
Tephrosia vogelii	2.6	1.01	2.3	1.4	2.2	4.61
Crotalaria senegalensis	1.4	0.60	2.8	2.2	0.8	3.60
Mucuna pruriens	2.2	0.60	2	0.8	0.8	2.2
Crotalaria retusa	1.8	0.81	1.3	0.8	2	3.61
Indigofera hirsuta	1.8	0.40	2.5	2	0.6	3
Tephrosia purpurea	2	0.81	1.5	0.6	0.6	2.01
Tephrosia paniculata	0.6	0.40	1.5	0.6	2.2	3.2
Tephrosia linearis	0.6	0.02	1.4	1.4	1.6	3.02
Indigofera conferta	1.4	1.01	1	0.2	1.6	2.81
Indigofera nummulariifolia	1.4	0.02	2.3	1.4	1.4	2.82
Crotalaria arenaria	0.6	0.60	1.7	1.4	1.6	3.60
Centrosema molle	0.8	0.81	1.5	0.6	2.2	3.61
Melochia corchorifolia	2.2	0.04	2	0.8	0.4	1.24
Hibiscus safdarifa	1.6	0.40	1.6	2.2	0.2	2.80
Sida ovata	1.6	0.60	1.4	1.6	2.4	3.60
Biophytum petersianum	1.4	0.81	2	1.6	0.2	2.61
Sesamum radiatum	1.6	1.01	2.2	1.4	1.6	4.01
Sesamum orientale	2.2	1.01	1	1.6	1.6	4.21
Sesamum alatum	0.4	0.81	1	1.6	2.2	3.61
Scoparia dulcis	0.2	1.01	2.4	1.4	2.1	4.51
Cenchrus biflorus	2.4	0.02	1	1.6	1.2	2.82
Eleusine indica	0.2	0.02	2	2.2	2	4.22
Cynoidon dactylon	2.4	1.01	2.6	0.4	1.6	3.01
Datura stramonium	0.2	0.02	2.2	0.2	2.2	2.42
Solonum americanum	1.6	0.81	1.5	2.4	1.6	4.81
Solanum lycopersicum	1.6	0.60	1.4	0.2	1.4	2.20

Table 4 below showed the Shannon Weiner diversity index in which the herbaceous species has a total index of 4.0097.

Table 4: Shannon Weiner diversity index for herbaceous species.

Herb species	Pi	Ln Pi	H
Hygrophila schulli	0.014	-4.268	-0.0655
Zaleya pentandra	0.018	-2.250	-0.0405
Anisopus mannii	0.012	-4.422	-0.0530
Leptadenia hastate	0.026	-3.649	-0.0437
Caralumma dalziella	0.01	-4.605	-0.0460
Mimosa pudica	0.012	-4.422	-0.0530
Vernonia strummambigum	0.008	-2.525	-0.0202
Baccharoides adoensis	0.016	-4.135	-0.0413
Physalis angulata	0.006	-5.115	-0.0306
Centaurea perrottetii	0.014	-4.268	-0.0597
Gynandropsis gynandra	0.028	-3.575	-0.1001
Byrsocarpus scoccineus	0.006	-5.115	-0.0306
Evolvulu salsinoides	0.016	-4.135	-0.0661
Ipomea asarifolia	0.028	-3.575	-0.1001
Citrullus colocynthis	0.014	-4.268	-0.0597
Citrullus lanatus	0.006	-5.115	-0.0306
Ricinus comminis.	0.016	-4.135	-0.0661
Euphorbia balsamifera	0.038	-3.270	-0.1242
Indigofera astragalina	0.016	-4.135	-0.0661

