Sudan University of Science and Technology

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Eco-taxonomic Study on the Vegetation of Elsuki Area Sinnar State – Sudan

دراسة بيئية تصنيفية للغطاء النباتي لمنطقة السوكي، ولاية سنار - السودان

A thesis Submited in Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Range Science

By

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DIDICATION

To .....

Soul of my father and mother.....

To .....

My brothers..... Sisters..... and friends.

To .....

My small family

ACKNOWLEDGMENT

All thanks to Allah who support me in all of my life and make me strong to go on and gave me persistence, and patience to complete this work.

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Abbreviation

NOAA	National Oceanic AND Atmothphric Administratin
NCDC	National Climate Data Center
ITCZ	Inter Tropical Convergence Zone
WMO	World Meteorological Organization

Abstract

The study was conducted at ES suki, south-east of Sinnar State. It is located in an area between Abu Teaga (N: 12º.80404 E: 34º.22265) and Abu Oshar (N: 12º. 47048 E: 34º.26082), in 41351.3m length and 35558.9m width, and total area of 147.040.6741.57m^2.

The first aim of the study is to investigate the climatic, edaphic and biotic ccological factors and their role in creating the existing composition of the plant species in the study area and to to check plant associations. Also the second aim is to study the overstory and understory flora of the area taxonomically so as to contribute on the updating of the Sudan Flora, besides that detailed taxonomic account will be done for the most ecologicaly dominant and important species. The last aim is to produce a check list for all plants which are existings in the study area.

The study composed of two parts: ecological study and taxonomical study. For the ecological assessement five rectangular transects representing 10% of the study area were made. Ecological parameters such plant abndance, frequency, density, diversity and biomass were measured. SPSS Program was used for data analyses. For the taxonomic study herbarium specimens were collected using the normal procedure for plant collection. Specimens collected were identified and described.

In the ecological study results showed that, *Commelina amplexcaulis* and *Sporobolus pyramidatus* were highly abundant, frequent and dense and had less diversity for herbs, *Acacia seyal* and *Acacia senegal* for trees and *Acacia oerfota* for shrubs showed the same results in the two seasons of 2011 and 2012 respectively, while high abundance, density, frequency and low diversity was reported for families **Poaceae** and **Acanthaceae** in the two seasons.

There is a high significant effect for plant in transect 5, a high significant in transect 1 for litters and a high significant in transect 3 for baresoil in season 2011, while there is no significant effect in season 2012.

Biomass had a high significant effect in transect 2 and 4, while there was no significant effect for other transects in season 2011 and also in season2012.

15 ecologically dominant and important plant species were investigated and detailed taxonomical studies were done, 5speceis from each catigory trees, shrubs and herbs, and finally a check list of plants species was produceed to fulfil the taxonomical part of the study.

ملخص الدراسة

أجريت الدراسة في منطقة السوكي جنوب شرق ولاية سنار. وهي تقع في منطقة بين أبوتيقة (12º.80شمالاً : 34º.22 شرقا) و أبوعشر (12º .47شمالاً : 34º.26 شرقاً) بطول 41531.3 متر وعرض 35558.9م ومساحة كلية 6741.57.040.147 م^2.

الهدف الأول من هذه الدراسة إلى التعرف على العوامل البيئية المناخية، عوامل التربة والحيوية ودورها في خلق تركيبة الموجودة من الأنواع النباتية في منطقة الدراسة وللتحقق من العلاقات النباتية .أيضا الهدف الثاني هو دراسة الأشجار والشجيرات والحشائش في المنطقة تصنيفيا وذلك للمساهمة في استكمال فلورا السودان ، بالإضافة إلى ذلك سيتم عمل حساب تصنيفي مفصل لأكثر الأنواع السائدة بيئياً والمهمة .والهدف الأخير هو لإستخلاص قائمة لجميع النباتات الموجودة في منطقة الدراسة

تتكون الدراسة من جزئين, دراسة بيئية ودراسة تصنيفية. بالنسبة للدراسة البيئية لقد تم أخذ عدد 5 مستطيلات تمثل 10% من مساحة منطقة الدراسة. لتقييم العوامل البيئية المختلفة كالكثافة، التواجد، التردد، التنوع والكتلة. كما تم استعمل برنامج (SPSS) للتحليل الإحصائي. بالنسبة للدراسات التصنيفية فقد تم جمع عينات من النباتات استعملت فيها الطرق المعروفة في جمع النباتات ومن ثم قد تم تشخيصها و تصنيفها ووصفها.

في الجانب البيئي أوضحت الدراسة اوضحت الدراسة أن ابريق الفكي *Commelina amplexcaulis* وعيش الفار *Sporobolus pyramidatus* هما الأكثر وفرةً وترددا ً وكثافةً والأقل تنوعاً من جانب الأعشاب, بينما الطلح *Acacia seyal* والهشاب *Acacia senegal* من الأشجار واللعوت *Acacia oerfota* من جانب الشجيرات في الموسمين بالترتيب. بينما الأكثر وفرةً وترددا ً وكثافةً والأقل تنوعاً في العوائل النباتية فقد كانت العائلة النجيلية (Poaceae) وعائلة حنك السبع (Acanthaceae) في الموسمين بالترتيب.

تأثير معنوي ايجابي عالي للتغطية النباتية في الشريط الخامس بالنسبة للنباتات, وفي الشريط الأول بالنسبة لأجزاء النبات الساقطة وفي الشريط الثالث للتربة العارية في الموسم 2011, بينما لا يوجد تاثير معنوي ايجابي لكل القراءات في موسم 2012م.

أظهرت الدراسة ان الكتلة الحية في موسم 2011 لها تأثير معنوي ايجابي عالي في الشريطين 4 و2 بينما لم تظهر اي أثر ايجابي في بقية الأشرطة وفي موسم 2012.

حوالي 15 نوع من النباتات المهمة السائدة بيئياً في المنطقة تم أخذها وأجريت لها الدراسة التصنيفية (5 لكل من الأشجار, الشجيرات والأعشاب) كما تمأخيراًوضع قائمة للأنواع النباتية بمنطقة الدراسة لتفي بالجانب التصنيفي للدراسة.

CHAPTER ONE

INTRODUCTION

Description of the Sudan's vegetation commenced with early travellers, explorers and colonizers. By the end of the 19th century, systematic investigations started and many produced well-documented information on the flora and fauna of the Sudan (El Awad, 1995).

Not all of the Sudan has been covered by post studies; and parts of it seemed more favoured research work than the others. The Red Sea Hills area was studied by Schweinfurth as early as 1873, so did Engler (1910), Shantz and Marbut in 1923, Crowfoot (1928) and Massey (1926) who studied the Sudan grasses. Of the Pre-second War era, Broun and Massey (1929) stands as the best Flora produced for the Sudan. Later on after the second World War Andrews (1950-1956) produced his comerhensive Flora in The Flower Plants of Englo Egyption Sudan.

Studies linking the environment and the soils to plant cover in the Sudan came later on. Collier (1971) linked tree growth and grass species to soil types, water and landform. Whyte (1947) studied northern Sudan. Andrews (1949) was the first to detail the vegetation zones of the Sudan. Smith (1948) related trees distribution in Northern Sudan to climatic and edaphic factors. An outstanding contribution is the well-documented classification of the Sudan vegetation by Harrison and Jackson (1958). Yousif *etal*. (1995) made an account of how to understand and measured vegetation changes in the Sudan.

Studies on selected areas in the Sudan are quite few. Willimott (1957) studied the vegetation of Jebal Boma in southern Sudan (Now the Republic of Southern Sudan). Ramsay (1958) studied central Darfur. Worval (1960) studied vegetation in northern Sudan.

Recently, more comprehensive studies were undertaken. These include: Hassan (1974) who studied the flora of Erkouit, Wicken's (1976) presented a detailed multi-disciplinary studies of Jebal Marra. Gumma (1988) study was on Ingessana Hills, Elghazali (1985) studied the Nuba Mountains, El Amin (1973 and 1990) covered the woody taxa of the Sudan, El Awad (1995) presented an eco-taxonomical study of the Red Sea Hills, Mohemmed (2001) studied the ecology of Jebal AlFaw and surrounding area. Elsafori (2006) and Ismail (2013) did an Eco-taxonomic studies on the vegetation of Um Rimitta (White Nile) and Rashad and Abassia Localities (Nuba Mountens).

This study will try to fill the gap in El Sukki area. The Butana plain, which extends westwards covering the study area, was given more attention as it is representing the best rangeland in the Sudan. No comprehensive studies which were done concerning the flora of the area before. Only some fragmented few studies were done for *Acaica nilotica* as timber tree in both sides of Blue Nile. More over the vegetational cover of the area has been subjected to changes for many reasons.

Research objectives

1. To investigate the climatic, edaphic and biotic ccological factors and their role in creating the existing composition of the plant species in the study area and to to check plant associations.
2. To the second aim is to study the overstory and understory flora of the area taxonomically so as to contribute on the updating of the Sudan Flora, besides that detailed taxonomic account will be done for the most ecologicaly dominant and important species.
3. To produce a check list for all plants which are existings in the study area.

CHAPTER TWO

THE STUDY AREA

The study was conducted at Elsuki area about 50 km the south-east of Sinnar State. It is located in an area between Abu Teaga (N: 12.80404 E: 34.22265) and Abu Oshar (N: 12. 47048 E: 34.26082), in 41351.3m length and 35558.9m width, and total area of 147.040.6741.57m^2 (Fig. 1). Five major transects were taken, each transect 3000m length and 10m width, their total area of the study is 150.000m^2 which it is about 10% of the total area.

The total area of the state is about 40860 kms². The population is about 1,144,755 distributed within three localities, Sinnar, Dindir, and Singa with the following ratios, 40.2 %, 32.2 %, and 27.6 % respectively. The rangeland represents about 40 % of the total area of the state. This area includes enclosures, valleys, banks of the Blue Nile, Rahad and Dindir rivers in addition to rangelands around mountains and forests. The main pastoral tribes are: Kenana, Lahawein, Nefadia, Arakein, Agalein, Falata, Ambararo, Ruffaa and others. (Abdelaziz A.A 2010).

2.1 Climate

Sudan's climate is affected by relatively little topography, being mainly comprised of flat plains with isolated clusters of mountains, and bordered by mountain ranges to the south, east and west (Metz 1991). The smooth nature of the terrain means that localised influences are minimised unlike neighbouring Ethiopia where extremely high spatial variation in rainfall is noted due to the complex orography (Gissila *et al.* 2004).

Ireland (1948) divided the Sudan into three climate regions:

i. N. of about latitude 19 N.
ii. S. of about latitude 19 N.

iii. The Red Sea coast and the eastern slopes.

The study area falls within the second division where the climate is described as typically continental dominated by the annual movement of the boundary between the dry northerlies and the moist southerlies with which the rains are associated. Most of the rain convictional and has a market diurnal maximum in the afternoons and evenings. According to (Ireland 1948) the variability or reliability of rainfall in the study area is 20-25%.

The climate can thus be summarized as hot, tropical and semi-arid with a rainy season from May to October, followed by a spell of a cool dry winter during which the dry northern winds predominate (El Tom, 1974).

The Northern part of the State lies within the low rainfall Savanna zone, where the average annual rainfall is between 400-600 mm, while the Southern part lies in the high rainfall Savanna zone, with the average annual rainfall of about 800mm . The mean temperature ranges from 35º C to 40ºC in summer and from 20ºC to 25ºC in winter. (Abdelaziz A.A 2010).

2.2. Rainfall:

Rainfall is considered as the most important climate factor because of its more direct influence over the other climate parameters. On a rainy day, there is minimum sun radiation, cooler temperature, least evapo-transpiration and higher relative humidity and rains are more changeable in time and place than any other climate parameter (Agromat, 1976).

The total distribution of rainfall over the whole Sudan is directly linked with latitudes. It increases from North to South, but it does not follow the exact latitudes position (Adam, 1996).

Figure (2) demonstrates the contrast in observed long term climatological rainfall as recorded by WMO monitored rain gauge stations in the Global

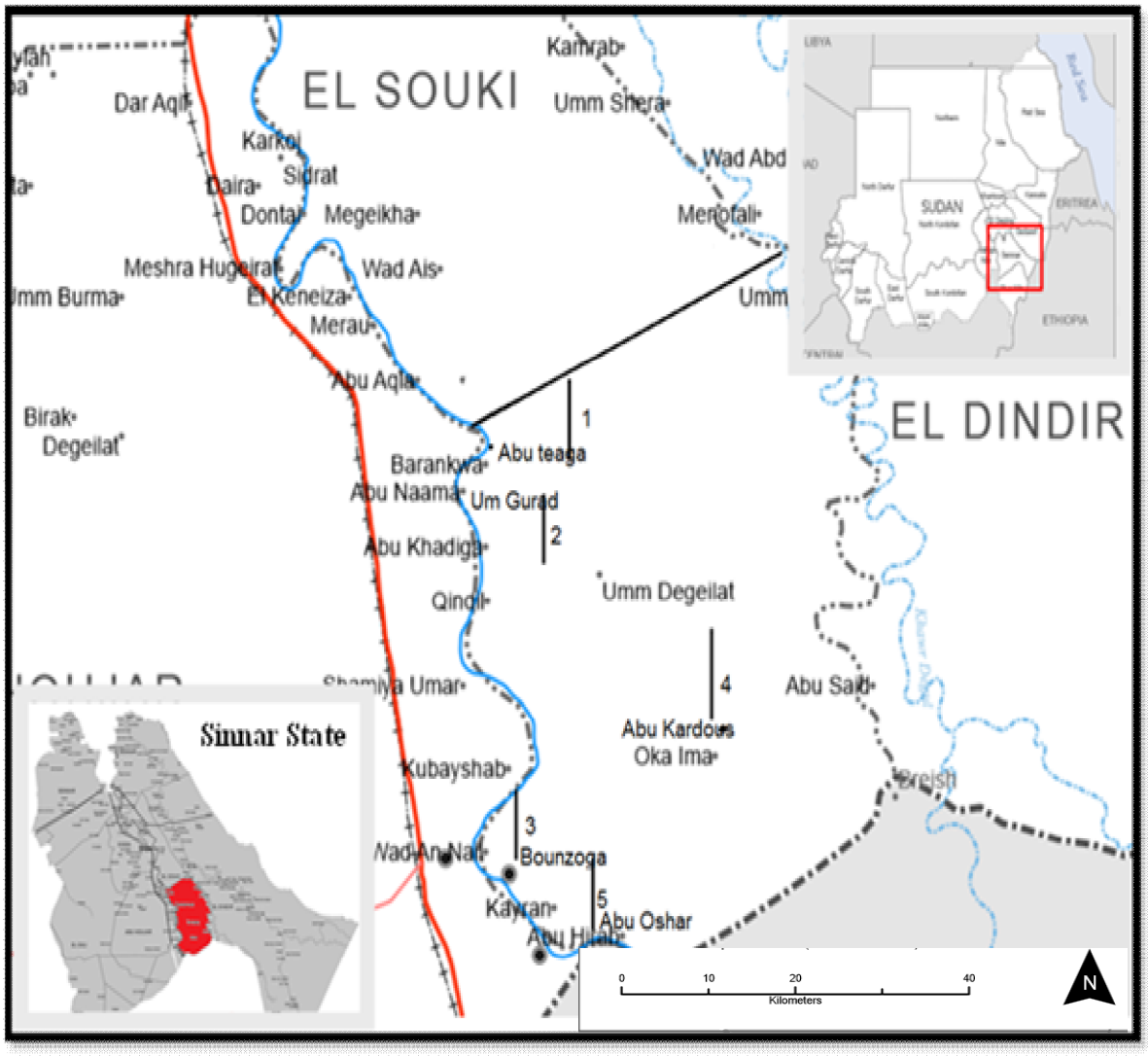
Historical Climatology Network (GHCN). Figure 2[A] shows stations colour-coded by their mean January totals. Very little rainfall is recorded during January, with the exception of stations on the Red Sea coast where localised weather systems from the Red Sea and the Mediterranean influence the rainfall total in the winter months (Metz 1991). Figure 2[B] represents August; this is the peak of the rainy season throughout the majority of Sudan, with upwards of 200 mm/month falling as far north as Khartoum, and some increases in rainfall reaching as far north as the Sudan-Egypt border.

These peaks are indicative of the movement of the ITCZ throughout the year; however in areas with discernible "long" and "short" rains further to the south a trough would be evident clearly defining the two rainy seasons.

Khartoum's observations are consistent with most central and northern regions; arid for much of the year, with the exception of a peak from June to September. The onset of the rainy season tends to be more gradual than the withdrawal, which occurs rapidly throughout September. By November the rains have entirely retreated from northern and central regions, whilst the south experiences its rainfall minimum between December and January.

Port Sudan shows a pattern common to the Red Sea coast, whereby the peak rains occur in November as a result of weather systems developing as a result of Red Sea Troughs (Krichak et al. 1997). These systems only affect localised coastal regions and are unrelated to the ITCZ-related rainy season further south, and therefore lie beyond the focus of this research project.

Fig.1: Study Area



Source: OCHA 2012

Fig (2): Rainfall Distribution

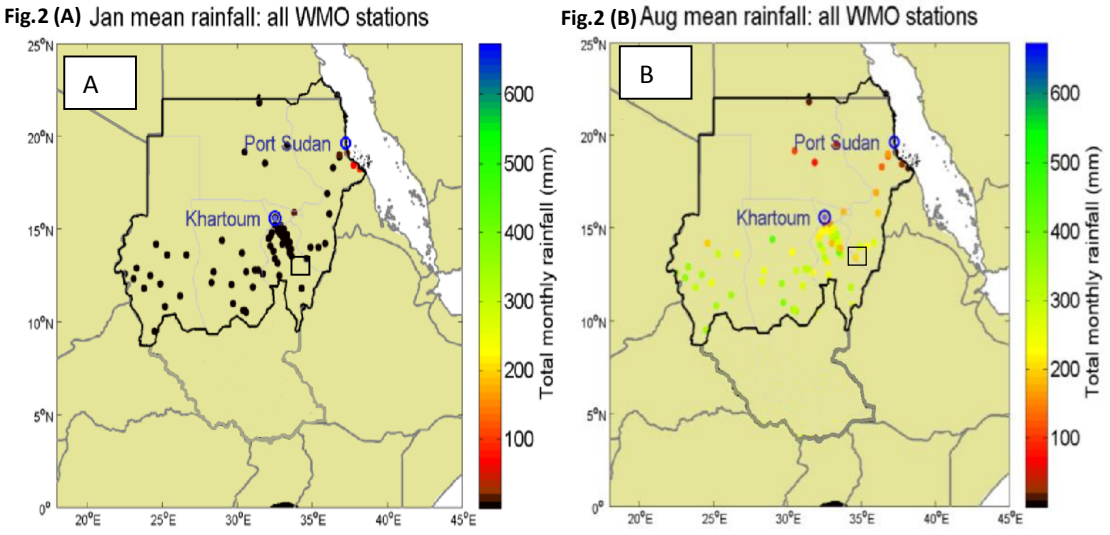


Figure 2: Rain gauge stations as recorded in the GHCN: representative months during January and August (left and right respectively). Stations are coloured according to mean total rainfall volume recorded during the month. Note localised influence of Red Sea systems in January. (Source NOAA NCDC (2012)

Cook's system (1946) classed the rainfall months as dry and wet. The wet months are those with a mean annual rainfall of the least 10%, while the dry months receive less than 5% of the main annual rainfall. (El Tom, 1975) reported that, July, August and September are sole months that satisfy this categorization and together regarded as forming the general rainy season of the Sudan.

Two-thirds of the northern Sudan receives more than 60% of their total precipitation during July to September. The study area falls within this category.

From the available sources (Management Plant for Dinder National Park – Sudan 2005 and Metrological station Khartoum 2013). The average annual rainfall in the study area since 2000 to 2012 varies from 695 mm to 413 mm. This is evidence suggesting that, significant climate changes had occurred. Investigations of the Central Sahara and the study of Near-Eastern, suggested

that arid conditions were associated with the close of the Pleistocene ameliorated period between 9000 to 2000 years (Wicken's, 1976).

2.3 Temperature:

The Sudan is likely to experience fairly high temperatures throughout the year as consequence of its tropical continental location. The mean annual temperature vary between 22º C in the southeast and 32º C in the vicinity of the northern frontier (El Tom 1974).

The annual range of the temperature reaches its minimum near the southern frontier and its maximum in the vicinity of the northern border.

February is the hottest month in southern Sudan, while July is the hottest one in the extreme northern parts of the Sudan (Abdalla, 1992). El Tom (1975) said that, during the winter season the temperature over the Sudan tend to be negatively correlated with the latitudes and thus the zone of daily maximum temperatures 36º C remains over the southern Sudan from which temperature levels drop gradually northwards. However, as the summer season approaches, the zone of daily maximum temperatures moves northwards to lie over the Central Plain during the month of April. By July, the zone of maximum temperature reaches the extreme northern part of the Sudan where it remains stationary up to the end of September. During this period the average daily maximum temperature rises to 42ºC over the northern third of the Sudan.

The extrapolated data for El Suki area from the available data indicate a mean annual temperature of 35º C to 40ºC (Abdelaziz A.A 2010).

Table (1): Temperature, relative humidity and rain fall at Sinnar state during the period from 2000-2012.

Year	Min / temp	Max / temp	R.H	Rainfall
2000	19-5	34-2	67%	544.4 mm
2001	20-7	35-5	65%	326.4
2002	19-8	35-9	49%	341
2003	20-3	37-8	50%	504.5
2004	20-3	37-3	47%	224
2005	20-7	37-7	49%	191.5
2006	20-1	36-9	50%	437.2
2007	20-0	36-4	53%	742.4
2008	20-2	36-6	53%	384.4
2009	20-5	37-5	53%	309
2010	22-3	38-3	48%	327.3
2011	20-5	36-6	54%	535
2012	21-1	35-4	50%	413

Source: Metrological station Khartoum (2013).

Study area recorded during the last 10 years a mean annual temperature of 36.04ºC to 20.7ºC (Table1).

2.4 Relative Humidity:

Relative Humidity is generally low. The highest mean R.H. for last 10 years for the study area was 67% where the lowest was 47% (Table 1).

2.5 The vegetation

The native vegetation is a complex mixture of grasses, herbs and woody species. Dominant annual grasses are: *Echinochloa colonum, Cymbopogon nervatus.* The dominant herbs are*: Ipomea spp* and *Ocimum bacilicum*. The dominant trees and shrubs include: *Acacia spp, Balanites aegyptiaca*. (Abdelaziz A.A 2010).

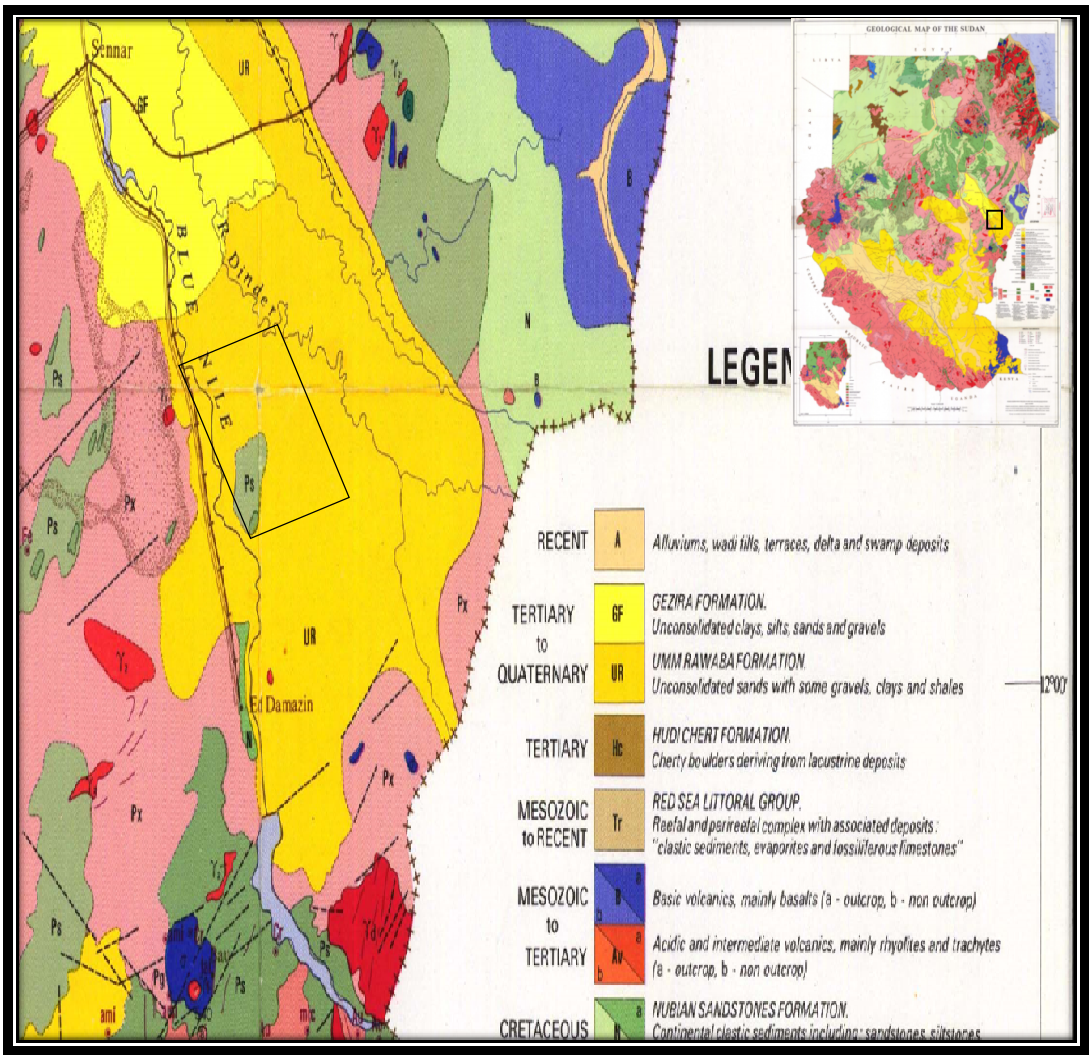
2.6 Soils

Elsuki soil is a vertisoil, which is mainly alluvial sediment of the Blue Nile, drived mostly from basic igneous rocks of Ethiopian Highlands. It is a part of central clay plain of the Sudan. In general the soil is dark cracking with very high clay content, characterized by high swelling and shrinking characteristic. (Abdelaziz A.A 2010).

Elsuki soil is a vertisoil, which is mainly alluvial sediment of the Blue Nile, derived mostly from basic igneous rocks of Ethiopian Highlands. It is a part of central clay plain. In general the soil is dark cracking with very high clay content, characterized by high swelling and shrinking characteristic (Abdelaziz A.A 2010).

The general land formation is the (UR) Um Rawaba formation which unconsolidated sands with some gravels, clays and shale's. In the transect 4 (Jabal Abu Kardus) the formation changed to (Ps) undifferentiated Schist group of marble, quartzite, graphite and micaschists (Fig.3).

Fig. (3): Study Area Land Formation



Source: ISIRC (2012)

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction:

Plant ecology has its origin in the application of plant physiology to the questions raised by plant geographers (Vander Valk and Arnold 2011), (Barbour *et.al* 1999). Similar climates produced similar types of vegetation, even when they were located in different parts of the world. Willdenow's student, used physiognomy to describe vegetation types and observed that the distribution of vegetation types was based on environmental factors. Schouw's work, published in 1822, linked plant distributions to environmental factors (especially temperature) and established the practice of naming plant associations by adding the suffix *-etum* to the name of the dominant species. Working from herbarium collections, De Candolle searched for general rules of plant distribution and settled on using temperature as well, (Barbour *et.al* 1999) Grisebach's two-volume work, *Die Vegetation der Erde nach Ihrer Klimatischen Anordnung*, published in 1872, saw plant geography reached its "ultimate form" as a descriptive field. (Vander Valk and Arnold 2011).

In the 1870s, Swiss botanist Simon Schwendener, together with his students and colleagues, established the link between plant morphology and physiological adaptations, laying the groundwork for the first ecology textbooks, Eugenius Warming's *Plantesamfund* (1895) and Andreas Schimper's (1898) *Pflanzengeographie auf Physiologischer Grundlage* (Vander Valk and Arnold 2011). Warming successfully incorporated plant morphology, physiology, taxonomy and biogeography, into plant geography to create the field of plant ecology. Although more morphological than physiological, Schimper's has been considered the beginning of plant physiological ecology

(Barbour *et.al* 1999). Plant ecology was initially built around static ideas of plant distribution; incorporating the concept of succession added an element to change through time to the field. Henry Chandler Cowles' studies of plant succession on the Lake Michigan sand dunes (1899) and Frederic Clements' (1916) monograph on the subject established it as a key element of plant ecology (Van der Valk and Arnold 2011).

Plant ecology developed within the wider discipline of ecology over the twentieth century. Inspired by Warming's *Plantesamfund*, Arthur Tansley set out to map British plant communities. In 1904 he teamed up with William Gardner Smith and others involved in vegetation mapping to establish the Central Committee for the Survey and Study of British Vegetation, later shortened to British Vegetation Committee. In 1913, the British Vegetation Committee organised the British Ecological Society (BES), the first professional society of ecologists (Cooper 1957). Then was followed in 1917 by the establishment of the Ecological Society of America (ESA); plant ecologists formed the largest subgroup among the inaugural members of the ESA(Van der Valk and Arnold 2011).

Cowles' students played an important role in the development of the field of plant ecology during the first half of the twentieth century, among them William S. Cooper, E. Lucy Braun and Edgar Transeau(Barbour et.al 1999).

3.2 Distribution

Plant distributions are governed by a combination of historical factors, eco-physiology and biotic interactions. The set of species that can be present at a given site is limited by historical contingency. In order to show up, a species must either have evolved in an area or dispersed there (either naturally or through human agency), and must not have gone locally extinct. The set of species present locally is further limited to those that possess the physiological

adaptations to survive the environmental conditions that exist. This group is further shaped through interactions with other species (Lambers, Hans et.al 2008).

Plant communities are broadly distributed into biomes based on the form of the dominant plant species. For example, grasslands are dominated by grasses, while forests are dominated by trees. Biomes are determined by regional climates, mostly temperature and precipitation, and follow general latitudinal trends. Within biomes, there may be many ecological communities, which are impacted not only by climate and a variety of smaller-scale features, including soils, hydrology, and disturbance regime. Biomes also change with elevation, high elevations often resembling those found at higher latitudes (Lambers *et.al* 2008).

3.3 Biomes

Biomes are climatically and geographically defined as contiguous areas with similar climatic conditions on the Earth, such as communities of plants, animals, and soil organisms (The world biomass 2008) and are often referred to as ecosystems. Some parts of the earth have more or less the same kind of abiotic and biotic factors spread over a large area, creating a typical ecosystem over that area. Such major ecosystems are termed as biomes. Biomes are defined by factors such as plant structures (such as trees, shrubs, and grasses), leaf types (such as broadleaf and needleleaf), plant spacing (forest, woodland, savanna), and climate. Unlike ecozones, biomes are not defined by genetic, taxonomic, or historical similarities. Biomes are often identified with particular patterns of ecological succession and climax vegetation (quasiequilibrium state of the local ecosystem). An ecosystem has many biotopes and a biome is a major habitat type. A major habitat type, however, is a compromise, as it has an

intrinsic inhomogeneity. Some examples of habitats are ponds, trees, streams, creeks, under rocks and burrows in the sand or soil.

The biodiversity characteristic of each extinction, especially the diversity of fauna and subdominant plant forms, is a function of abiotic factors and the biomass productivity of the dominant vegetation. In terrestrial biomes, species diversity tends to correlate positively with net primary productivity, moisture availability, and temperature (Pidwirny 2006)

Eco-regions are grouped into both biomes and eco-zones:

- A fundamental classification of biomes is:

1. Terrestrial (land) biomes
2. Aquatic biomes (including freshwater biomes and marine biomes)

Biomes are often known in English by local names. For example, a temperate grassland or shrubland biome is known commonly as steppe in central Asia, prairie in North America, and pampas in South America. Tropical grasslands are known as savanna in Australia, whereas in southern Africa it is known as certain kinds of veld (from Afrikaans).

Sometimes an entire biome may be targeted for protection, especially under an individual nation's biodiversity action plan.

Climate is a major factor determining the distribution of terrestrial biomes. Among the important climatic factors are:

- Latitude: Arctic, boreal, temperate, subtropical, tropical
- Humidity: humid, semi-humid, semiarid, and arid
    - Seasonal variation: Rainfall may be distributed evenly throughout the year or be marked by seasonal variations.

- Dry summer, wet winter: Most regions of the earth receive most of their rainfall during the summer months; Mediterranean climate regions receive their rainfall during the winter months.

- Elevation: Increasing elevation causes a distribution of habitat types similar to that of increasing latitude.

The most widely used systems of classifying biomes correspond to latitude (or temperature zoning) and humidity. Biodiversity generally increases away from the poles towards the equator and increases with humidity.

3.4 Competition

Plants, like most life forms, require relatively few basic elements: carbon, hydrogen, oxygen, nitrogen, phosphorus and sulphur; hence they are known as CHNOPS life forms. There are also lesser elements needed as well, frequently termed micronutrients, such as magnesium and sodium. When plants grow in close proximity, they may deplete supplies of these elements and have a negative impact upon neighbours. In many cases (perhaps most) the negative effects upon neighbours arise from competition for light, with larger plants shading smaller plants. In other cases, there may be competition below ground for water, nitrogen, or phosphorus. To detect and measure competition, experiments are necessary; these experiments require removing neighbours, and measuring responses in the remaining plants (Keddy 2001). Many such studies are required before useful generalizations can be drawn.

Overall, it appears that light is the most important resource for which plants compete, and the increase in plant height over evolutionary time likely reflects selection for taller plants to better intercept light. Many plant communities are therefore organized into hierarchies based upon the relative competitive abilities for light (Keddy 2001). In some systems, particularly infertile or arid systems, below ground competition may be more significant (Capser *et.al* 1997). Along

natural gradients of soil fertility, it is likely that the ratio of above ground to below ground competition changes, with higher above ground competition in the more fertile soils (Belcher *et.al* 1995) (Twolan-Strutt *et.al* 1996). Plants that are relatively weak competitors may escape in time (by surviving as buried seeds) or in space (by dispsersing to a new location away from strong competitors.)

In principle, it is possible to examine competition at the level of the limiting resources if a detailed knowledge of the physiological processes of the competing plants is available. However, in most terrestrial ecological studies, there is only little information on the uptake and dynamics of the resources that limit the growth of different plant species, and, instead, competition is inferred from observed negative effects of neighbouring plants without knowing precisely which resources the plants were competing for. In certain situations, plants may compete for a single growth-limiting resource, perhaps for light in agricultural systems with sufficient water and nutrients, or in dense stands of marsh vegetation, but in many natural ecosystems plants may be co-limited by several resources, e.g. light, phosphorus and nitrogen at the same time (Craine. 2009).

There are therefore many details that remain to be uncovered, particularly the kinds of competition that arise in natural plant communities, the specific resource(s), the relative importance of different resources, and the role of other factors like stress or disturbance in regulating the importance of competition (Keddy 2007) (Grime 1979).

3.5 Mutualism

Mutualism is defined as an interaction "between two species or individuals that is beneficial to both". Probably the most widespread example in plants is the mutual beneficial relationship between plants and fungi, known as

mycorrhizae. The plant is assisted with nutrient uptake, while the fungus receives carbohydrates. Some of the earliest known fossil plants even have fossil mycorrhizae on their rhizomes (Keddy 2007).

The flowering plants are a group that have evolved by using two major mutualisms. First, flowers are pollinated by insects. This relationship seems to have its origins in beetles feeding on primitive flowers, eating pollen and also acting as pollinators. Second, fruits are eaten by animals, and the animals then disperse the seeds. Thus, the flowering plants actually have three major types of mutualism, since higher plants also have mycorrhizae (Keddy 2007).

Plants may also have beneficial effects upon one another, but this is less common. Examples might include "nurse plants" whose shade allows young cacti to establish. Most examples of mutualism, however, are largely beneficial to only one of the partners, and may not really be true mutualism. The term used for these more one-sided relationships, which are mostly beneficial to one participant, is facilitation. Facilitation among neighboring plants may act by reducing the negative impacts of a stressful environment (Callaway 1995). In general, facilitation is more likely to occur in physically stressful environments than in favorable environments, where competition may be the most important interaction among species (Keddy 2001).

Commensalism is similar to facilitation, in that one plant is mostly exploiting another. A familiar example is the ephiphytes which grow on branches of tropical trees, or even mosses which grow on trees in deciduous forests.

It is important to keep track of the benefits received by each species to determine the appropriate term. Although people are often fascinated by

unusual examples, it is important to remember that in plants, the main mutualisms are mycorrhizae, pollination, and seed dispersal (Keddy 2007).

3.6 Herbivore:

An important ecological function of plants is that they produce organic compounds for herbivores (Schulze *et al*. 2005) in the bottom of the food web. A large number of plant traits, from thorns to chemical defenses, can be related to the intensity of herbivory. Large herbivores can also have many effects on vegetation. These include removing selected species, creating gaps for regeneration of new individuals, recycling nutrients, and dispersing seeds. Certain ecosystem types, such as grasslands, may be dominated by the effects of large herbivores, although fire is also an equally important factor in this biome. In few cases, herbivores are capable of nearly removing all the vegetation at a site (for example, geese in the Hudson Bay Lowlands of Canada, and nutria in the marshes of Louisiana (Keddy 2010) but normally herbivores have a more selective impact, particularly when large predators control the abundance of herbivores. The usual method of studying the effects of herbivores is to build exclosures, where they cannot feed, and compare the plant communities in the exclosures to those outside over many years. Often such long term experiments show that herbivores have a significant effect upon the species that make up the plant community (Keddy 2007).

3.7 Abundance:

The ecological success of a plant species in a specific environment may be quantified by its abundance, and depending on the life form of the plant different measures of abundance may be relevant, e.g. density, biomass, or plant cover (Keddy 2007).

The change in the abundance of a plant species may be due to both abiotic factors, e.g. climate change, or biotic factors, e.g. herbivory or interspecific competition (Keddy 2007).