Senna tora	0.05	-2.995	-0.1497
Abrus precatorius	0.01	-4.605	-0.0460
Vigna membranaceae	0.024	-3.729	-0.0745
Desmodium velutinum	0.012	-4.422	-0.0530
Senna italica	0.04	-3.219	-0.1287
Crotalaria goreensis	0.026	-3.649	-0.0948
Crotalaria pallida var.obovata	0.016	-4.135	-0.0661
Crotalaria pallida alton	0.012	-4.422	-0.0530
Vigna vexillata	0.016	-4.135	-0.0661
Melochia corchorifolia	0.008	-2.525	-0.0202
Ocimum gratissimum	0.032	-3.442	-0.1101
Tephrosia pedicellata	0.02	-3.912	-0.0782
Indogofera pilosa	0.01	-4.605	-0.0460
Uraria picta	0.01	-4.605	-0.0460
Tephrosia bracteolate.	0.018	-4.017	-0.0723
Indigofera oblongifolia	0.014	-4.268	-0.0597
Indigofera polyphylla	0.018	-4.017	-0.0723
Indgofera conferta	0.012	-4.422	-0.0530
Crotalaria macrocalyx	0.026	-3.649	-0.0948
Tephrosia vogelii	0.01	-4.605	-0.0460
Crotalaria senegalensis	0.012	-4.422	-0.0530
Mucuna pruriens	0.008	-2.525	-0.0202
Crotalaria retusa	0.016	-4.135	-0.0661
Indigofera hirsuta	0.006	-5.115	-0.0330
Tephrosia purpurea	0.006	-5.115	-0.0306
Tephrosia paniculata	0.006	-5.115	-0.0306
Tephrosia linearis	0.014	-4.268	-0.0597
Indigofera conferta	0.002	-6.214	-0.0124
Indigofera nummulariifolia	0.014	-4.268	-0.0597
Crotalaria arenaria	0.014	-4.268	-0.0597
Centrosema molle	0.006	-5.115	-0.0306
Melochia corchorifolia	0.008	-4.828	-0.0386
Hibiscus safdarifa	0.022	-3.816	-0.0839
Sida ovata	0.016	-4.135	-0.0661
Biophytum petersianum	0.016	-4.135	-0.0661
Sesamum radiatum	0.014	-4.268	-0.3421
Sesamum orientale	0.016	-4.135	-0.0661
Sesamum alatum	0.016	-4.135	-0.0661
Scoparia dulcis	0.014	-4.268	-0.0597
Cenchrus biflorus	0.016	-4.135	-0.0661
Eleusine indica	0.022	-3.816	-0.0839
Cynoidon dactylon	0.014	-4.268	-0.0597
Datura stramonium	0.002	-6.214	-0.1242
Solonum americanum	0.024	-3.729	-0.0894
Solanum lycopersicum	0.002	-6.214	-0.1242
Total	0.994	-268.808	-4.0097

Thus, Shannon Index (H') for herbs = - (-H), Therefore : -(- -4.0097) which is 4.0097

DISCUSSION

This study has documented herbaceous flora's diversity, composition and environmental relevance in Federal Polytechnic Kaura Namoda. Herbaceous plants around our environment are vital in promoting sustainable community development. As an important component of green infrastructure, herbs can provide several social, communal, psychological, economic and environmental benefits. They also contribute greatly to the health and welfare of everyone who lives and works in the environment. All the herbs in the study area are terrestrial due to the climatic conditions of the study area. These results agree with the work of Osawaru *et al*., (2014), and Oni and Ndiribe (2019), where mostly terrestrial weeds were found in the study site. The reason for the poor establishment of some families may be attributed to anthropogenic activities like land clearing and weeding during the rainy season, and most of the herbs are perennial in nature.

In the study area, the families Acanthaceae, Aizoaceae, Cleomaceae, Connaraceae, Laminaceae, and Oxalidaceae, Plantaginaceae had one species each. Convolvulaceae,

Cucurbitaceae and Euphobiaceae had two species each. Apocynaceae, Asteraceae, Malvaceae, Pedaliaceae and Poaceae had three species each. Solonaceae is the only family with four species. Fabaceae is the only family with the highest number of species (thirty-two). The Fabaceae family is one of the most widely distributed and abundant groups and an important family of the earth's flora. Their success resulted from their tolerance of grazing herbivores and drought, their varied means of reproduction, and their versatility in photosynthesis. Iheyen *et al*., (2009) also reported the Fabaceae family as the most abundant family in Ehor Forest Reserve, Edo State. Predominance of this family may be as a result of their efficient seed dispersal mechanism. Most Fabaceae family members are wind-dispersed, which may account for their widespread occurrence.

A similar study was carried out by Atiku and Bello (2011) at Wassaniya Forest Reserve of Sokoto State Abbat *et al.,* (2015) at Kanawa Forest Reserve in Gombe State (Nigeria), using the point-centered quarter method. Another study was carried out in the Yankari Game Reserve (YGR) in the Savanna-Woodlands of Northern Nigeria by Abdullahi (2010). The number obtained (Families and the number of species) in the present study was higher than that of Wassaniya Forest Reserve, probably because of the size, location, soil composition, soil types and climatic factors, which gave rise to a higher number of species. It was, however, higher than that of Yankari Game Reserve, because of the statute of Yankari as a game reserve and the area's moist–warm climate, geological and topographic nature. The species has high economic value, including medicinal and auxiliary purposes, foods, vegetables and animal fodder.