3.8 Frequency:

Definition - Frequency is the number of times a plant species is present in a given number of quadrats of a particular size or at a given number of sample points. Frequency is usually expressed as a percentage and sometimes called a Frequency Index. The concept of frequency refers to the uniformity of a species in its distribution over an area. No counting is involved just a record of species present (Smith *et.al* 1986).

A. Frequency is most often used to compare plant communities and to detect changes in vegetation composition over time.

B. Used to describe the distribution of a species in a community.

C. Often used in combination with density or cover estimates.

D. Used to measure trend or condition.

E. Shouldn't use frequency to compare abundance of different species.

- Frequency Advantages:

A. High repeatability can be obtained.

B. Fast and easy to measure.

C. Frequency of rooted plants is less sensitive to fluctuations in climatic and biotic influences; especially for perennial vegetation.

D. Can describe distribution of species in a community.

- **Frequency Limitations:**

A. Frequency is highly influenced by the size and shape of the quadrats used.

B. Highly sensitive to changes resulting from seedling establishment.

C. Sensitive to abundance and changes in pattern of distribution in the sampled area.

D. Frequency cannot tell which parameter has changed: canopy, cover, density or pattern of distribution.

E. Hard to interpret frequency data due to no definite relationship between frequency and density for non-randomly distributed plant population.

- **How to Determine If a Species Is Present or Absent:**

A. First, specify what constitutes a plant species being present. Any of these will work as long as the technique is documented.

1. Rooted inside the plot or runners?

2. Shoots or whole plant?

3. Overhang inside the plot or rooted only?

B. Rooted Frequency - the plant of interest must be rooted inside the sample plot in order to be counted. This is the most commonly recorded measure of frequency.

C. Shoot Frequency - any runners, shoots, leaves, and/or overhang, etc. that lie inside the plot allows the plant to be counted.

- Frequency Is Influenced by Plot Size and Shape:

A. If the sample plot is small, the chances of the plant species of interest being recorded are small, causing a low frequency.

B. If the plot is too large, the plant species of interest will be in almost all the plots. This will cause a high Frequency Index and will not show the plant distribution in a community.

C. Suggested empirical sizes (Cain and Castro 1959).

- Moss layer 01-.0 m^2

- Herb layer 1-2 m^2

- Tall herbs and low shrubs 4 m^2

- Tall shrubs and low trees 10 m^2

- Trees 100 m^2

- Other commonly used units 1m^2 (1x1 m or 2 x ½ m)

(Remember: Frame size must be uniform in order to use for comparisons between species!)

- Karen's Collection of Guidelines:

A. Plot size should be such that frequency for the important species falls between 10% and 90%.; or, if possible between 20% and 80%.

B. Plot size may change depending on species measured. Plot size should be 1 to 2 times as large as mean area of most common species.

C. Include max number of species (big enough plot to include many species).

D. There is a math equation to help determine size of plot using a logarithmic relationship between frequency and density (Bohnam, 1989).

E. 25 plots randomly located or 25 randomly located transects should give satisfactory results within a homogeneous plant community.

F. If frequency is 100% for the plant species in interest, reduce the frame size (Daubenmire 1968).

G. If plant species of interest is not present in most of the samples taken, increase plot size.

- Frequency measurement methods:

A. Frequency measures can be accomplished by random or systematic locations of plots.

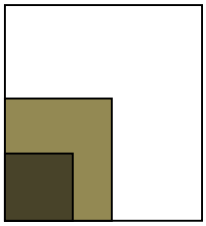
B. Plots

1. Count and record the number of individuals of each species in an each plot

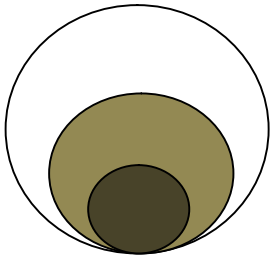
$$\%freq.Spp_1 = \frac{\text{Num. of plots in which } Spp_1 \text{ occurs}}{\text{Total number of plots examined}} 100$$

For example If 200 plots were examined and *Festuca idahoensis* occurred in 34 of the plots then, % Frequency of *Festuca* is 17% = (34 ÷ 200) × 100

C. Nested Plots



3 Square Nested plots



3 Circular Nested plots

1. A series of 3 -5 plots nested within each other

2. Record plant nested in smallest plot, then in successively larger plots

3. Presence of a plant in smaller plot = presence in larger plot

4. Estimate Frequency for each plot separately (equation given above)

5. Look at data to see which plot size most appropriately estimates each important species. The advantage of this technique is that one does not need to determine in advance which plot size is going to best represent each species.

D. Points - sampling or step-point (Also, used for cover measurements).

1. At each point, record the species at the tip of the boot or the plant nearest to that point.

$$\%\text{freq.Spp}_1 = \frac{\text{Num. of hits of Spp}_1}{\text{Total number of step-point}} 100$$

3.9 Colonisation and local extinction:

Whether a plant species is present at a local area depends on the processes of colonisation and local extinction. The probability of colonisation decreases with distance to neighbouring habitats where the species is present and increases with plant abundance and fecundity in neighbouring habitats and the dispersal distance of the species. The probability of local extinction decreases with abundance (both living plants and seeds in the soil seed bank).

3.10 Plant ecology:

Plant ecology is a sub descripts line of ecology which studies the distribution and abundance of plants, the effects of environmental factors upon the abundance of plants, and the interactions among and between plants and other organisms (Keddy 2007). Examples of these are the distribution of temperate deciduous forests in North America, the effects of drought or flooding upon plant survival, and competition among desert plants for water, or effects of herds of grazing animals upon the composition of grasslands.

3.11 Tropical plants community:

A global overview of the Earth's major vegetation types is provided by (Archibold 1995). He recognizes 11 major vegetation types: tropical forests, tropical savannas, arid regions (deserts), Mediterranean ecosystems, temperate forest ecosystems, temperate grasslands, coniferous forests, tundra (both polar and High Mountain), terrestrial wetlands, freshwater ecosystems and coastal/marine systems. This breadth of topics show the complexity of plant ecology, since it includes plants from floating single-celled algae up to large canopy forming trees.

One feature that defines plants is photosynthesis. One of the most important aspects of plant ecology is the role plants have played in creating the

oxygenated atmosphere of earth, an event that occurred some two billion years ago. It can be dated by the deposition of banded iron formations, distinctive sedimentary rocks with large amounts of iron oxide. At the same time, plants began removing carbon dioxide from the atmosphere, thereby initiating the process of controlling Earth's climate. A long term trend of the Earth has been toward increasing oxygen and decreasing carbon dioxide, and many other events in the Earths history, like the first movement of life onto land, are likely tied to this sequence of events (Keddy 2007).

One of the early classic books on plant ecology was written by Weaver and Clements (1938). It talks broadly about plant communities, and particularly the importance of forces like competition and processes like succession. Although some of the terminology is dated, this important book can still often be obtained in used book stores.

Plant ecology can also be divided by levels of organization including plant eco-physiology, plant population ecology, community ecology, ecosystem ecology, landscape ecology and biosphere ecology (Keddy 2007).

The study of plants and vegetation is complicated by their form. First, most plants are rooted in the soil, which makes it difficult to observe and measure nutrient uptake and species interactions. Second, plants often reproduce vegetative, that is asexually, in a way that makes it difficult to distinguish individual plants. Indeed, the very concept of an individual is doubtful, since even a tree may be regarded as a large collection of linked meristems (Williams 1975). Hence, plant ecology and animal ecology have different styles of approach to problems that involve processes like reproduction, dispersal and mutualism. Some plant ecologists have placed considerable emphasis upon trying to treat plant populations as if they were animal populations, focusing on population ecology (Harper 1977). Many other

ecologists believe that while it is useful to draw upon population ecology to solve certain scientific problems, plants demand that ecologists work with multiple perspectives, appropriate to the problem, the scale and the situation (Keddy 2007)

3.12 Association:

In community ecology and phytosociology an association is a type of ecological community with a predictable species composition, consistent physiognomy (structural appearance) which occurs in a particular habitat type (Barbour *et al*. 1999) The term was first coined by Alexander von Humboldt (Barbour *et al*. 1999) and formalized by the International Botanical Congress in 1910. (Barbour *et al*. 1999) (Willner 2006).

An association can be viewed as a real, integrated entity shaped either by species interactions or by similar habitat requirements or it can be viewed as merely a common point along a continuum. The former viewed was championed by American ecologist Frederic Clements, who viewed the association as a whole that was more than the sum of its parts, and by Josias Braun-Blanquet, a Swiss-born phytosociologist. On the other end of the argument was American ecologist Henry Gleason, proponent of the "individualistic concept" of plant associations (Barbour *et al*. 1999).

3.13 The importance of plant diversity:

The diversity of plant life is an essential underpinning of most of our terrestrial ecosystems. Humans and most other animals are almost totally dependent on plants, directly or indirectly, as a source of energy through their ability to convert the sun's energy through photosynthesis. Worldwide tens of thousands of species of higher plants, and several hundred lower plants, are currently used by humans for a wide diversity of purposes as food, fuel, fibre,

oil, herbs, spices, industrial crops and as forage and fodder for domesticated animals. In the tropics alone it has been estimated that 25,000-30,000 species are in use, and up to 25,000 species have been used in traditional medicines. In addition, many thousands of species are grown as ornamentals in parks, public and private gardens, as street trees and for shade and shelter. Another important role of plant life is the provision of ecosystem services the protection of watersheds, stabilization of slopes, improvement of soils, moderation of climate and the provision of a habitat for much of our wild fauna.

While it is generally accepted today that the conservation of all biodiversity should be our goal, especially through the preservation and sustainable use of natural habitats, this is an ideal that is unlikely to be achieved and there are convincing scientific, economic and sociological reasons for giving priority to the conservation of the major centres of plant diversity throughout the world, especially as this will very often also lead to the conservation of much animal and micro-organism diversity as well of the world's population.

3.14 Determining priority areas for plants:

The problem of determining priority areas can be approached at different geographical scales global, regional, national or local. At a global level, an approach based devolobed on analysis of the size of floras that are threatened, and highlighted the fact that about 170,000 of the world's estimated total of 250,000 species of angiosperms grow in tropical regions of the world, with an estimated 85,000 in Latin America, 35,000 in tropical and subtropical Africa (excluding the Cape), and at least 50,000 in tropical and subtropical Asia. Who drew attention to the remarkable fact that more than 40,000 plant species about a quarter of total tropical diversity occur in Colombia, Ecuador and Peru.

Some of these regional figures have been modified subsequently: for example, the count for tropical Africa has been reduced from 35,000 to 21,000 in the light of more accurate assessments and the figure for tropical Asia appears to have been under-estimated. The total number of single country endemics recorded by the World Conservation Monitoring Centre is a remarkable 175,976 species, an estimate which casts doubt on the generally accepted global total of about 250,000 species.

3.15 Climate:

Sudan's climate is affected by relatively little topography, being mainly comprised of flat plains with isolated clusters of mountains, and bordered by mountain ranges to the south, east and west (Metz 1991). The smooth nature of the terrain means that localised influences are minimised unlike neighbouring Ethiopia where extremely high spatial variation in rainfall is noted due to the complex orography (Gissila *et.al.* 2004).

CHAPTER FOUR

MATERIALS AND METHODS

4.1 The study is composed two parts:

4.1.1 Ecological study:

For study of the ecology of the area, five major transects were carried out which were:

Transect 1: **North East Abu Teaga** (Khour Taweel) from point (N:12.80404 E: 34.22265) to point (N:12.77917 E: 34.22678).

Transect 2: **East Um Gorad**, from point (N:12.72235 E: 34.17759) to point (N: 12.72832 E: 34.15311).

Transect 3: **North Bonzoga**, from point (N: 12.52396 E: 34.16587) to point (N: 12.54356 E: 34.17983).

Transect 4: **North West Jabal Abu Kardous**, from point (N: 1257799 E: 34.33834) to point (N: 12.59078 E: 34.31731).

Transect 5**: North Abu Oshar**, from point (N: 12.45194 E: 34.27264) to point (N: 12. 47048 E: 34.26082).

After every 200m within the total length 3km of any transect we used quadrate and belt or line transects to collect data for total plant cover (T.P.C), Baresoil cover (B.S.C), litters of plants (L.P), plant frequency (P.F), density of each species (S.D) , diversity (SiD),biomass and state of species growth were recorded.

For all the five transects a total of 75 quadrates were sampled to represent all of the area.

For detailed climatic parameters, rainfall, temperature and relative humidity, the standard data was obtained from NOAA(2012) , NCDC (2012)

and Khartoum meteorological station (2013). The climatological norms which cover the period 2000-2013, used to describe the weather.

Sampling precision is obtained by long narrow rectangles crossing contour lines, according to Borman (1953). Barbours *et al*. (1987) suggested manipulating the quadrate size and number so as to include up to 20% of stand in the samples.

4.1.2 Taxonomical study:

Taxonomical specimen were collected for the plant species, and used transects (belt) to prepare a checklist for all plant species present in the study area. All transects took the form of belt transect according to Barbours *et al*. (1987).

Then most important 15 species were collected, identified and botanically discriped and taxonomiclly detail.

Materials were used which help in collecting plant specimens like scissors, pressers and drying papers etc.

4.2 Data analyses:

SPSS analyses program was used to analyse the data of soil cover and biomass only, the other data analysed by formulas.

4.3. Measurements formulas:

4.3.1 Determination of Biomass productivity:

The formula used for determine the biomass was:-

$$\text{Biomass} = \frac{W1 - W2}{W1}$$

Where: -

W1 = Fresh weight of plant sample.

W2 = Dry weight of plant sample.

4.3.2 Quantitative ecological parameters:

4.3.2.1 Diversity Indices:

When ecologists talk of high diversity, they often mean a community containing a large number of different species. However, Anne (1988) states that most methods for measuring diversity actually consist of true components (species richness and relative abundance). The index used for measuring diversity is the index of Simpson's (1949). It is calculated as follows:

$$SiD = \frac{N (N-1)}{\sum n (n-1)}$$

Where:

SiD = Simpson's Index of diversity.

N = Total number of individuals.

n = Number of individuals of each species.

Σ = Sum of.

4.3.2.2 Density (D):

This is the number of individuals per unit area, and determined as follows:

$$D = \frac{\text{Total number of individuals}}{\text{Total number of quadrats}}$$

4.3.2.3 Abundance (A):

This was determined as follows:

$$A = \frac{\text{Total number of individuals}}{\text{Number of occupied quadrats}}$$

4.3.2.4 Frequency (F):

This is calculated as follows:

$$F = \frac{\text{Number of occupied quadrats} \times 100}{\text{Total number of quadrats}}$$

CHAPTER FIVE

RESULTS AND DISCUSSION

The Results were divided into two sections:

5.1 Section I: Ecological studies:

Six parameters were taken through all the five transects to represent the abundance, frequency, diversity, density, biomass, and plant cover for herbs, shrubs and trees.

Because of huge data collected from the field, we just showed 15 species of herbs in results which were 5 for high, medium and low values and all of shrubs and trees. More raw data is available on appendices.

5.1.1 Herbs Abundance:

In season 2011 *Commelina amplexicaulis* had a high abundance in Transect 1and 4, while *Pennistum purpureum, Sporobolus pyramidatus* and *Cassia occidentalis* had a high abundance in Transect 2, 3 and 5 respectively (Table 2).

Medium abundances were recorded for *Merremia emarginata* in Transect 1 and 5*, Rhynchosia memnonia* in Transect 2 and Transect 4, *Crotalaria senegalensis* in Transect 3 (Table 2). While low abundances were recorded for *Cucumis melo* in Transect 1, *Ipomoea cordofana* in Transect 2, *Helieotroium sudanicum* in Transect 3, *Boerhavia erecta* in Transect and *Cuscuta hyalnia* in Transect 5 (Table 2).

In season 2012 *Justicia palustris* had a highly abundance in Transect 1, while *Commelina amplexicaulis, Sporobolus pyramidatus*, *Commelina kotschyi*

and *Cassia occidentalis* had a highly abundance in Transects 2, 3, 4 and 5 respectively (Table 3).

Medium abundances were recorded for *Commelina kotschyi* in Transect 1 and 3 *Cenchrus echinatus* in Transect 2 *Cassia occidentalis* in Transect 4 and *Merremia emarginata* in Transect 5 (Table 3). While low abundances were recorded for *Indogofira pilosa* in Transect 1, *Acalyphe indica* in Transect 2, *Oxygonum atriplicifolium* in Transect 3, *Cenchrus echinatus* in Transect 4 and *Clitoria ternate* in Transect 5.

The change in the abundance between the two seasons in all transects except transect 3 and 5 may be due to the both abiological factors, e.g. climate change or herbivory interspecific competition or any biotic facters.

Abdelaziz A.A 2010 reported that, the native vegetation is a complex mixture of grasses, herbs and woody species. Dominant annual grasses are: *Echinochloa colona, Cymbopogon nervatus.* The dominant herbs are*: Ipomea spp and Ocimum bacilicum.*

The change in the abundance of a plant species may be due to both abiotic factors, e.g. rainfall fluctuation in both quantity and biotic factors, e.g. herbivory or interspecific competition as Van der Valk and Arnold (2011) found.

5.1.2 Herbs Frequency%:

In season 2011, *Acalyphe indica* had a highly frequency percentage in Transects 1, 2 and 4, shared with *Commelina amplexicaulis* in Transect 2 and with *Commelina kotschyi* in Transects2 and 4 in frequency percentage, where *Sporobolus pyramidatus* had a highly frequency in Transect 3 and 5

respectively and shared the same percentage with *Crotalaria senegalensis, Commelina kotschyi,* in Transect 5 (Table 4).

Table (2): Herbs Abundance for season 2011

Species	**TR1**	**TR 2**	**TR 3**	**TR4**	**TR 5**
	High				
Commelina amplexicaulis	**48.1**	27.6	16	**118.4**	20.5
Pennistum purpureum	1	**36.5**	8.4	0	4
Sporobolus pyramidatus	0	0	**78.1**	1	19.8
Cassia occidentalis	0	6	7.4	2	**35.3**
Med					
Merremia emarginata	**8.5**	2.1	4	2	**4.2**
Rhynchosia memnonia	4.3	**5.8**	6	**5.4**	3.5
Crotalaria senegalensis	7.1	3.1	**8**	2	5.8
Low					
Cucumis melo	**1**	2	0	0	0
Ipomoea cordofana	0	**1**	0	2	1
Helieotroium sudanicum	1	1.8	**1**	0	0
Boerhavia erecta	0	0	0	**1**	0
Cuscuta hyalnia	0	0	0	0	**1**

Table (3): Herbs Abundance for season 2012

Species	TR1	TR 2	TR 3	TR 4	TR 5
	High				
Justicia palustris	**35.9**	9.5	2	11.5	0
Commelina amplexicaulis	19.6	**35.3**	14.3	6.5	11.2
Sporobolus pyramidatus	0	0	**32.3**	0	0
Commelina kotschyi	5	14.3	5.8	**22.8**	6.5
Cassia occidentalis	0	1	2	3.2	**21.3**
Med					
Commelina kotschyi	**5**	14.3	**5.8**	22.8	6.5
Cenchrus echinatus	1	**8.8**	16	0	4.5
Cassia occidentalis	0	1	2	**3.2**	21.3
Merremia emarginata	4	2	2	0	**2.2**
Low					
Indogofira pilosa	**1**	0	0	1	2
Acalyphe indica	0	**2**	1	0	0
Oxygonum atriplicifolium	0	0	**6**	0	0
Cenchrus echinatus	0	0	0	**1**	0
Clitoria ternate	0	0	0	0	**1**

Medium frequency percentage were recorded for *Chloris virgata* in Transects 1, *Cenchrus echinatus* in Transects 2, *Sesbania arabica* in Transects 3, *Panicum repenslinn* in Transects 4 and *Cassia occidentalis* in Transects 5, While *Corchorus depressus* was recorded as lower frequency percentages in all Transects s (Table 4).

In season 2012, *Justicia palustris* had a high frequency percentage in Transects 1, while *Chloris virgata* had a highly one in Transects 2, while *Cassia occidentalis* had a highly frequency in Transects 3 and Transects 5. In Transects 4 *Brachairia ruciformis* had a highly frequency percentage (Table 5).

Medium frequency percentage were recorded for *Cenchrus chinatus* in Transect1, *Phyllonthus niruri* in Transects 2, *Echinochloa colonum* in Transects 3, *Corchorus depressus* in Transects 4 and *Digera muricata* in Transects 5. *Withania somnifra* in Transects 1, *Cyperus rotundus* in Transects 2, *Trianthema portulacastum* in Transect3, *Cenchrus chinatus* in Transect and *Digera muricata* in Transect5 were recorded as lower frequencies percentages (Table 5).

As Odum, 1971 found, many of the plant species that were reported to occur in the area had disappeared from the study area. This is attributed to retrogression and harsh climate condition of the past hundred years or near.

5.1.3 Herbs Diversity Indices (SiD):

Depending on the index of Simpson's, in season 2011 *Phyllonthus niruri* had a high diversity in Transect 1, while *Cucumis melo* had a high diversity in Transect 2. In Transect 3 *Acnthespermum hispidum* had a high diversity, while *Merremia emarginata* had a high diversity in Transect 4. In l Transect 5 *Tribulus terrestris* had a high diverse (Table 6).

Table (4): Herbs Frequency (F) %: season 2011

Species	TR 1	TR 2	TR 3	TR 4	TR 5
	High				
Acalyphe indica	**93.3**	**60**	6.7	**93.3**	6.7
Commelina amplexicaulis	73.3	**60**	6.7	86.7	26.7
Sporobolus pyramidatus	0	0	**66.7**	6.7	**33.3**
Commelina kotschyi	40	**60**	6.7	**93.3**	**33.3**
Crotalaria senegalensis	53.3	46.7	6.7	33.3	**33.3**
Med					
Chloris virgata	**40**	13.3	6.7	0	13.3
Cenchruse chinatus	13.3	**26.7**	6.7	0	0
Sesbania Arabica	0	20	**20**	0	0
Panicum repenslinn	20	20	0	**13.3**	0
Cassia occidentalis	0	6.7	53.3	6.7	**20**
Low					
Solanum dubium	**6.7**	0	0	**6.7**	**6.7**
Aristolochia bracteolate	0	**6.7**	0	0	0
Corchorus depressus	**6.7**	**6.7**	**6.7**	0	**6.7**
Euphorbia aegyptiaca	13.3	0	0	**6.7**	0
Cuscuta hyalnia	0	0	0	0	**6.7**

Table (5): Herbs Frequency (F) %: season 2012

Species	TR 1	TR 2	TR 3	TR 4	TR 5
	High				
Justicia palustris	**46.7**	26.7	6.7	73.3	0
Chloris virgata	33.3	**46.7**	13.3	13.3	13.3
Cassia occidentalis	0	13.3	**60**	33.3	**46.7**
Brachairia ruciformis	6.7	26.7	6.7	**80**	26.7
Med					
Cenchruse chinatus	**20**	26.7	6.7	0	13.3
Phyllonthus niruri	0	**13.3**	6.7	0	20
Echinochloa colonum	0	6.7	**13.3**	0	0
Corchorus depressus	0	0	6.7	**20**	0
Cuscuta hyalnia	0	6.7	6.7	0	**13.3**
Low					
Withania somnifra	**6.7**	0	0	0	0
Cyperus rotundus	0	**6.7**	13.3	0	0
Trianthem aportulacastum	0	0	**6.7**	0	0
Cenchruse chinatus	0	0	0	**6.7**	0
Digera muricata	0	0	0	0	**6.7**

Medium diversity was recorded for *Cucumis melo* in Transect 1, *Thunbergia annua* in Transect 2 and 4, *Commelina kotschyi* in Transect 3 and *Justicia palustris* in Transect 5. The lowest diversity was recorded for *Commelina amplexicaulis* in Transects1, 2, and 4. In Transect 3 *Sporobolus pyramidatus* had a lower diversity, where *Cassia occidentalis* had a lower one in Transect 5 (Table 6).

In season 2012 *Sida alba* showed high diversity in Transect 1, while *Phyllanthus madraspatensis* in Transect 2 was very diversed. *Phyllonthus niruri* had a high diversed in Transect 3, while *Acnthespermum hispidum* showed highly diversed in Transect 4. In Transect 5 *Rhynchosia memnonia* was a highly diversity (Table 7).

Medium diversity was recorded for *Cenchrus chinatus* in Transect 1, *Rottobeolla cochinchinensis* in Transect 2, *Cymbopogon nervatus* in Transect 3, *Ipomoea cordofana* in Transect 4 and *Chloris virgata* in Transect 5. *Justicia palustris* recorded the lowest diversity in Transects1 and 4. In Transect 2 *Commelina amplexicaulis* recorded a low diversity, *Sporobolus pyramidatus* in Transect 3, *Cassia occidentalis* had a low one in Transect 5 (Table 7).

Vander and Arnold (2011) found that, the diversity of plant life is an essential underpinning of most of our terrestrial ecosystems. Humans and most other animals are almost totally dependent on plants, directly or indirectly, as a source of energy through their ability to convert the sun's energy through photosynthesis. Worldwide tens of thousands of species of higher plants, and several hundred lower plants, are currently used by humans for a wide diversity of purposes as food, fuel, fibre, oil, herbs, spices, industrial crops and as forage and fodder for domesticated animals.

Table (6): Herbs Diversity Indices (SiD) season 2011

Species	TR 1	TR 2	TR 3	TR 4	TR 5
	High				
Phyllonthus niruri	**1502511**	128443.5	0	0	0
Cucumis melo	250418.5	**770661**	0	0	0
Acnthespermum hispidum	0	8468.802	**744810**	404985	0
Merremia emarginata	351.22	5666.63	26600.36	**2429910**	943.5
Tribulus terrestris	0	0	1601.74	0	**198135**
Med					
Cucumis melo	**250418.5**	770661	0	0	0
Thunbergia annua	0	**256887**	0	**809970**	7076.25
Commelina kotschyi	1926.29	277.72	**248270**	78.69	143.79
Justicia palustris	33.73	35.46	8184.73	2690.93	**66045**
Low					
Commelina amplexicaulis	**10.76**	**25.16**	1501.63	**2.05**	59.66
Sporobolus pyramidatus	0	0	**2.45**	0	40.84
Cassia occidentalis	0	51377.4	435.31	2429910	**35.60**

Table (7): Diversity Indices (SiD) season 2012

Species	TR 1	TR 2	TR 3	TR 4	TR 5
	High				
Sida alba	**179700**	5550.12	26838	0	0
Phyllanthus madraspatensis	0	**155403**	0	3103.47	0
Phyllonthus niruri	0	51801	**161028**	0	11501
Acnthespermum hispidum	59900	7400.14	161028	**139656**	11501
Rhynchosia memnonia	3993.33	1707.73	4473	604.57	**69006**
Med					
Cenchruse chinatus	**59900**	261.18	1341.9	0	1916.83
Rottobeolla cochinchinensis	6417.86	**51801**	0	0	0
Cymbopogon nervatus	0	0	**53676**	552	1254.66
Ipomoea cordofana	0	0	0	**46552**	69006
Chloris virgate	1711.43	478.16	16102.8	912.78	**23002**
Low					
Justicia palustris	**5.73**	221.07	161028	**17.73**	0
Commelina amplexicaulis	37.81	**27.93**	178.33	1790.46	44.81
Sporobolus pyramidatus	0	0	**4.86**	0	0
Cassia occidentalis	0	155403	1052.47	1163.8	**6.26**

5.1.4 Herbs Density:

In season 2011*Commelina amplexcaulis* had a high density percentage in Transects 1, 2 and 4. *Sporobolus pyramidatus* had a highly density percentage in Transect 3, while *Cassia occidentalis* had a high density percentage in Transect 5 (Table 8).

Medium density percentage was recorded for *Chloris virgata* in Transect 1, *Sorghum arundinaceum* in Transect 2, *Dactyloctenium aegyptium* in Transect 3, *Commelina kotschyi* in Transects 4 and 5, while the lowest density percentage was recorded for *Euphorbia acalyphoides* in Transect1, *Aristolochia bracteolate* in Transect 2, *Thunbergia annua* in Transect 3, *Boerhavia erecta* in Transect 4 and *Cuscuta hyalnia* in Transect 5 (Table 8).

In season 2012 *Justicia palustris* had a high density in Transect 1, while *Commelina amplexcaulis* had a high density in Transects 2 and 5. In Transect 3 *Sporobolus pyramidatus* had a high density, while *Commelina kotschyi* had a high density in Transect 4 (Table 9).

Medium density percentage was recorded for *Srtiga hermothica* in Transect 1, *Cenchrus echinatus* in Transect 2, *Dactyloctenium aegyptium* in Transect 3, *Rhynchosia memnonia* in Transect 4 and *Merremia emarginata* in Transect 5, while the lowest density percentage was recorded for *Ipomoea cordofana* in Transect 1, *Cucumis melo* in Transects 2 and 3, *Cenchrus echinatus* in Transect 4 and *Clitoria ternate* in Transect 5 (Table 9).

Keddy (2001) said that, in many cases (perhaps most) the negative effects upon neighbours arise from competition for light, with larger plants shading smaller plants. In other cases, there may be competition below ground for water, nitrogen, or phosphorus.

Table (8): Herbs Density 2011

Species	TR1	TR 2	TR 3	TR 4	TR 5
	High				
Commelina amplexicaulis	**30.51**	**19.97**	2.62	**69.84**	13.02
Sporobolus pyramidatus	0.00	0.00	**63.96**	0.05	15.71
Cassia occidentalis	0.00	0.48	4.83	0.09	**16.83**
Med					
Chloris virgata	**7.61**	0.97	1.31	0.00	1.90
Sorghum arundinaceum	4.84	**8.53**	0.00	0.00	0.63
Dactyloctenium aegyptium	0.00	0.00	**5.00**	0.00	2.38
Commelina kotschyi	2.31	6.04	0.25	**11.29**	**8.41**
Low					
Euphorbia acalyphoides	**0.06**	0.00	0.00	0.00	0.00
Aristolochia bracteolate	0.00	**0.08**	0.00	0.00	0.00
Thunbergia annua	0.00	0.24	**0.08**	0.14	1.27
Boerhavia erecta	0.00	0.00	0.00	**0.05**	0.00
Cuscuta hyalnia	0.00	0.00	0.00	0.00	**0.16**

Table (9): Herbs Density 2012

Species	TR1	TR 2	TR 3	TR 4	TR 5
	High				
Justicia palustris	**41.83**	6.81	0.35	23.82	0.00
Commelina amplexcaulis	16.33	**19.00**	7.57	2.46	**53.33**
Eragrostis diplochnoides	0.00	0.00	**45.42**	0.00	0.00
Commelina kotschyi	2.50	7.71	4.05	**30.06**	0.00
Med					
Srtiga hermothica	**10.00**	2.69	0.18	0.00	0.00
Cenchrus echinatus	0.50	**6.27**	2.82	0.00	0.00
Dactyloctenium aegyptium	0.00	0.00	**8.80**	0.00	0.00
Rhynchosia memnonia	1.67	2.51	1.58	**4.16**	0.00
Merremia emarginata	4.00	1.43	0.35	0.00	**13.33**
Low					
Ipomoea cordofana	**0.17**	0.00	0.00	0.57	0.00
Cucumis melo	2.83	**0.18**	**0.18**	0.57	0.00
Clitoria ternate	0.00	0.00	0.00	0.00	**6.67**

5.1.5 Herbs abundance, frequency, diversity and density:

In season 2011 in all of the study area *Commelina amplexcaulis* had a highly abundances, frequency and density, but less diversity (Table 10).

The lowest abundance, frequency, density and a high diversity were recorded for *Withania somnifra, Euphorbia acalyphoides* and *Boerhavia erecta* (Table 10).

In season 2012 at all of the study area *Sporobolus pyramidatus* had a high abundant but *Justicia palustris* had a high density, *Withania somnifra* had a high diversity (Table 10).

The lowest abundance, density and a high diversity were recorded for *Withania somnifra*. Also the lowest frequency shared with *Sporobolus pyramidatus* (Table 10).

Commelina amplexcaulis is common throughout the study area with *Sporobolus pyramidatus* as ecological associates, because they showed high abandances, frequency and density in both season.

Table (10): Herbs abundance, frequency, diversity and density 2011/ 2012

Species	Season 2011				Season 2012			
	A	F	SiD	Density	A	F	SiD	Density
Commelina amplexcaulis	**486.2**	**100**	8.3696	**34.57**	63.2	**100**	69.30	11.81
Justicia palustris	113.6	**100**	153.5199	8.08	104.25	80	39.77	**18.37**
Chloris virgate	43	**80**	1681.014	2.45	13.4	**100**	1560.04	2.82
Merremia emarginata	28.2	**100**	2504.66	2.01	11.75	80	3190.79	1.59
Acalyphe indica	52.6	**100**	717.53	3.74	1	60	1149750	0.13
Sporobolus pyramidatus	293.67	60	63.77	12.53	**258**	20	104.04	11.37
Rottobeolla cochinchinensis	27.33	60	7443.841	1.17	5.5	40	62713.65	0.48
Withania somnifra	1	20	**0**	0.01	1	20	**0**	0.04
Euphorbia acalyphoides	1	20	**0**	0.01	3	40	229950.1	0.26
Boerhavia erecta	1	20	**0**	0.01	0	0	0	0.00

5.1.6 Trees density:

In season 2011 *Acacia seyal* showed a high density in Transect 1, while *Acacia nilotica* had a high density in Transects 2 and 3, while *Acacia senegal* had a high density in Transect 4, but in Transect 5 *Balanites aegyptica* had a high density (Table 11).

The lowest density was recorded for *Acacia nilotica* in Transect 1, *Balanites aegyptica* in Transect 2, *Sterculia setigera* in Transect 3, *Adansonia digitata* and *Anogeissus leiocarpus* in Transect 4, while *Acacia senegal* and *Combretum hatmannianum* in Transect 5 (Table 11).

In season 2012 *Acacia seyal var seyal* had a high density in Transect 1, while *Acacia nilotica* had a high density in Transect 2, but *Balanites aegyptica* had a high density in Transects 3 and 5, while *Acacia senegal* had a high density in Transect 4 (Table 11).

The lowest density was recorded for *Balanites aegyptica* in Transect 1, *Acacia seyal var seyal, Ziziphus spina-chiristi* and *Acacia senegal* in Transect 2, *Sterculia setigera* and *Hyphaene thebaica* in Transect 3, *Combretum hatmannianum* in Transect 4, while *Ziziphus spina chiristi* in Transect 5 (Table 11).

Keddy (2001) found in many cases the negative effects upon neighbours arise from competition for light, with larger plants shading smaller plants. In other cases, there may be competition below ground for water, nitrogen, or phosphorus. In addition to theses factors some species were removed for the agricultural expension for both irrigated and rainfed.

5.1.7 Trees abundance, frequency, diversity and density:

In season 2011 at all of the study area *Acacia seyal* had a high abundant, frequency percentege shared same trend with *Acacia senegal* and *Balanites aegyptica,* but shared less diversity (Table 12).

Table (11): Trees density 2011/2012

sp.	Season 2011					Season 2012				
	TR 1	**TR2**	**TR 3**	**TR 4**	**TR 5**	**TR 1**	**TR2**	**TR 3**	**TR 4**	**TR 5**
Acacia seyal var seyal	**71.88**	10.19	8.72	11.95	6.16	**83.57**	5.06	2.33	17.64	0.00
Ziziphus spina -chiristi	20.54	14.81	2.56	5.98	0.00	6.43	5.06	0.00	1.70	0.76
Acacia senegal	4.69	11.11	27.69	**61.75**	0.68	7.86	5.06	11.63	**67.91**	0.00
Dichrostachys cinerea	1.79	27.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Balanites aegyptica	0.89	8.80	25.64	10.36	**89.04**	2.14	5.91	**75.58**	11.69	**93.18**
Acacia nilotica	0.22	**27.78**	**32.31**	0.00	0.00	0.00	**78.90**	5.81	0.00	0.00
Combretum hatmannianum	0.00	0.00	2.56	0.40	0.68	0.00	0.00	2.33	0.11	0.00
Sterculia setigera	0.00	0.00	0.51	0.00	0.00	0.00	0.00	1.16	0.00	0.00
Cephalucroton cordofanus	0.00	0.00	0.00	8.57	0.00	0.00	0.00	0.00	0.00	0.00
Acacia polyacontha	0.00	0.00	0.00	0.60	3.42	0.00	0.00	0.00	0.21	3.03
Adansonia digitata	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00
Anogeissus leiocarpus	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00
Hyphaene thebaica	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.16	0.00	0.00
Acacia seyal var fistula	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.43	3.03
Delbergia melanoxylon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00

The lowest abundance was recorded for *Sterculia setigera, Adansonia digitata* and *Anogeissus leiocarpus*. Lowest frequency was shared the same trend with *Dichrostachys cinerea, Cephalucroton cordofanus, Adansonia digitata* and *Anogeissus leiocarpus.* Lowest density was also shared same trend with *Adansonia digitata* and *Anogeissus leiocarpus* but the high diversity shared with *Adansonia digitata* and *Anogeissus leiocarpus* (Table 12).

In season 2012 at all of the study area *Acacia senegal* had a high abundance and density, but *Acacia seyal, Balanites aegyptica* had a high frequency. *Acacia senegal* had less diversity compare to other species (Table 12).

The lowest abundance and density and a high diversity was recorded for *Sterculia setigera,* and *Hyphaene thebaica*. Also the lowest frequency was shared with *Delbergia melanoxylon* (Table 12).

The dominant trees and shrubs include: *Acacia spp, Balanite s aegyptiaca* and *Acacia oerfota* as Abdelaziz A.A 2010 found.

In many cases (perhaps most) the negative effects upon neighbours arise from competition for light, with larger plants shading smaller plants. In other cases, there may be competition below ground for water, nitrogen, or phosphorus (Keddy2001).

Acacia seyal with *Acacia Senegal* and *Balanites aegyptica* were common trees throughout the study area as ecological relationship because they are showed high abundance, frequency and density in both seasons. Jackson (1958) considered this zone as the *Acacia seyal* - *Balanites aegyptica* bell of the low rainfall savannah.

5.1.8 Shrubs density:

In season 2011 *Acacia oerfota* had a high density at all Transects with *Combretum aculeatum* in Transect 4(Table 13).