The biodiversity indices applied in this study align with Edet *et al*., (2012), Linares-Palomino *et al*., 2009, Moro *et al*., 2014, and Queiroz *et al*., 2015. *Senna obtusifolia*had relative density of 5, *Senna italica* 4, *Ocimum gratissimum* and *Euphorbia balsamifera* had 3.8 each, showing their abundance in the study area. Some species had a density of less than 1 and may be considered threatened or endangered within the study area. These species are endangered and may soon be absent from the study area if sustainable management practices such as massive replanting exercise and constituting a committee to oversee herbs management are not adopted. The disappearance of many plant species due to anthropogenic activities is depleting the world's genetic resources and putting man's biodiversity heritage under serious threat. There is an urgent need to preserve genetic diversity including plant resources of known and unknown economic importance, to guarantee the availability of their potential in the interest of unborn children (Olowokudejo, 1987; Samedani *et al*., 2013).

CONCLUSION

Although the study was conducted within Federal Polytechnic Kaura Namoda, Zamfara State, the polytechnic serves as the habitat of different species of herbs due to the large size of the school and soils, which support the growth of different flora in the area. Many species (herbs) were found to be of economic value. The area needs to be conserved to protect the area from further encroachment from human activities such as harvesting herbs for medicinal purposes and animals foraging on the grasses. Conservation efforts should be stepped up for such species to prevent them from going into extinction. The results of this work will serve as baseline data that could be helpful in the appraisal of plant resources of the School ecosystem for its effective management. The continuous involvement of rural communities around the School should be rewarded, in the form of incentives, by the government agency responsible for the protection and management of the Polytechnic.

REFERENCE

Abba Halima Mohammed, Sawa Fatima Binta Jahun, Gani Alhassan Mohammed, Abdul Suleiman Dangana (2015). Herbaceous Species Diversity in Kanawa Forest Reserve (KFR) in Gombe State, Nigeria. American Journal of Agriculture and Forestry. Vol. 3, No. 4, 2015, pp. 140-150. **[Crossref]**

Abdullahi M.B (2011). An investigation into the herbaceous plant formations Of Yankari Game Reserve Bauchi, Nigeria. Botany Research Journal 4(3) pp 29-34.

Abdullahi, M.B (2010). Phytosociological Studies and Community Rural ApppraisalTowards Biodiversity Conservation in Yankari Game Reserve, Bauchi State, Nigeria. An unpublished Ph.D Thesis. Abubakar Tafawa Balewa University, Bauchi, Nigeria, pp 99

Abdullahi, M.B (2010). Phytosociological Studies and Community Rural Apppraisal Towards Biodiversity

Ahmad, S. S. and Ehsan, H. (2012) Analyzing the herbaceous flora of Lohi Bher Wildlife Park under variable environmental stress. Pak. J. Bot., 44(1): pp11-14.

Akobundu, I.O. and C.W Agyakwa. (1998). A Hand Book of West African Weeds.International Institute of Tropical Agriculture, IITA, Ibadan.pp 1-.557.

Ardakani MR.Ecology. Tehran UniversityPress.2004; 340.

Atiku, M, and Bello, A.G (2011). Diversity of herbaceous plants in Wassaniya Forest Reserve of Sokoto State, Nigeria.Forestry Association of Nigeria, Conference paper. pp 438-443

Blair, R.A (1976). A Field Key to the Common Genera ofNigerian Grasses.Part 1 and 2. University Press Ibadan. Pp 76 .

Campbell, DG (1994). Scale and pattern of community structure in Amazonian rainforest in Edwaeds P J. May RM.Web NR (eds) Larger scale ecology and conservation biology. Blackwell, Oxford.

Chape S, Spalding M, Jenkins M. The World's protected areas: Status, values, and prospects in the twenty-first century. Berkeley, CA: University of CaliforniaPress; 2008.