Lowest density was recorded for *Combretum aculeatum* in Transects 1, 2 and 5 which wasshared the same trend with *Capparis decidua.* Lowest density was also recorded for *Calotropis procera* in Transect 3 and *Cadaba forinosa* and *Aerva jovanica* Transect 4 (Table 13).

Table (12): Trees abundance, frequency, diversity and density 2011/2012

Species	Season 2011				Season 2012			
	A	F%	SiD	Density%	A	F%	SiD	Density%
Acacia seyal var seyal	**86**	**100**	12.30	**28.53**	59.4	**100**	26.8	19.34
Ziziphus spina chiristi	39.75	80	90.34	10.55	9.5	80	1676.9	2.47
Acacia senegal	82	100	13.53	27.21	**168**	80	5.2	**43.75**
Dichrostachys cinerea	33.5	40	513.24	4.45	0	0	0	0.00
Balanites aegyptica	51	100	35.04	16.92	63	**100**	23.8	20.51
Acacia nilotica	41.33	60	148.80	8.23	96	40	64.3	12.50
Combretum hatmannianum	2	80	40527.54	0.53	1.5	40	392960	0.20
Sterculia setigera	0.5	40	**0**	0.07	1	20	**0**	0.07
Cephalucroton cordofanus	21.5	40	1256.67	2.85	0	0	0	0.00
Acacia polyacontha	2.67	60	40527.54	0.53	3	40	78592	0.39
Adansonia digitata	0.5	40	**0**	0.07	0	0	0	0.00
Anogeissus leiocarpus	0.5	40	**0**	0.07	0	0	0	0.00
Hyphaene thebaica	0	0	0	0	1	20	**0**	0.07
Acacia f seyal var istula	0	0	0	0	4	40	42102.9	0.52
Delbergia melanoxylon	0	0	0	0	3	20	392960	0.20

In season 2012 *Acacia oerfota* also had a high density in all Transects except in Transect 4 which *Acacia mellifra* showed a high density (Table 13).

The lowest density was recorded for *Capparis decidua* in Transects 1 and 2 shared the same trened with *Grewia tenax* in Transect 4,*Calotropis procera* in Transect l and Transect 3and *Stereospermum kunthianum* in Transect 5(Table 13).

Table (13): Shrubs density 2011/ 2012

Species	Season 2011					Season 2012				
	TR 1	TR2	TR 3	TR 4	TR 5	TR 1	TR2	TR 3	TR 4	TR 5
Acacia oerfota	**92.25**	**86.89**	**96.63**	**33.33**	**99.28**	**72.73**	**90.81**	**95.08**	38.46	**97.22**
Acacia mellifra	6.68	10.78	0.48	31.91	0.36	21.21	8.46	2.84	**48.95**	0.00
Combretum aculeatum	1.07	0.21	0.00	**33.33**	0.18	0.00	0.00	0.00	12.59	0.00
Capparis decidua	0.00	0.42	1.69	0.00	0.18	6.06	0.37	0.76	0.00	0.00
Cadaba forinosa	0.00	1.69	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00
Grewia tenax	0.00	0.00	0.96	0.00	0.00	0.00	0.37	1.14	0.00	0.00
Calotropis procera	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.19	0.00	0.00
Aerva jovanica	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00
Stereospermum kunthianum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.78

5.1.9 Shrubs abundance, frequency and diversity:

In season 2011 at all of the study area *Acacia oerfota* had a high abundance, frequency and density, but less diversity (Table 14).

The lowest abundance and density and a high diversity was recorded for *Calotropis procera,* and *Aerva jovanica*. Also lowest frequency was shared with *Grewia tenax* (Table 14).

In season 2012 at all of the study area *Acacia oerfota* had a high abundance, frequency and density, but less diversity (Table 14).

The lowest abundance, density and a high diversity were recorded for *Calotropis procera*. Also lowest frequency was shared with *Stereospermum kunthianum* (Table 14).

Table (14): Shrubs abundance, frequency and diversity 2011/2012

Species	Season 2011				Season 2012			
	A	F	SiD	Density%	A	F	SiD	Density%
Acacia oerfota	**351.2**	**100**	1.3	**89.64**	**207.6**	**100**	1.3	**87.08**
Acacia mellifra	25	**100**	247.5	6.38	23	**100**	108.3	9.65
Combretum aculeatum	13.3	80	1391.8	2.71	9	40	4639.5	1.51
Capparis decidua	3.3	60	42619.1	0.51	2.3	60	33801.7	0.59
Cadaba forinosa	4.5	40	53273.9	0.46	0	0	0	0.00
Grewia tenax	4	20	319643.5	0.20	3.5	40	33801.7	0.59
Calotropis procera	1	20	**0**	0.05	1	**20**	**0**	0.08
Aerva jovanica	1	20	**0**	0.05	0	0	0	0.00
Stereospermum kunthianum	0	0	0	0	6	**20**	47322.4	0.50

5.1.10 Family's density:

In season 2011 at all of the study area the family commelinaceae had a highly density in Transects 1, 2 and 4, while the family Poaceae had a high density in Transects 3 and 5 (Table 15).

Family Bignoniaceae showed the lowest density in Transect 1 and 3 and this was shared the same trend with family Asteraceae in Transect 1, while the family Tiliaceae showed the lowest density in Transect 2 shared the same result with family Aristolochiaceae and Transect 5 shared the same result with family

Solanaceae. The lowest density in Transect 4 was recorded for family Nyctaginaceae (Table 15).

In season 2012 at all of the study area the family of Acanthaceae recored high density in Transect 1and 4, while the family Poaceae had a high density in Transects 2 and 3, but the family Fabaceae had a high density in Transect 5 (Table 15).

Family Euphorbiaceae was the lowest density in Transect 1, while Family Cucurbitaceae showed the lowest density in Transect 2, Transect 3 and this was shared the same trend with family Asteraceae, Transect 4 and line5 shared the same trend with families Amaranthaceae, Malvaceae and Tiliaceae (Table 15).

5.1.11 Family's abundance, frequency, diversity and density:

In season 1 in the all of the study area the family of Poaceae had a high Abundance and density and high frequency as the same as families Commelinaceae, Acanthaceae, Convolvulaceae, Euphorbiaceae, Fabaceae, but it showed low diversity (Table 16).

Family Aristolochiaceae had a low abundance, frequency, density and highly diversity shared the same trend with family Nyctaginaceae and with family Azoaceae in low frequency only (Table 16).

In season 2012 at all of the study area the family Acanthaceae had a high abundance, density and frequency as the same as families Poaceae, Commelinaceae,Convolvulaceae, Euphorbiaceae, Fabaceae and Cucurbitaceae. But family Acanthaceae had a low diversity (Table 16).

Family Aristolochiaceae showed a low abundance, frequency, density and a high diversity shared the same result with family Nyctaginaceae and family Azoaceae in low frequency only (Table 16).

Table (15): Families density season 2011

Families	Season 2011					Season 2012				
	TR1	TR2	TR3	TR4	TR5	TR1	TR2	TR3	TR4	TR5
Poaceae	21.45	18.97	**79.58**	20.68	**41.65**	8.99	**35.36**	**72.43**	7.94	25.19
Commelinaceae	**32.81**	**31.59**	2.85	**49.00**	20.67	18.80	26.61	12.13	10.19	17.38
Acanthaceae	17.47	15.61	1.30	5.64	0.46	**41.76**	6.79	0.00	**76.01**	1.01
Convolvulaceae	5.36	2.91	0.81	1.00	2.30	4.66	7.32	1.10	0.30	7.30
Euphorbiaceae	6.81	7.84	0.57	11.90	1.38	0.67	1.61	0.55	0.59	1.01
Lamiaceae	3.75	3.21	0.00	1.00	0.46	1.83	3.39	0.00	0.59	2.27
Fabaceae	7.09	6.57	3.17	5.26	9.65	5.32	9.82	3.68	1.90	4.53
Amaranthaceae	1.90	2.17	0.33	2.51	0.00	0.00	0.00	1.29	1.13	0.25
Scrophulariaceae	0.58	0.60	0.00	0.00	1.38	9.98	2.68	0.18	0.00	1.01
Malvaceae	0.58	0.52	0.00	2.13	1.84	1.16	3.21	0.74	0.00	0.25
Solanaceae	0.69	0.82	0.00	0.50	0.15	0.17	0.36	0.18	0.00	0.00
Cyperaceae	0.40	5.53	0.24	0.00	0.00	0.00	0.71	1.10	0.00	0.00
Tiliaceae	0.35	0.07	1.30	0.00	0.15	3.83	0.00	0.37	0.24	0.25
Cucurbitaceae	0.23	0.15	0.00	0.00	0.00	2.83	0.18	0.18	0.18	0.25
Bignoniaceae	0.06	1.05	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Polygonaceae	0.00	0.67	0.73	0.00	0.00	0.00	0.00	1.10	0.00	0.00
Fabaceae	0.00	0.45	4.80	0.25	16.23	0.00	0.36	3.31	0.95	**37.53**
Aristolochiaceae	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Balanitaceae	0.00	0.00	2.52	0.00	0.31	0.00	0.00	1.10	0.00	0.00
Aizoaceae	0.00	0.00	1.30	0.00	0.00	0.00	0.00	0.37	0.00	0.00
Nyctaginaceae	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00
Papilionaceae	0.40	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Asteraceae	0.06	1.05	0.41	0.00	3.37	0.00	1.61	0.18	0.00	1.76

Table (16): Family's abundance, frequency, diversity and density 2011/2012

Families	Season 2011				Season 2012			
	A	F	SiD	Density	A	F	SiD	Density
Poaceae	**408.20**	**100**	7.95	**35.48**	176.00	**100**	18.56	23.22
Commelinaceae	310.60	**100**	13.73	26.99	113.80	**100**	44.43	15.01
Acanthaceae	115.20	**100**	99.91	10.01	**315.20**	**100**	5.79	**41.58**
Convolvulaceae	33.00	**100**	1222.88	2.87	21.80	**100**	1219.87	2.88
Euphorbiaceae	66.80	**100**	297.52	5.81	6.00	**100**	16506.10	0.79
Lamiaceae	29.75	80	2356.59	2.07	12.25	80	6105.57	1.29
Fabaceae	71.00	**100**	263.32	6.17	31.40	100	586.33	4.14
Amaranthaceae	21.50	80	4526.85	1.49	9.00	60	20456.28	0.71
Scrophulariaceae	9.00	60	47138.54	0.47	20.00	80	2272.20	2.11
Malvaceae	11.50	80	15986.11	0.80	7.50	80	16506.10	0.79
Solanaceae	7.00	80	43771.50	0.49	1.33	60	1196692.50	0.11
Cyperaceae	28.00	60	4746.31	1.46	5.00	40	159559.00	0.26
Tiliaceae	6.00	80	59947.93	0.42	7.50	80	16506.10	0.79
Cucurbitaceae	3.00	40	1103041.87	0.10	4.60	100	28380.06	0.61
Bignoniaceae	5.33	60	137880.23	0.28	0.00	0	0.00	0.00
Polygonaceae	9.00	40	108141.36	0.31	6.00	20	478677.00	0.16
Fabaceae	43.25	80	1112.09	3.01	46.25	80	421.87	4.88
Aristolochiaceae	1.00	20	0.00	0.02	0.00	0	0.00	0.00
Balanitaceae	16.50	40	31336.42	0.57	6.00	20	478677.00	0.16
Aizoaceae	16.00	20	137880.23	0.28	2.00	20	7180155.00	0.05
Nyctaginaceae	1.00	20	0.00	0.02	0.00	0	0.00	0.00
Papilionaceae	4.50	40.00	459600.78	0.16	0.00	0	0.00	0.00
Asteraceae	10.50	80.00	19216.76	0.73	5.67	80	52795.26	0.45

5.1.12 Plant cover %:

In season 2011 the cover percentage of the study area had a high significant effect in Transect 5 for plants, in Transect 1 for litter and in Transect 3 for baresoil, while there is no any significant effect for stones in all Transect s (Table 17).

In season 2012 the cover percentage of the study area have no any significant effect for all parameters in all Transects, but Transect 5 recorded a high mean for plants, Transect 2 had a high mean for litter and Transect 1 for ber soil (Table 18).

Table (17): Herbs cover % season 2011

Transects	Plant	Litter	P.S	Stones
1	78.80 ±10.48 B	21.200±10.476 A	0.000±0.000 B	0.000±0.000 A
2	88.80 ±11.19 AB	9.267±6.766 B	1.933±6.408 AB	0.000±0.000 A
3	83.80 ±16.25 AB	11.267±11.190 B	4.933±8.075 A	0.000±0.000 A
4	89.27 ±8.71 AB	9.600±7.799 B	1.133±2.031 AB	0.000±0.000 A
5	94.93 ±7.03 A	4.400±5.642 B	0.667±1.799 AB	0.000±0.000 A

Table (18): Plant cover % season 2012

Transects	Plant	Litter	P.S	Stones
1	82.87 ±29.03 A	15.33 ±28.26 A	1.800 ±4.678 A	0.000±0.000 A
2	73.67 ±31.3 A	25.47 ±30.55 A	0.867 ±1.727 A	0.000±0.000 A
3	86.53 ±17.80 A	12.27 ±16.70 A	1.200 ±2.513 A	0.000±0.000 A
4	81.20 ±21.70 A	18.80 ±21.70 A	0.000 ±0.000 A	0.000±0.000 A
5	89.07 ±10.28 A	10.20 ±9.25 A	0.800 ±1.146 A	0.000±0.000 A

5.1.13 Biomass:

In season 2011 biomass of the study area in Transect 2 and Transect 4 had a significant effect, but Transect 4 had a high mean compared to Transect 2 (Table 19)

In season 2012 biomass of the study area had no significant effect for all Transects, but Transect 2 recorded a high mean compared to the other Transects (Table 19).

Table (19): Biomass

Transect	Wight	
	Season1	Season2
1	8.433 ±3.316 AB	4.180 ±3.186 A
2	9.647 ±6.135 A	4.647 ±2.909 A
3	6.327 ±3.870 AB	3.927 ±2.704 A
4	9.660 ±3.742 A	3.887 ±1.825 A
5	4.413 ±2.810 B	3.33 .617 A

5.2 Section II: Taxonomical studies

5.2.1 Taxonomical Details:

5.2.1.1 Herbs:

5.2.1.1.1 Scientific name: *Commelina amplexicaulis* Hassk.
Local name: Ebreeg Elfaki

Family: Commelinaceae

Description:

Plants in the genus are perennial or annual herbs with roots that are usually fibrous or rarely tuberous or rhizomatous. The leaves are distichous (i.e. 2-ranked) or spirally arranged with blades that either lack or have a petiole. The pities or the way the leaf is folded in the bud, is either involute (i.e. having in rolled margins) or super volute.

The inflorescences are terminal, meaning the stem terminates with an inflorescence, and often leaf opposed, meaning it emerges at the node with a leaf of a new axillary stem. The inflorescence is composed of one or two cincinni, also called scorpioid cymes, which are monochasiums (i.e. cymes with a single branched main false axis) in which the lateral branches arise alternately on opposite sides of the false axis. The distal cincinnus may either be vestigial or contain one to several flowers that are typically male. The proximal cyme is always present and is multi-flowered. The cincinni are enclosed in a folded spathe, a modified leaf, which is often filled with a mucilaginous liquid. The spathe may either have completely distinct margins or they may be fused to varying degrees at the basal end.

The flowers are borne on pedicels and are strongly zygomorphic, meaning there is only a single plane of symmetry. Bracteoles occasionally subtend the

pedicels, but they are usually absent. The flowers are either bisexual or male. There are three unequal sepals, which may either be free or the two lateral ones may be fused. The petals are free and unequal with the two upper ones being larger and clawed while the lower petal is typically reduced and often differs in colour from the other two. Flower colour is most typically blue, but lilac, lavender, yellow, peach, apricot and white also occur. There are three stamens and two to three staminodes, or infertile stamens, all of which have free, glabrous filaments. The staminodes occur posteriorly and have antherodes with four to six lobes. The stamens are anterior and are longer than the staminodes. The medial stamen differs in size and form from the lateral two, and when a central staminode is present it also differs from the other staminodes. The ovaries are bi- or trilocular and one to two ovules is present per locule.

The fruit is a capsule that is typically bi- or trilocular, but in rare cases may be unilocular, and it is bi- or trivalved. The locules may contain one or two seeds or no seed at all. The seeds are uniserriate (i.e. arranged in a single row), have a linear hilum and a lateral embryotega.

Distribution: at all of the study area

5.2.1.1.2 Scientific name: *Commelina kotschyi*- Hassk
Synonyms: *Commelina petersii, Commelina latifolia*and *Commelina imberbis.*
Local name: Beeaid

Family: Commelinaceae

Description

Weedy annuals with long, straggling stems rooting at the nodes, usually glabrous. Leaves broadly linear-acuminate, cordate and amplexicaul at the base, 50-90 x 10-15 mm, pale green, margins often crenulate, minutely and sparsely setaceous with the setae ap-pressed to the leaf-surface. Spathes pedunculate, short and broad, free or fused basally, acute, c. 20 x 10 mm. Upper cyme 0 or represented by a peduncle. Flowers with blue petals. Capsule quadrate with the dorsal locule aborted or rarely 1-seeded; seeds cylindric-ellipsoid, 3 mm long, smooth, farinose with a short thick hilum, slightly marbled.

Distribution: all of the study area special in transect 4

5.2.1.1.3 Scientific names: *Cassia occidentalis*
Synonyms: *Senna occidentalis, Cassia caroliniana, C. ciliata, C. falcata, C. foetida, C. frutescens, C. geminiflora, C. linearis, C. longisiliqua, C. obliquifolia, C. planisiliqua, C. sophera, Ditremexa occidentalis.*

Local name: Soreeb

Family: Fabaceae

Description:

Grows 5–8 m high and is found in many tropical areas of South America, including the Amazon. Indigenous to Brazil, it is also found in warmer climates and tropical areas of South, Central, and North America. It is in the same genus as senna (*C. senna*) and is sometimes called "coffee senna." It is botanically classified as both *Senna occidentalis* and *Cassia occidentalis*. Its seeds, found in long seed pods, are sometimes roasted and made into a coffee-like beverage. The *Cassia* genus comprises some 600 species of trees, shrubs, vines, and herbs, with numerous species growing in the South American rainforests and tropics. Many species have been used medicinally, and these tropical plants have a rich history in natural medicine. Various *Cassia* plants have been known since the ninth or tenth centuries as purgatives and laxatives, including *Cassia angustifolia* and *Cassia senna.* (Site 3)

Distribuation: transect 5 Abu Oshar

5.2.1.1.4 Scientific name :*Sporobolus pyramidatus (*Lam.) Hitchc.

Synonyms: *S. humifusus* var. *cordofanus* Stapf.ex Massey

Local name: Aish Elfar

Family: Poaceae

Description:

Erect to ascending, tufted, slender annual grass; up to 0.6 m high, usually around 0.3m. Culm glabrous, smooth, slender; nodes glabrous. Leaves lanceolate to narrowly lanceolate, finely acuminate at the apex, broadest at the base; sparsely tubercle-based. Ligule short, ciliate rim. Inflorescences dense, open, panicles of verticillate and alternate slender racemes. Seeds oval, rugose, brownish red; 1.5mm long. (Braun *et al* 1991).

Distribution: Transect 3 Bonzoga

5.2.1.1.5 Scientific name:*Justicia palustris* (Hochst.) T. Anderson

Local name: Fakha

Family: Acanthaceae

Description

Leaves up to 3 1/4 by 1 1/4 in. (usually smaller), ovate-lanceolate, hairy on both surfaces, shortly decurrent on the petiole; petiole 0– 2/3 in. long. Spikes terminal, 4–8 by 3/4 in., continuous, or interrupted at the base, lower whorls sometimes distant and passing into axillary clusters; floral leaves 1/3– 1/2 in. long, broad-lanceolate to linear-oblong, obtuse, containing 3–1 flowers, green, hairy; flower-bract nearly similar but smaller. Sepals 5, 1/10– 1/8 in. long, with long white hairs and also with very short moniliform hairs. Filaments glabrous; one anther-cell below the other, tailed; pollen ellipsoid with two stopples and a row of tubercles on each side of the stopple upon the longitudinal band. Ovary nearly glabrous except at the top; style hairy below, branches 2, very short, oblong, subequal. Capsule 1/3 by 1/8 in., 4-seeded, shortly and densely retrose-hairy; stalk 1/10– 1/8 in. long, nearly as thick as the capsule; seeds globose, moderately compressed, yellow-brown, finally nearly black, marked by corrugations perpendicular to the margin (as in many Ammonites).

Distribuation: transect 1 Abu Teega

5.2.1.2 Trees:

5.2.1.2.1 Scientific name: *Acacia nilotica* (L.) Willd. ex Del.

Synonyms: *Acacia arabica* (Lam.) Willd.and *Acacia subalata* Vatke. Acacia scorpioides W. Wight, *Mimosa arabica* Lam., *Mimosa nilotica* L., *Mimosa scorpioides* L.

Local name: Sonut

Family: Fabaceae

Description

Tree 5-20 m high with a dense spheric crown, stems and branchlets usually dark to black coloured, fissured bark, grey-pinkish slash, exuding a reddish low quality gum. Thin, straight, light, grey spines in axillary pairs, usually in 3 to 12 pairs, 5 to 7.5 cm long in young trees, mature trees commonly without thorns. Leaves bipinnate, with 3-6 pairs of pinnulae and 10-30 pairs of leaflets each; leaflets 4-5 mm long and plus - tomentose, rachis with a gland at the bottom of the last pair of pinnulae. Flowers in globulous heads 1.2-1.5 cm in diameter of a bright golden-yellow color, set up either axillary or whorly on peduncles 2-3 cm long located at the end of the branches. Pods grey, thick, softly tomentose, straight or slightly curved, 5 to 15 cm long on a pedicel, 0.5 to 1.2 cm wide, with constrictions between the seeds giving a necklace appearance, fleshy when young, becoming black and hard at maturity (Andrews, 1952).

Distribuation: transect 1 Abu Teega

5.2.1.2.2 Scientific name: *Acacia senegal* (L.) Will var. Senegal Brena

Local name: Hashab

Family: Fabaceae

Description

Acacia senegal is a deciduous shrub, growing to 15 m tall and usually branched from the ground. Branches fork repeatedly and in mature trees commonly form a rounded, flat-topped crown. The trunk may vary in diameter up to about 30 cm. The bark is greyish-white, although in old trees growing in the open it may be dark, scaly and thin, showing the bright green cambium layer just below the surface if scratched with a nail.

The slash is mottled red. Powerful hooked thorns, 3-5 mm long, with enlarged bases appear at the nodes of the branches, usually in 3s. They are sharp, with twopointing forwards and one backwards.

Leaves bipinnate, 3-8 pinnae (glands between uppermost and lowermost pinnae); rachis up to 2.5 cm long; pannacles are pairs of 8-15, green.

Flowers yellowish-white and fragrant, in cylindrical, axillary pedunculate spikes, 5-10 cm long; calyx of each flower has 5 deep lobes, 5 petals and a mass of short stamens; pistil inconspicuous.

The pods are straight, thin, flat, shortly stipitate and oblong (7.5 x 2 cm), green and pubescent when young, maturing to shiny bronze, often with dark patches and bearing prominent veins; seeds 3-6, smooth, flat, rather small, shiny, dark brown.

Distribuation: Transect 4 Jabal Kardous

5.2.1.2.3 Scientific name: *Acacia seyal var seyal* Del.

Synonyms: *Acacia stenocarpa* Hochst. ex Rich, *Acacia hockii,* De Wild. and *Acacia boboensis* Aubrev.

Local name: Talih

Family: fabaceae

Description

Small, slender tree, reaching 6-15 m in height, with a stem diameter up to 60 cm, develops a characteristic umbrella-shaped canopy in adult individuals, usually thin and rather scarce foliage. Bark is usually smooth, pale green to greenish yellow when young or orange on exposure after the old bark has sloughed off. Bark smooth, peeling, rust-red or pale-green (both types may coexist in any population), covered with a pruinous, rusty, powdery coating. Bright red mottled slash, exuding a yellowish gum. Twigs with many small reddish glands and paired axillary thorns, up to 7 cm long, narrow and straight, vulnerant-sharp-ended and grey in color. Leaves dark green, with 4-12 pairs of pinnae having each 10-22 pairs of leaflets. Rachis up to 8 cm long clustered by 2 or 3. Flowers clustered by 2-3 with bright yellow globose heads ca 1.5 cm in diameter on peduncles about 3 cm long starting from the leaves axils. Pods hanging, slightly curved, dehiscent, light brown when mature, 10-15 cm long by 1 cm wide at the bottom, containing 6-10 seeds each.

Distribuation: all of the study area

5.2.1.2.4 Scientific name : *Balanites aegyptiaca* Del.

Synonyms: *Ximenia aegyptiaca* L. (excl. *Balanites roxburghii* Planch), *Agialida senegalensis* van Tiegh., *Agialida barteri* van Tiegh., *Agialida tombuctensis* van Tiegh., *Balanites ziziphoides* Milbr. Et Schlechter, *Balanites latifolia* (van Tiegh.) Chio

Local name: Hegleeg

Family: Balanitaceae

Description

It is multibranched, spiny shrub or tree up to l0 m tall. Crown spherical, in one or several distinct masses. Trunk short and often branching from near the base. Bark dark brown to grey, deeply fissured. Branches armed with stout yellow or green thorns up to 8 cm long. Leaves with two separate leaflets; leaflets obovate, asymmetric, 2.5 to 6 cm long, bright green, leathery, with fine hairs when young. Flowers in fascicles in the leaf axils, and are fragrant, yellowish-green.

Fruit is a rather long, narrow drupe, 2.5 to 7 cm long, 1.5 to 4 cm in diameter. Young fruits are green and tormentose, turning yellow and glabrous when mature. Pulp is bitter-sweet and edible. Seed is the pyrene (stone), 1.5 to 3 cm long, light brown, fibrous, and extremely hard. It makes up 50 to 60% of the fruit. There are 500 to 1 500 dry, clean seeds per kg.

Flowers are small, inconspicuous, hermaphroditic, and pollinated by insects. Seeds are dispersed by ingestion by birds and animals. The tree begins to flower and fruit at 5 to 7 years of age and maximum seed production is when the trees are 15 to 25 years old. (Daya L. Chothani and H. U. Vaghasiya 2011)

5.2.1.2.5 Scientific name: *Ziziphus spina-christi* (L.) Desf.

Local name: Sedir

Family: Rhamnaceae

Description

Ziziphus spina-christi is a shrub, sometimes a tall tree, reaching a height of 20 m and a diameter of 60 cm; bark light-grey, very cracked, scaly; trunk twisted; very branched, crown thick; shoots whitish, flexible, drooping; thorns in pairs, one straight, the other curved.

Leaves glabrous on upper surface, finely pubescent below, ovate-lanceolate or ellipsoid, apex acute or obtuse, margins almost entire, lateral veins conspicuous.Flowers in cymes, subsessile, peduncle 1-3 mm. Fruit about 1 cm in diameter.

There are 2 varieties: var. spina-christi is a tree with white branches, leaves larger, ovate-lanceolate with an acute or obtuse apex, 2.5-8.5 cm long and 1-3.5 cm wide, margins slightly crenate, 3 strong veins from the base, lateral veins inconspicuous; flowers many per cyme, peduncle up to 1.5 cm; fruit 2 cm in diameter; var. microphylla Hochst ex A. Rich. is a very \bushy shrub, leaves are widely ellipsoid or ovate-ellipsoid, rounded at the tip, 1-3 cm long and just as wide, margins almost entire, basal veins not reaching the apex, 1-2 strong lateral veins on each side of the central vein; branches brown-reddish; fruits up to 1 cm in diameter.

Dictribuation: at all of the study area except transect 5 Abu Oshar

5.2.1.3 Shrubs:

5.2.1.3.1 Scientific name: *Acacia mellifera* (Vahl) Benth

Local name: Ketir

Family: Fabaceae - Mimosoideae

Description

Acacia mellifera is a low, branched shrub with a more or less spherical crown. Black bark on stem becomes ash-grey to light brown on the branches, bearing small, short, sharply hooked prickles in pairs. It has a shallow but extensive root system radiating from the ground, allowing the plant to exploit soil moisture and nutrients from a large volume of soil. The roots rarely penetrate more than 1 m.

Leaves characterized by 2 pairs of pinnae, each with a single pair of leaflets. Leaflets were elliptic 0.6-2 cm long and 0.6-1.2 cm wide, glabrous and highly coloured beneath.

Flowers sweetly scented, especially at night, in elongated spikes, cream to white in spiciform racemes, up to 3.5 cm long; pedicels 0.5-1.5 mm long; calyx up to 1 mm long; corolla 2.5-3.5 mm long.

The papery pods with 2-3-seeds are reticulate, flat, elongated, 2.5-5.5 cm long, 6 cm wide, hemmed, sometimes more or less narrowed between the seeds.

Distribuation: trasect 4 Abu Kardous

5.2.1.3.2 Scientific name: *Acacia oerfota* (Forssk.) Schweinf.

Synonyms: *Acacia nubica* Benth, *Acacia merkeri* Harms and *Acacia virchoviana* Vatke

Local name: La'oot

Family: Fabaceae

Description:

Small shrubs 1-2 m tall with a flattened top, hence triangular funnel-shaped in vertical profile, with numerous grey branches starting from soil surface ; spines straight. 2 cm long, hard, white with a brown tip, grouped in pairs on a strong basal peduncle. Leaves were 3 cm long with 3-12 pairs of pinnae having 5-15 pairs of leaflets each. Flowers were whitish, very fragrant, clustered in balls of 1-3 in the axil of spines on a short peduncle not exceeding 1.3 cm. Pods were flat elongated-ellipsoid in shape acute at both ends with a sub-mucronate tip, 5-10 cm long by 1.2-1.3 cm wide. Seeds were of an olive-green color, numbering 5-10 per pod.

Distribuation: all of the study area

5.2.1.3.3 Scientific name: *Capparis decidua* (forsk.) Edgew.

Syn: *Capparis aphylla* (Heyne) Roth. *Capparis sodata* R.Br.*Sodata decidua* Forssk Kursan, Tundub (Ar.). Caper (E.)

Local name: Tondub

Family: Capparaceae

Description:

A shrub or small deciduous tree in dense tufts4– 5m high, with many green vine-like apparentlyleafless branches, hanging in bundles armed with small, light brown stipular prickles up to 0.5cmlong brown-yellowish much-branched. Branches and twigs are a glossy dark green, small. **Bark:** smooth green turns whitish-grey colour with age. **Leave:** simple very minute 1 – 2mm long with a very short life span on young shoots, so that the plant look leafless most of the time. **Inflorescences:** fascicles or corymbose racemes, terminal flowers in a small group, pink, average size (2.25x3.5cm), pedicels about 1cm long sepals unequal, larger and deeply saccate. Flower in the axils off the prickles. Flowering December – March. **Fruits:** globose berry of the sized and shape of a cherry, 1.5–0.5 cm across edible turns when dry blackish. Seeds many ovoid or sub-globulous `slightly mucronate. Fruiting March – May.

5.2.1.3.4 Scientific name: *Grewia tenax* (Forsk.) Fiori
Local name: Gudaim

Family: Tiliaceae

Description

Grewia tenax is a multistemmed shrub up to 2 m tall, usually rounded but generally battered and untidy due to browsing. Bark smooth, grey, very fibrous so that twigs are hard to break.

Leaves were alternate, almost circular in outline, 1.5-4 cm in diameter, margins toothed and prominently tri-nerved at the base, often hairy, particularly beneath with star shaped hairs. Stipules were inconspicuous, falling early.

Flowers solitary or in pairs, axillarily placed, petals white, about 1 cm long; sepals long and recurved. Fruit were orange-red at maturity, with 1-4 spheroid lobes. Grewia tembensis and G. tenax are virtually indistinguishable in fruit.

The specific epithet refers to the plant's tenacious growth habit. The genus was named after Nehemiah Grew (1641-1712), one of the founders of plant physiology. (http://www.worldagroforestry.org)

5.2.2 Table (20) Acheck List of plants found in the Study Area

No.	Scientific Name	Family	Local Arabic Name	Habit
1.	*Abelmoschus esculentus* (L.) Moench.	Malvaceae	Waika	Hearb
2.	*Acacia mellifra* (Val.) Benth	Fabaceae	Kitir	Shrub
3.	*Acacia seyal var seyal* Del.	Fabaceae	Taleh	Trees
4.	*Acacia nilotica* (L.) Wild. Ex Del	Fabaceae	Sunt	Trees
5.	*Acacia oerfota*	Fabaceae	La'ot	Shrub
6.	*Acacia polyacantha*	Fabaceae	Kakamout	Trees
7.	*Acacia senegal* (L.) Willd.	Fabaceae	Hashab	Trees
8.	*Acacia seyal var fistula*	Fabaceae	Sofar Abiad	Trees
9.	*Acalyphe indica* L.	Euphorbiaceae	Um gloot	Hearb
10.	*Acnthespermum hispidum* L.	Asteraceae	Hirab Husa	Hearb
11.	*Adansonia digitata* L.	Bombacaceae	Tabaldi	Trees
12.	*Aerva javanica* (Burn.f.) Juss.& Schult	Amaranthaceae	Ara	Shrub
13.	*Aeschynomene indica* L.	Fabaceae	Seha	Hearb
14.	*Anogeissus leiocarpus*	Combretaceae	Sealag sahab	Trees
15.	*Aristolochia bracteolate.* Lam.	Aristolochiaceae	Um Glagil	Hearb
16.	*Balanites aegyptica* (L.) Del.	Balanitaceae	Heglig	Trees
17.	*Boerhavia erecta* L.	Nyctaginaceae	Triba	Hearb
18.	*Brachairia ruciformis* (Sm.) Grieseb.	Poaceae	Agaiz galas an	Hearb
19.	*Cadaba farinose* Forisk	Capparaceae	Seraeh	Shrub

20.	*Calotropis procera* (Ait.) Ait. F.	Asclepiadaceae	Usher	Shrub
21.	*Capparis decidua* (Forssk.) Edgeu.	Capparaceae	Tundub	Shrub
22.	*Cassia occidentalis* (L.)	Fabaceae	Soreeb	Hearb
23.	*Cephalocroton cordofanus*	Euphorbiaceae	Dangal	Trees
24.	*Chloris virgata* Sw.	Poaceae	Abu Meleaha	Hearb
25.	*Choloris barbarta* ver. Meccana Ash. et.Schweinf	Poaceae	Um Shelial	Hearb
26.	*Clitoria ternata* L.	Fabaceae	Clitoria	Hearb
27.	*Combretum hartimanniam* Schweinf.	Combretaceae	Habil	Trees
28.	*Commelina amplexicaulis* Hassk	Commelinaceae	Beeaid	Hearb
29.	*Commelina kotschyi* Hassk	Commelinacea e	Ebreaq Elfaki	Hearb
30.	*Corchorus depressus* (L.) Christens.	Tiliaceae	Khodra Hamra	Hearb
31.	*Corchorus fascicularis* Lam.	Tiliaceae	KHodra	Hearb
32.	*Crotalaria senegalensis* (Pers.) Bacle ex DC	Fabaceae	Tagtaga	Hearb
33.	*Cucumis melo* (L.)	Cucurbitaceae	Humaidh	Hearb
34.	*Cuscuta hyalina* Roth.	Convolvulacea e	Hamoul	Hearb
35.	*Cymbopogon nervatus* (Hochst.) chiov.	Poaceae	Nal	Hearb
36.	*Cyperus rotundus* L.	Cyperaceae	Se'ida	Hearb

37.	*Dactyloctenium aegyptium* (L.) Beauv.	Poaceae	Um Asabie	Hearb
38.	*Dalbergia melanoxylon* Guill& Perr	Fabaceae	Abanus	Trees
39.	*Desmodium dichotomum* (Klein) DC.	Fabaceae	Abu Areeda	Hearb
40.	*Dichrostachys cinerea* (L.) whiee & Arn	Fabaceae	Kadad	Trees
41.	*Digera alternifolia* (L.) Mart.	Amaranthaceae	Khashm elnaseeba	Hearb
42.	*Digera muricata* (L.) Aschers.	Amaranthaceae	Um Hreeera	Hearb
43.	*Dinebra retroflexa* (Vahl.) Panz	Poaceae	Um mamlaiha	Hearb
44.	*Echinochloa colona* (L.) link	Poaceae	Defae	Hearb
45.	*Echinocloa pyramidalis* (Lam)	Poaceae	Um chir	Hearb
46.	*Eragrostis megastachya* (Koel.) Link	Poaceae	Aish elsimber – Bano	Hearb
47.	*Eriochloa nubica* (Stude.) Hack. And stapf. ex thell.	Poaceae	Melaisa	Hearb
48.	*Euphorbia acalyphoides* Hochst. ex Bioss	Euphorbiaceae	Um alabana	Hearb
49.	*Euphorbia aegyptiaca* Bioss	Euphorbiaceae	Um lebaina	Hearb
50.	*Grewia tenax* (Forisk) Fiori.	Tiliaceae	Godiam	Shrub
51.	*Heliotroium sudanicum* F.W. Ander.	Boragniaceae	Danab elagrab	Hearb
52.	*Hyphaene thebaica* (L.) Mart.	Arecaceae	Dom	Trees
53.	*Indigofera oblongifolia* Forsk.	Fabaceae	Dhaseer	Hearb
54.	*Indogofira pilosa* Poir.	Fabaceae	Babon	Hearb

55.	*Ipomoea aquatica* Forsk.	Convolvulacea e	Arkla	Hearb
56.	*Ipomoea cordofana* Choisy.	Convolvulacea e	Taber	Hearb
57.	*Ipomoea sinensis* (Desr.) Coisy.	Convolvulacea e	Hantoot	Hearb
58.	*Justicia palustris* (Hochst.) T. Anders.	Acanthaceae	Fakha	Hearb
59.	*Merremia emarginata* (Burm.f.) Hallierf	Convolvulacea e	Deriea-Metaet	Hearb
60.	*Ocimum basilicum* L.	Lamiaceae	Raihan	Hearb
61.	*Oxygonum atriplicifolium* (Meisn.) Martelli	Polygonaceae	Abu Khameira	Hearb
62.	*Panicum repens* (L.)	Poaceae	Bano	Hearb
63.	*Penisetum pedicellatum (*Trin)	Poaceae	Balang	Hearb
64.	*Pennistum purpureum* Schumach.	Poaceae	Danab Kaleb	Hearb
65.	*Phyllanthus madraspatensis* L.	Euphorbiaceae	Um regaiga	Hearb
66.	*Phyllonthus niruri* L.	Euphorbiaceae	Um baleela	Hearb
67.	*Physalis angulata* (L.)	Solanaceae`	Karm karm	Hearb
68.	*Rhynchosia memnonia* (Del.) Cooke.	Fabaceae	Erg Eldam	Hearb
69.	*Rottboella cochichinensis*	Poaceae	Razza	Hearb
70.	*Sesbania arabica* Steud.. & Hochst.	Fabaceae	Soreeb	Hearb
71.	*Sesbania pachycarpa* DC.	Fabaceae	Soreeb elfaki	Hearb
72.	*Sida alba* (L.)	Malvaceae	Um shedaida	Hearb

73.	*Socchus cornutus* (Forssk.) cass.	Asteraceae	Molaita	Hearb
74.	*Solanum dubium* Fresen.	Solanaceae`	Jobain	Hearb
75.	*Sorghum arundinaceum* (Dew.) stapf	Poaceae	Adar	Hearb
76.	*Sporobolus pyramidatus (Lam.)*	Poaceae	Aish elfar	Hearb
77.	*Srtiga hermothica* (Del.) Benth.	Scrophulariaceae	Booda	Hearb
78.	*Sterculia setigera* Del	Sterculiaceae	Tartar	Trees
79.	*Stereospermum kunthiamum* Cham.	Bignoniaceae	Kashkash abiad	Shrub
80.	*Thunbergia annua* ex Nees.	Acanthaceae	Um rekaibat	Hearb
81.	*Trianthema portulacastrum* L.	Aizoaceae	Raba'a	Hearb
82.	*Tribulus terrestris* L.	Balanitaceae	Deraisa	Hearb
83.	*Vernonia amygdalina*	Asteraceae	Abu Morua	Hearb
84.	*Withania somnifra* (L.) Dunal.	Solanaceae`	Shar elfagri	Hearb
85.	*Xanthium brasilicum*	Asteraceae	Rantok	Hearb
86.	*Ziziphus spina chiristi* (L.) Desf.	Rhamnaceae	Sidir	Trees

Conclusion

It is to be concluded that the study was conducted at ES suki, south-east of Sinnar State in total area of 147.040.6741.57m^2. The study covered the areas of Abu Teaga, Um Gurad, Bonzogam, Abu Kardous and Abu Oshar from September 2011 to October 2012 along the to rainy seasons.