Chapin FS III, Zavaleta ES, Eviner VT, Naylor RL, Vitousek PM, Reynolds HL, Hooper DU, Lavorel S, Sala OE, Hobbie SE, Mack MC, Diaz S. Consequences of changing biodiversity. Nature. 2000; 405:234-242. **[Crossref]**

Connell JH. Diversity in tropical rain forests and coral reefs. Science. 1978; 199 (4335):1302-1310. **[Crossref]**

Conservation in Yankari Game Reserve, Bauchi State, Nigeria. An unpublished Ph.D Thesis. Abubakar Tafawa Balewa University, Bauchi, Nigeria, pp 99.

Cottam, G and Curtis J.T (1956). The use of distance measurements in phytosociological sampling.Ecology 37(3) pp460. **[Crossref]**

Curtis, JT (1957). The vegetation of Winsconsin: An ordination of plant communities.Uniersity of Wisconsin press Madison,Wisconsin. pp657

Dallmeier, F. (Ed.). (1992). Long-term monitoring of biological diversity in Tropical Digest 11 .UNESCO, Paris.

David, M. (2008).118/119 Biodiversity and Tropical Forest Assessment for Nigeria. USDA Forest Service/International Forestry for USAID/Bureau for Africa. Washington, DC.

Decocq G, Beina D, Jamoneau A, Gourlet-Fleury S, ClossetKopp D (2014) Don't miss the forest for the trees! Evidence for vertical differences in the response of plant diversity to disturbance in a tropical rain forest. Perspect Plant Ecol Evol Syst 16:279-287. **[Crossref]**

Department of Environment and resource management (2010). Fitzroy Basin Draft Water Resource Plan environmental assessment: Stage 2 assessment report, DERM, Brisbane.

Dix, R. L (1971). An application of the point-centered quarter method to the samplingof grassland vegetation. Journal of Range Management. 14:63-69pp. **[Crossref]**

Duguid MC, Ashton MS (2013) A meta-analysis of the effect of forest management for timber on understory plant species diversity in temperate forests. For Ecol Manage 303:81-90. **[Crossref]**

Edet, D.I., Ijeomah, H. M.and Ogogo, A. U. (2012). Preliminary assessment of tree species diversity in Edo State, Nigeria. Nature and Science 7(8): 8 - 18.

Ellis EC, Antill EC, Kreft H (2012) All is not loss: Plant biodiversity in the Anthropocene. PLoS ONE 7:e30535. **[Crossref]**

Federal Government of Nigeria (2001).First National Biodiversity Report. Nigeria Afi Mountain Wildlife Sanctuary, Southern Nigeria. Agricultural and Biology Journal of North America

Flinn KM, Vellend M (2005) Recovery of forest plant communities in post-agricultural landscapes. Front Ecol Environ 3:243-250. **[Crossref]**

Gbile, Z.O., Ola-Adams, B.A. and Soladoye, M.O. (1984). List of rare species of the Nigerian Flora. Research Paper Forest Series No 47. Forestry Research Institute of Nigeria, Ibadan, Nigeria.

Gilliam FS (2007) The ecological significance of the herbaceous layer in temperate forest ecosystems. Bioscience 57:845-858. **[Crossref]**

Gilliam FS (2014) The herbaceous layer in forests of eastern North America, 2nd edn. Oxford University Press, New York, NY. **[Crossref]**

Gilliam, F. S. (2007). Ecological Significance of the Herbaceous Layer in Temperate Forest Ecosystems; Biosceince. 57 (10) 845 - 858pp. 2007 American Institute of Biological Sciences. **[Crossref]**

Hooper DU, Chapi FSI,Ewel JJ, Hector A,Inchausti P, Lavorel S, Lawton JH, LodgeD, Loreau M, Naeem M, Schmid SB,Setala H, Symstad AJV, Vandermeer J.Wardle DA. Effects of biodiversity on ecosystem functioning: A consensus ofcurrent knowledge. Ecological Monograph.2005; 75:3-35. **[Crossref]**

Hornby, A. S. (2001). Oxford Advanced Learners Dictionary .6th Edition. Oxford University Press, Oxford, New York.pp580.

Huston M. A general hypothesis of species diversity. American Naturalist.1979; 113 (1):81-101. **[Crossref]**

Iheyen, J., Okoegwale, E.E., and Mensah, J.K. (2009). Composition of tree species in Ehor Forest Reserve,

Iwara A.LOffiong,R.A, Nar, G.N.Ogundele,F.O (2014). An assessment of Herbaceous Species Diversity, Density, Cover in Agoi Ekpo, Cross River State, Nigeria.International Journal of Biological Sciences. 01(01) : 21-29.