The study composed of two parts, ecological study and taxonomical study. For the ecological assessement five rectangular transects representing 10% of the study area were made. Ecological parameters such plant abndance, frequency, density, diversity and biomass were measured. For the taxonomic study herbarium specimens were collected using the normal procedure for plant collection. Specimens collected were identified and described.

In the ecological study results showed *Commelina amplexcaulis* and *Sporobolus pyramidatus* as common herbs becous of thire highly abundant, frequent and dense. Also *Acacia seyal*, *Acacia senegal* and *Balanites aegyptica* for trees are common and *Acacia oerfota* is awide spread shrub in the study area in the two seasons of 2011 and 2012 respectively, while high abundance, density, frequency and low diversity was reported for families Poaceae and Acanthaceae in the two seasons.

There is a significant result on plant cover in the area of Abu Oshar (transect 5), while the area of Abu Teaga (transect 1) had a significant result in litters; while the study showed a high significant result for baresoil in Bonzoga area (transect 3) in season 2011. Biomass had a high significant results in transect 2 and 4 the areas of Um Grad and Abu Kardous.

About 15 ecologically dominant and important species of plants were investigated and detailed taxonomical studies were done, 5speceis from each catigory trees, shrubs and herbs, and finally a check list of plants species was produceed to fulfil the taxonomical part of the study.

Recommendation

It is to be recommended that:

1. Try to increase the palatable plants (like Clitoria ternate) by reseeding in the study area.
2. Try to decrease the un palatable plants (like Commelina amplexcaulis) by biological or chemical control.
3. Try to keepe the ecological diversity of plants by using the lows of natural resources.
4. Further research work is needed in the study area to know the ecological relationships between trees, shrubs and herbs species comperhensive taxonomic study should be done too.
5. Also further research work is needed to know the ecological relationships between plant families.
6. More research work is needed for the biomass and the carrying capacity of the range land.

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APPENDIX

1. Data for lines of Season 2011

Line 1

Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	TOTAL
Commelina amplexcaulis	17	12	86	86	80	46	76	26	0	0	0	0	8	16	76	529
Justiciapalustris	11	0	1	0	0	0	0	4	6	0	76	46	2	153	0	299
Chloris virgata	1	0	10	0	3	1	0	116	0	0	0	0	1	0	0	132
Merremiaemarginata	10	5	4	29	7	8	8	5	0	8	0	0	6	0	3	93
Acalypheindica	7	1	1	2	8	0	6	11	6	4	7	9	5	4	20	91
Sorghum arundinaceum	1	14	3	0	0	0	0	3	63	0	0	0	0	0	0	84
Rottobeollacochinchinensis	2	0	3	12	56	0	0	0	0	0	0	0	0	0	0	73
Ocimumbasilicum	1	10	14	13	7	2	11	5	0	0	2	0	0	0	0	65
Cenchrusechinatus	0	0	0	0	0	0	0	0	0	5	0	0	0	0	54	59
Crotalaria senegalensis	2	16	3	2	0	0	0	5	8	1	0	0	0	0	20	57
Commelinakotschyi	0	1	0	0	0	0	0	6	15	3	14	1	0	0	0	40

Digeramuricata	1	4	5	1	0	0	9	5	0	0	0	0	2	6	0	33
Rhynchosiamemnonia	0	0	0	0	2	0	0	0	2	0	0	1	17	2	2	26
Indogofirapilosa	0	0	3	7	6	5	1	0	0	0	1	0	0	0	0	23
Phyllanthusmadraspatensis	0	1	5	2	8	0	0	0	0	3	0	0	0	1	0	20
Dinebraretroflexa	0	9	1	0	2	0	0	0	0	0	0	0	0	0	0	12
Srtigahermothica	**0**	**0**	**0**	**2**	**0**	**3**	**0**	**3**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**10**
Desmodiumdichotomum	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**9**	**0**	**0**	**0**	**0**	**0**	**0**	**10**
Abelmoschusesculentus	**0**	**0**	**3**	**0**	**0**	**0**	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**9**
Physalis angulate	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**9**	**0**	**0**	**0**	**0**	**0**	**0**	**9**
Panicumrepenslinn	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**6**	**0**	**0**	**1**	**0**	**0**	**8**
Aeschynomeneindica	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**7**
Sesbaniapachycarpa	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**7**
Cyperusrotundus	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**7**
Corchorousfasicularis	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**2**	**0**	**0**	**5**

Euphorbia aegyptiaca	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**
Soncuchuscornutes	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**4**
Cucumismelo	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**1**	**1**	**4**
Phyllonthusniruri	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**2**
Solanumdubium	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**
Penisetumpedicellatum	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**
Brachairiaeruciformis	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Withaniasomnifra	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Sida alba	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Helieotroiumsudanicum	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Euphorbia acalyphoides	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Vernoniaamygdatina	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Corchorusdepressus	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Pennistumpurpureum	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**

LINE 2

Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	TOTAL
Commelinaamplexcaulis	6	16	0	24	22	0	0	32	42	0	4	0	0	86	16	248
Justiciapalustris	162	17	8	4	2	0	11	1	0	0	0	0	2	0	2	209
Sorghum arundinaceum	0	0	0	0	0	1	57	3	18	0	11	0	16	0	0	106
Acalypheindica	7	18	18	14	9	0	3	0	4	0	1	0	2	0	0	76
Commelinakotschyi	12	8	0	9	9	0	3	0	0	22	2	0	0	8	2	75
Cyperusrotundus	0	0	0	0	0	0	0	0	0	26	0	21	0	0	27	74
Pennistumpurpureum	0	0	0	0	0	0	0	0	1	0	0	72	0	0	0	73
Cenchrusechinatus	21	0	1	0	0	0	0	2	0	0	0	0	0	0	26	50
Ocimumbasilicum	3	0	3	6	0	0	8	15	0	0	2	0	2	4	0	43
Desmodiumdichotomum	0	0	6	11	0	4	0	6	0	0	0	0	3	0	0	30
Digeramuricata	0	0	0	0	0	0	2	3	0	18	0	0	0	0	2	25
Phyllanthusmadraspatensis	3	0	0	6	11	2	3	0	0	0	0	0	0	0	0	25
Rhynchosiamemnonia	6	3	5	9	0	0	0	0	0	0	0	0	0	0	0	23

Crotalaria senegalensis	4	0	4	0	4	4	0	3	0	0	0	1	0	0	2	22
Merremiaemarginata	3	2	0	0	0	2	0	0	0	1	1	0	5	2	1	17
Helieotroiumsudanicum	0	0	0	12	0	1	1	0	0	0	0	0	0	0	0	14
Ipomoea sinensis	8	0	0	0	0	0	2	0	0	0	0	0	0	4	0	14
Acnthespermumhispidum	0	0	0	0	0	0	0	0	9	0	0	5	0	0	0	14
Chloris virgata	0	0	0	0	0	0	1	0	0	0	0	0	0	0	11	12
Physalis angulate	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	11
Oxygonumatriplicifolium	0	0	0	0	0	0	0	0	8	0	1	0	0	0	0	9
Srtigahermothica	0	0	0	0	0	0	0	0	4	0	4	0	0	0	0	8
Ipomoea aquatic	0	0	0	0	0	0	0	0	0	4	0	0	0	0	3	7
Cassia occidentalis	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	6
Rottobeollacochinchinensis	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	5
Abelmoschusesculentus	0	0	0	0	0	0	0	0	0	3	0	0	0	2	0	5

Sesbaniaarabica	0	0	0	0	0	0	1	0	0	0	0	2	2	0	0	5
Indigoferaoblongifolia	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	5
Dinebraretroflexa	0	1	0	0	1	0	0	0	0	0	0	0	0	2	0	4
Phyllonthusniruri	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	4
Digeraalternifolia	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Indogofirapilosa	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3
Panicumrepenslinn	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	3
Thunbergiaannua	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	3
Sida alba	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Aeschynomeneindica	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
Cucumismelo	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2
Brachairiaeruciformis	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Corchorusdepressus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Hibiscus obtusilobus	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Ipomoea cordofana	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Aristolochia bracteolate	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1

LINE 3

Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	TOTAL
Eragrostisdiplochnoides	371	56	0	8	5	36	1	0	27	92	162	23	0	0	0	781
Dactylocteniumaegyptium	0	0	0	4	11	0	0	0	38	2	2	4	0	0	0	61
Cassia occidentalis	8	9	17	9	0	0	2	4	4	0	6	0	0	0	0	59
Pennistumpurpureum	0	0	13	3	0	0	8	0	0	0	16	0	0	2	0	42
Commelinaamplexcaulis	0	0	0	0	0	0	0	0	0	0	0	0	16	16	0	32
Tribulusterrestris	0	0	0	0	0	26	0	0	0	0	0	5	0	0	0	31
Echinochloacolonum	0	4	5	4	0	0	3	8	0	0	0	0	0	0	0	24
Indigoferaoblongifolia	19	0	0	0	0	0	0	0	0	0	0	2	0	0	0	21

Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	TOTAL
Eragrostismegastechya	0	0	0	0	0	0	0	0	13	2	1	0	0	2	0	18
Chloris virgata	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	16
Corchorusdepressus	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	16
Trianthemaportulacastum	0	6	0	5	2	0	0	3	0	0	0	0	0	0	0	16
Justiciapalustris	0	0	9	0	0	0	3	2	0	0	0	0	0	0	0	14
Cenchrusechinatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	13
Echinochloacolona	0	0	0	2	9	0	0	0	0	0	0	0	0	0	0	11
Oxygonumatriplicifolium	0	0	0	0	0	0	0	7	0	0	0	0	0	2	0	9
Merremiaemarginata	0	0	1	0	0	0	0	7	0	0	0	0	0	0	0	8
Crotalaria senegalensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8
Acalypheindica	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	7
Rhynchosiamemnonia	0	0	0	0	0	0	0	0	0	0	1	0	1	0	4	6
Acnthespermumhispidum	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	5

Rottobeollacochinchinensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
Digeraalternifolia	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	4
Sesbaniaarabica	0	0	2	0	0	0	0	1	0	0	0	0	0	1	0	4
Commelinakotschyi	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3
Cyperusrotundus	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3
Ipomoea sinensis	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
Brachairiaeruciformis	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Helieotroiumsudanicum	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Thunbergiaannua	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1

LINE 4

Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	TOTAL
Commelinaamplexcaulis	8	19	0	213	186	32	8	370	0	116	63	168	66	167	124	1540
Commelinakotschyi	6	25	1	6	11	4	43	9	11	92	2	7	25	0	7	249
Brachairiaeruciformis	22	26	36	0	2	24	2	0	0	0	3	4	3	1	1	124
Acalypheindica	4	4	1	2	4	16	19	4	2	0	3	2	4	8	8	81

Justiciapalustris	4	7	0	0	9	17	0	0	2	0	0	0	2	2	0	43
Rhynchosiamemnonia	0	0	16	0	0	4	0	0	0	0	0	1	5	1	0	27
Dinebraretroflexa	0	0	0	0	0	1	0	5	3	0	0	1	6	1	0	17
Abelmoschusesculentus	0	0	0	0	0	1	0	5	3	0	0	1	6	1	0	17
Digeramuricata	0	0	0	2	0	0	3	1	3	4	0	0	1	1	1	16
Phyllanthusmadraspatensis	0	0	0	0	0	0	2	8	0	0	0	1	0	1	0	12
Indogofirapilosa	0	3	1	0	0	0	6	0	1	0	0	0	0	0	0	11
Panicumrepenslinn	0	0	0	0	0	0	0	2	8	0	0	0	0	0	0	10
Crotalaria senegalensis	0	0	2	0	2	0	0	2	0	0	0	1	3	0	0	10
Ocimumbasilicum	0	0	0	0	0	0	0	1	0	0	0	2	2	0	3	8
Cymbopogonnervatus	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Penisetumpedicellatum	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4
Ipomoea sinensis	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	4
Digeraalternifolia	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	4

Thunbergiaannua	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3
Desmodiumdichotomum	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	3
Physalis angulate	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	3
Merremiaemarginata	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Ipomoea cordofana	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Cenchrusechinatus	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
Cassia occidentalis	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Solanumdubium	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Phyllonthusniruri	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Euphorbia aegyptiaca	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Eragrostisdiplochnoides	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Boerhaviaerecta	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Indigoferaoblongifolia	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1

LINE 5

Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	TOTAL
Cassia occidentalis	27	67	0	0	0	0	12	0	0	0	0	0	0	0	0	106
Eragrostisdiplochnoides	13	0	16	42	27	0	1	0	0	0	0	0	0	0	0	99
Commelinaamplexcaulis	0	0	0	0	0	0	0	36	19	0	5	0	0	0	22	82
Commelinakotschyi	0	18	4	0	0	0	2	13	0	0	0	0	0	0	16	53
Eragrostismegastechya	9	4	0	0	15	7	1	0	0	0	0	0	0	0	0	36
Crotalaria senegalensis	0	0	1		0	4	0	0	0	2	9	13	0	0	0	29
Merremiaemarginata	0	0	0	0	0	0	0	0	9		2	3	3	4	0	21
Desmodiumdichotomum	0	0	0	0	0	0	0	6	0	4	2	0	8	0	0	20
Eriochloanobica	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
Brachairiaeruciformis	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	16
Dactylocteniumaegyptium	0	2	0	9	4	0	0	0	0	0	0	0	0	0	0	15
Vernoniaamygdatina	0	0	0	0	0	0	0	0	0	0	0	8	6		0	14

Rhynchosiamemnonia	0	0	0	0	0	0	4	2	0	4	4	0	0	0	0	14
Chloris virgata	0	0	0	0	0	0	0	0	0	0	0	0	5	0	7	12
Penisetumpedicellatum	0	0	0	0	0	0	0	0	0	6	0	0	4	0	0	10
Echinochloacolonum	0	6	0	0	0	0	0	4	0	0	0	0	0	0	0	10
Srtigahermothica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	9
Abelmoschusesculentus	0	0	0	0	0	0	0	0	1	0	2	3	3	0	0	9
Thunbergiaannua	0	0	0	0	0	0	3	0	0	0	2	0	3	0	0	8
Acnthespermumhispidum	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	8
Acnthespermumhispidum	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	8
Acalypheindica	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	8
Cymbopogonnervatus	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	6
Sorghum arundinaceum	0	0	0	0	0	0	0	0	0	0	0	2	2		0	4
Pennistumpurpureum	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Cenchrusechinatus	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4
Sida alba	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3

Ocimumbasilicum	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3
Justiciapalustris	**0**	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3
Tribulusterrestris	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Solanumdubium	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Phyllanthusmadraspatensis	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Ipomoea sinensis	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Ipomoea cordofana	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Cuscutahyalnia	0	0	0	0	0	0	0	0		1	0	0	0	0	0	1
Corchorusdepressus	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1

2. Data for lines of Season 2012

Line 1

Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	TOTAL
Justiciapalustris	87	0	2	0	0	0	0	1	18	11	116	0	16	0	0	251
Commelinaamplexcaulis	0	11	13	0	0	54	16	0	0	0	0	4	0	0	0	98
Srtigahermothica	0	0	0	34	11	11	4	0	0	0	0	0	0	0	0	60
Merremiaemarginata	7	0	0	0	0	0	3	0	3	5	0	0	0	4	2	24
Corchorousfasicularis	0	0	0	0	0	0	0	0	22	0	0	0	0	1	0	23
Cucumismelo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	17
Chloris virgata	0	0	0	0	0	0	0	6	2	4	2		1	0	0	15
Commelinakotschyi	0	6	0	0	0	0	8	0	0	1	0	0	0	0	0	15
Crotalaria senegalensis	0	0	0	2	6	0	0	0	0	0	4	1	0	0	1	14
Sorghum arundinaceum	0	2	0	4	0	0	0	0	2		3	0	0	2		13
Dinebraretroflexa	0	2	0	0	0	0	0	2	0	0	0	0	0	0	9	13

Ocimumbasilicum	0	0	0	0		1	3	0	0	0	0	0	0	1	6	11
Rhynchosiamemnonia	0	0	0	0	0	0	0	0	2	3	3	0	2	0	0	10
Rottobeollacochinchinensis	0	0	0	0	7	0	0	0	0	0	1	0	0	0	0	8
Desmodiumdichotomum	0	0	0	0	5	0	0	0	0	1	0	0	0	0	0	6
Abelmoschusesculentus	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0	5
Euphorbia aegyptiaca	0	0	1	0	2	0	0	0	0	0	0	0	1	0	0	4
Cenchrusechinatus	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	3
Ipomoea sinensis	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	3
Sida alba	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
Brachairiaeruciformis	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Withaniasomnifra	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Indogofirapilosa	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Ipomoea cordofana	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Indigoferaoblongifolia	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1