Jennings, M.D., Faber-Langendoen, D., Loucks, O. L., Peet, R. K. and Roberts, D. (2009) Standards for associations and alliances of theU.S. National Vegetation Classification. Ecological Monographs, 79 (2):pp 173-199. **[Crossref]**

Linares-Palomino R, Cardona V, Hennig EI, Hensen I, Hoffmann D, Lendzion J, Soto D, Herzog SK and Kessler M 2009 Nonwoody life-form contribution to vascular plant species richness in a tropical American forest. Plant Ecol. 201: 87-99. **[Crossref]**

Lowe, J and Stanfeild, D. P (1974). The Flora of Nigerian Sedges (Family Cyperaceae).University press. Ibadan. Nigeria.pp 140-185.

Maezumi SY, Alves D, Robinson M, de Souza JG, Levis C, Barnett RL, Almeida de Oliveira E, Urrego D, Schaan D, Iriarte J (2018) The legacy of 4,500 years of polyculture agroforestry in the eastern Amazon. Nat Plants 4:540-547. **[Crossref]**

Misra, R (1968). Ecology work Book.Oxford and IBH Publishing Co. Calcutta.244 pp.of grassland vegetation.Journal of Range Management.14:pp63-69

Mongkhonsin B, Nakbanpote W, Meesungnoen O and Prasad MNV 2019 Adaptive and tolerance mechanisms in herbaceous plants exposed to cadmium. In: Cadmium Toxicity and Tolerance in Plants (pp. 73-109). Academic Press. **[Crossref]**

Moro MF, Lughadha EN, Filer DL, Araujo FS and Martins FR (2014). A catalogue of the vascular plants of the Caatinga phytogeographical domain: a synthesis of floristic and phytosciological surveys. Phytotaxa 160: 1-118. **[Crossref]**

Olowokudejo, J. D. (1987). Medicinal plants used as vermifuges in Nigeria and their conservation.

Oni R and Ndiribe C 2019Vegetation analysis of herbaceous species in the University of Lagos, Nigeria. UNILAG J. Med. Sci. Technol. 7(1): 129-141.

Osawaru, M.E., Ogwu, M.C., Chime, A.O. and Ebosa, A. B. (2014). Weed flora of University of Benin in terms of diversity and richness using two ecological models. Scientia Africana 13(2): 102 - 120.

Petraitis PS, Latham RE, Niesenbaum RA (1989). The maintenance of species diversity by disturbance. Quarterly Review of Biology. 64 (4):393-418. **[Crossref]**

Potapov P, Yaroshenko A, Turubanova S,Dubinin M, Laestadius L, Thies C,Aksenov D, Egorov A, Yesipova Y,Glushkov I, Karpachevskiy M, Kostikova A,Manisha A, Tsybikova E, Zhuravleva I. Mapping the world's intact forest land scopes by remote sensing. Ecology and Society. 2008; 13:51. **[Crossref]**

Queiroz RT, Moro MF and Loiola MIB (2015). Evaluating the relative importance of woody versus non woody plants for alphadiversity in semi-arid ecosystem in Brazil. Plant Ecology and Evolution 148(3): 361- 376. **[Crossref]**

Sabogal, C. (1992). Regeneration of tropical dry forests in Central America, with examples from Nicaragua. J Veg Sci 3:407-416 pp. **[Crossref]**

Samedani B, Juraimi AS, Rafii MY, Anuar AR, Sheikh A, Awadz SA and Anwar MP 2013 Allelopathic effects of litter axonopuscompressus against two weedy species and its persistence in soil. Sci. World J. 2013: Article ID 695404. **[Crossref]**

Sousa WP (1979). Disturbance in marine inter tidal boulder fields: The non-equilibrium maintenance of species diversity. Ecology. 60 (6):1225-1239. **[Crossref]**

Srivastava DS, Vellend M. Biodiversity-ecosystem function research: Is it relevant to conservation? Annual Review of Ecology, Evolution and Systematics. 2005; 36:267-294. **[Crossref]**

Stuart, S.N. and Adams, R.J. (1990). Biodiversity in Sub-Saharan Africa and its Islands: Conservation, Management, and Sustainable Use. Gland, Switzerland: IUCN.

Vitousek PM. Beyond global warming: Ecology and global change. Ecology. 1994; 75:1861-1876. **[Crossref]**