Line 2

Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	TOTAL
Commelinaamplexcaulis	0	0	0	0	0	13	0	0	31	0	62	0	0	0	0	106
Pennistumpurpureum	0	0	0	0	0	0	0	0	0	0	1	92	2	0	0	95
Commelinakotschyi	0	0	0	0	0	0	3		22	0	21	0	0	0	0	43
Chloris virgata	3	2	4		2	0	0	0	0	1	0	0	4		26	26
Justiciapalustris	0	11	9	13	5	0	0	0	0	0	0	0	0	0	0	38
Cenchrusechinatus	6	0	4	0	0	0	0	21	0	0	0	0	0	0	4	35
Sorghum arundinaceum	8	0	0	0	0	0	2		6	0	0	0	16	0	0	22
Ipomoea aquatic	0	0	0	0	0	0	0	0	0	18	0	0	0	0	2	20
Ocimumbasilicum	2	3	0	0	0	5	3	0	0	0	6	0	0	0	0	19
Sesbaniaarabica	0	0	0	0	0	0	0	0	0	3	0	14	0	0	0	17
Srtigahermothica	0	0	0	0	0	6	0	0	0	0	8		1	0	0	15
Desmodiumdichotomum	0	0	0	0	0	0	0	6	0	0	0	2	4	0	2	14

Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	TOTAL
Rhynchosiamemnonia	5	4	3	0	0	0	0	0	0	0	0	2	0	0	0	14
Brachairiaeruciformis	0	6	0	0	1		1	0	0	0	0	0	0	4	0	12
Crotalaria senegalensis		2	2	0	0	0	2	0	0	0	0	4	0	0	0	10
Abelmoschusesculentus	2	2	0	2	0	0	0	4	0	0	0	0	0	0	0	10
Merremiaemarginata	0	0	0	1	1	2	0	0	4	0	0	0	0	0	0	8
Sida alba	0	2	6	0	0	0	0	0	0	0	0	0	0	0	0	8
Ipomoea sinensis	0	0	0	5	0	0	0	0	2	0	0	0	0	0	0	7
Cuscutahyalnia	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	6
Vernoniaamygdatina	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	5
Cyperusrotundus	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	4
Hibiscus obtusilobus	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	4
Acnthespermumhispidum	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	4
Rottobeollacochinchinensis	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3

Phyllonthusniruri	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	3
Acalypheindica	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
Phyllanthusmadraspatensis	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Euphorbia aegyptiaca	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Physalis angulate	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Cassia occidentalis	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2
Echinochloacolonum	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Dinebraretroflexa	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Cucumismelo	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1

Line 3

Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	TOTAL
Eragrostisdiplochnoides	111	11	0	4	17		22	0	11	0	46	36	0	0	0	258
Dactylocteniumaegyptium	0	2	0	2	0	0	0	0	46	0	0	0	0	0	0	50
Commelinaamplexcaulis	0	0	0	0	0	0	0	16	0	0	0	0	16	11	0	43

Pennistumpurpureum	0	0	0	0	0	2	0	0	5	0	26	0	0	0	7	40
Echinochloacolona	0	7		16	0	0	0	0	0	1	0	0	0	0	0	24
Commelinakotschyi	0	0	0	0	0	0	0	9	0	1	0	0	4	9	0	23
Cassia occidentalis	1	1	2		3	1	1		4	2	0	0	0	0	3	18
Srtigahermothica	0	0	0	0	0	0	0	0	0	0	0	0	6	4	7	17
Cenchrusechinatus	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	16
Chorisparbata	0	0	1	0	0	0	0	0	0	0	0	2	0	0	11	14
Rhynchosiamemnonia	0	0	0	0	2	0	0	3	0	0	2	0	0	0	2	9
Crotalaria senegalensis	0	0	0	0	0	0	0	0	2	0	4	0	0	2	0	8
Digeraalternifolia	0	0	1	0	0	2	0	0	4	0	0	0	0	0	0	7
Cyperusrotundus	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0	6
Oxygonumatriplicifolium	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	6
Tribulusterrestris	2	0	0	0	0	0	0	0	0	1	0	3	0	0	0	6
Chloris virgata	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	5
Sida alba	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	4
Echinochloacolonum	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	4

Cymbopogonnervatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
Justiciapalustris	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Merremiaemarginata	0	0		0	0	0	0	2	0	0	0	0	0	0	0	2
Desmodiumdichotomum	0	0		0	0		0	0	0	0	0	0	0	0	2	2
Phyllonthusniruri	0	0	2	0	0		0	0	0	0	0	0	0	0	0	2
Corchorusdepressus	0	0	2	0	0		0	0	0	0	0	0	0	0	0	2
Ipomoea sinensis	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2
Cuscutahyalnia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Trianthemaportulacastum	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Brachairiaeruciformis	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Acalypheindica	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Digeramuricata	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Physalis angulate	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Cucumismelo	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1

Vernoniaamygdatina	0	0	0	0	0	0	0	1		0	0	0	0	0	0	1
Thunbergiaannua	0	0	0	0	0	0	0	0	0	0	1			0	0	1
Sesbaniaarabica	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1

Line 4

Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	TOTAL
Commelinakotschyi	0	0	0	0	0	0	21	36	17	46	2	26	0	0	11	159
Justiciapalustris	3	4	22	12	6	0	0	16	26	16	8	4	9	0	0	126
Brachairiaeruciformis	4	2	0	2	0	2	4	0	1	4	11	16	16	9	13	84
Cymbopogonnervatus		8	1	0	7	2	2	1	0	0	0	2	0	0	0	23
Rhynchosiamemnonia	2	0	0	0	2	4	0	0	3	2	4	4	1	0	0	22
Digeraalternifolia	0	0	11	0	0	0	0	0	0	8	0	0	0	0	0	19
Chloris virgata	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
Cassia occidentalis	0	0	0	1		5	0	4	2	0	0	0	0	0	4	16

Commelinaamplexcaulis	0	0	0	9	0	0	4	0	0	0	0	0	0	0	0	13
Ocimumbasilicum	0	0	0	0	0	4	2	0	0	0	4		0	0	0	10
Phyllanthusmadraspatensis	0	0	0	0	0	3	6	0	0	0	0	0	0	1	0	10
Corchorusdepressus	0	0	0	0	0	2	0	0	0	0	0	0	0	1	1	4
Indigoferaoblongifolia	0	0	1	2	0	0	0	0	0	0	0	0	1	0	0	4
Crotalaria senegalensis	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	3
Dinebraretroflexa	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	3
Cucumismelo	0	0	0	0	1	0	0		2	0	0	0	0	0	0	3
Ipomoea cordofana	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	3
Desmodiumdichotomum	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Ipomoea sinensis	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Thunbergiaannua	0	1	0	0	0	0	1		0	0	0	0	0	0	0	2

Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	TOTAL
Indogofirapilosa	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cenchrusechinatus	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Pennistumpurpureum	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1

Line 5

Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	TOTAL
Cassia occidentalis	26	53	4	21	36	6	3	0	0	0	0	0	0	0	0	149
Commelinaamplexcaulis	0	0	0	0	0	0	0	11	0	11	0	0	17	9	8	56
Brachairiaeruciformis	0	0	0	0	0	9		5	2	0	3	0	0	0	0	19
Eragrostismegastechya	5	2	5	3	1	0	0	0	0	0	0	0	0	0	0	16
Merremiaemarginata	0	0	0	0	0	1		2	5	0	0	0	1	2	2	13
Commelinakotschyi	0	4	0	0	0	0	0	9	0	0	0	0	0	0	0	13
Dactylocteniumaegyptium	4	0	0	8	0	0	0	0	0	0	0	0	0	0	0	12
Cymbopogonnervatus	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	11

Cuscutahyalnia	0	0	0	0	0	0	0	0	2	0	0	0	0	8	0	10
Ocimumbasilicum	0	0	0	0	0	0	0	0		0	1	2		2	4	9
Cenchrusechinatus	0	0	0	0	0	0	0	1		0	0	8	0	0	0	9
Desmodiumdichotomum	0	0	0	0	0	0	0	0	0	1	3	0	0	3	0	7
Crotalaria senegalensis	0	0	0	0	0	0	0	0	0	1	2	3	0		0	6
Acnthespermumhispidum	0	0	0	0	0	0	0	0	0	0	0	0	2	4	0	6
Srtigahermothica	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4
Soncuchuscornutes	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	4
Phyllonthusniruri	0	2	0	0	0	0	0	0	1	0	1	0	0	0	0	4
Ipomoea sinensis	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4
Eriochloanobica	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Chloris virgata	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	3
Indogofirapilosa	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2
Rhynchosiamemnonia	0	0	0	0	0	0		1	0	0	0	0	1	0	0	2
Ipomoea cordofana	0	0	0	0	0	0	0	0	0	0	0	2		0	0	2

Digeramuricata	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Abelmoschusesculentus	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Corchorousfasicularis	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Cucumismelo	0	0	0	0	0	0	1	0	0		0	0	0	0	0	1
Vernoniaamygdatina	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Penisetumpedicellatum	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Clitoria ternate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1

3. Number of herbs in the study area for the two seasons:

sp.	2011- 2012						2012- 2013					
	lin1	line 2	line 3	line 4	line 5	TOTAL	lin1	line 2	line 3	line 4	line 5	TOTAL
Commelinaamplexcaulis	529	248	32	1540	82	2431	98	106	43	13	56	316
Justiciapalustris	299	209	14	43	3	568	251	38	2	126	0	417
Chloris virgata	132	12	16	0	12	172	15	26	5	18	3	67
Merremiaemarginata	93	17	8	2	21	141	24	8	2	0	13	47
Acalypheindica	91	76	7	81	8	263	0	2	1	0	0	3
Sorghum arundinaceum	84	106	0	0	4	194	13	22	0	0	0	35
Rottobeollacochinchinensis	73	5	4	0	0	82	8	3	0	0	0	11
Ocimumbasilicum	65	43	0	8	3	119	11	19	0	10	9	49
Cenchrusechinatus	59	50	13	0	0	122	3	35	16	0	9	63
Crotalaria senegalensis	57	22	8	10	29	126	14	10	8	3	6	41
Commelinakotschyi	40	75	3	249	53	420	15	43	23	159	13	253
Digeramuricata	33	25	0	16	0	74	0	0	0	0	1	1
Rhynchosiamemnonia	26	23	6	27	14	96	10	14	9	22	2	57
Indogofirapilosa	23	3	0	11	0	37	1	0	0	1	2	4

Phyllanthusmadraspatensis	20	25	0	12	1	58	0	2	0	10	0	12
Dinebraretroflexa	12	4	0	17	0	33	13	1	0	3	0	17
Srtigahermothica	10	8	0	0	9	27	60	15	1	0	4	80
Desmodiumdichotomum	10	30	0	3	20	63	6	14	2	2	7	31
Abelmoschusesculentus	9	5	0	17	9	40	5	10	0	0	1	16
Physalis angulate	9	11	0	3	0	23	0	2	1	0	0	3
Panicumrepenslinn	8	3	0	10	0	21	0	0	0	0	0	0
Aeschynomeneindica	7	2	0	0	0	9	0	0	0	0	0	0
Sesbaniapachycarpa	7	0	0	0	0	7	0	0	0	0	0	0
Cyperusrotundus	7	74	3	0	0	84	0	4	6	0	0	10
Corchorousfasicularis	5	0	0	0	0	5	23	0	0	0	1	24
Euphorbia aegyptiaca	4	0	0	1	0	5	4	2	0	0	0	6
Soncuchuscornutes	4	0	0	0	0	4	0	0	0	0	4	4
Cucumismelo	4	2	0	0	0	6	17	1	1	3	1	23
Phyllonthusniruri	2	4	0	1	0	7	0	3	2	0	4	9
Solanumdubium	2	0	0	1	1	4	0	0	0	0	0	0
Penisetumpedicellatum	2	0	0	4	10	16	0	0	0	0	1	1
Brachairiaeruciformis	1	1	1	124	16	143	1	12	1	84	19	117
Withaniasomnifra	1	0	0	0	0	1	1	0	0	0	0	1
Sida alba	1	2	0	0	3	6	2	8	4	0	0	14

Helieotroiumsudanicum	1	14	1	0	0	16	0	0	0	0	0	0
Euphorbia acalyphoides	1	0	0	0	0	1	0	0	0	0	0	0
Vernoniaamygdatina	1	0	0	0	14	15	0	5	1	0	1	7
Corchorusdepressus	1	1	16	0	1	19	0	0	2	4	0	6
Pennistumpurpureum	1	73	42	0	4	120	0	95	40	1	0	136
Ipomoea sinensis	0	14	2	4	1	21	3	7	2	2	4	18
Acnthespermumhispidum	0	14	5	0	8	27	0	4	0	0	6	10
Oxygonumatriplicifolium	0	9	9	0	0	18	0	0	6	0	0	6
Ipomoea aquatic	0	7	0	0	0	7	0	20	0	0	0	20
Cassia occidentalis	0	6	59	2	106	173	0	2	18	16	149	185
Sesbaniaarabica	0	5	4	0	0	9	0	17	1	0	0	18

sp.	2011- 2012						2012- 2013					
	lin1	line 2	line 3	line 4	line 5	TOTAL	lin1	line 2	line 3	line 4	line 5	TOTAL
Indigoferaoblongifolia	0	5	21	1	0	27	1	0	0	4	0	5
Digeraalternifolia	0	4	4	4	0	12	0	0	7	19	0	26
Thunbergiaannua	0	3	1	3	8	15	0	0	1	2	0	3
Ipomoea cordofana	0	1	0	2	1	4	1	0	0	3	2	6
Aristolochia bracteolate	0	1	0	0	0	1	0	0	0	0	0	0
Eragrostisdiplochnoides	0	0	781	1	99	881	0	0	258	0	0	258
Dactylocteniumaegyptium	0	0	61	0	15	76	0	0	50	0	12	62
Tribulusterrestris	0	0	31	0	2	33	0	0	6	0	0	6
Echinochloacolonum	0	0	24	0	10	34	0	2	4	0	0	6
Eragrostismegastechya	0	0	18	0	36	54	0	0	0	0	16	16
Trianthemaportulacastum	0	0	16	0	0	16	0	0	2	0	0	2
Echinochloacolona	0	0	11	0	0	11	0	0	24	0	0	24
Cymbopogonnervatus	0	0	0	5	6	11	0	0	3	23	11	37

Cenchrusechinatus	0	0	0	2	4	6	0	0	0	1	0	1
Boerhaviaerecta	0	0	0	1	0	1	0	0	0	0	0	0
Eriochloanobica	0	0	0	0	16	16	0	0	0	0	4	4
Cuscutahyalnia	0	0	0	0	1	1	0	6	2	0	10	18
Cholorisparbata	0	0	0	0	0	0	0	0	14	0	0	14
Clitoria ternate	0	0	0	0	0	0	0	0	0	0	1	1

3.1 Herb Abundance for the two seasons:

Species	2011- 2012					2012- 2013				
	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5
Commelina amplexcaulis	48.1	27.6	16	118.4	20.5	19.6	35.3	14.3	6.5	11.2
Justiciapalustris	37.4	23.2	4.7	6.1	3	35.9	9.5	2	11.5	0
Chloris virgata	22	6	16	0	6	3	3.7	2.5	18	1.5
Merremia emarginata	8.5	2.1	4	2	4.2	4	2	2	0	2.2
Acalyphe indica	6.5	8.4	7	5.8	8	0	2	1	0	0
Sorghum arundinaceum	16.8	17.7	0	0	2	2.6	5.5	0	0	0
Rottobeolla cochinchinensis	18.3	5	4	0	0	4	3	0	0	0
Ocimum basilicum	7.2	5.4	0	2	3	2.8	3.8	0	3.3	3
Cenchruse chinatus	29.5	12.5	13	0	0	1	8.8	16	0	4.5
Crotalaria senegalensis	7.1	3.1	8	2	5.8	2.8	2.5	2.7	1.5	2
Commelina kotschyi	6.7	8.3	3	17.8	10.6	5	14.3	5.8	22.8	6.5
Digera muricata	4.1	2.8	0	2	0	0	0	0	0	1
Rhynchosia memnonia	4.3	5.8	6	5.4	3.5	2.5	3.5	2.25	2.8	1

Indogofira pilosa	3.8	3	0	2.8	0	1	0	0	1	2
Phyllanthus madraspatensis	3.3	4	0	3	1	0	2	0	3.3	0
Dinebra retroflexa	4	1.3	0	2.8		4.3	1	0	1	0
Srtiga hermothica	2.5	4	0	0	9	15	5	1	0	4
Desmodium dichotomum	5	6	0	1	5	3	3.5	2	2	2.3
Abelmoschuse sculentus	3	2.5	0	2.8	2.3	2.5	2.5	0	0	1
Physalis angulate	9	11	0	1.5	0	0	2	1	0	0
Panicum repenslinn	2.7	1	0	5	0	0	0	0	0	0

Species	2011- 2012					2012- 2013				
	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5
Aeschynomene indica	3.5	2	0	0	0	0	0	0	0	0
Sesbania pachycarpa	2.3	0	0	0	0	0	0	0	0	0
Cyperus rotundus	3.5	24.7	3	0	0	0	4	3	0	0
Corchorous fasicularis	1.3	0	0	0	0	11.5	0	0	0	1
Euphorbia aegyptiaca	2	0	0	1	0	1.3	2	0	0	0
Soncuchus cornutes	2	0	0	0	0	0	0	0	0	4
Cucumis melo	1	2	0	0	0	17	1	1	1.5	1
Phyllonthus niruri	1	2	0	1	0	0	1.5	2	0	1.3
Solanum dubium	2	0	0	1	1	0	0	0	0	0
Penisetum pedicellatum	2	0	0	4	5	0	0	0	0	1
Brachairia ruciformis	1	1	1	11.3	16	1	3	1	7	4.75

Withania somnifra	1	0	0	0	0	1	0	0	0	0
Sida alba	1	2	0	0	3	2	4	2	0	0
Helieotroium sudanicum	1	1.8	1	0	0	0	0	0	0	0
Euphorbia acalyphoides	1	0	0	0	0	0	0	0	0	0
Vernonia amygdatina	1	0	0	0	7	0	5	1	0	1
Corchorus depressus	1	1	16	0	1	0	0	2	1.3	0
Pennistum purpureum	1	36.5	8.4	0	4	0	31.7	10	1	0
Acnthespermum hispidum	0	4.7	2	2	1	1.5	3.5	2	1	2

Species	2011- 2012					2012- 2013				
	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5
Oxygonum atriplicifolium	0	4.5	4.5	0	0	0	0	6	0	0
Ipomoea aquatic	0	3.5	0	0	0	0	10	0	0	0
Cassia occidentalis	0	6	7.4	2	35.3	0	1	2	3.2	21.3
Sesbania Arabica	0	1.7	4	0	0	0	8.5	1	0	0
Indigofera oblongifolia	0	5	10.5	1	0	1	0	0	1.3	0
Digera alternifolia	0	4	4	2	0	0	0	2.3	9.5	0
Thunbergia annua	0	1.5	1	3	2.7	0	0	1	1	0
Ipomoea cordofana	0	1	0	2	1	1	0	0	1	2
Aristolochia bracteolate	0	1	0	0	0	0	0	0	0	0
Sporobolus pyramidatus	0	0	78.1	1	19.8	0	0	32.3	0	0
Dactyloctenium aegyptium	0	0	10.2	0	5	0	0	16.7	0	6
Tribulus terrestris	0	0	15.5	0	2	0	0	2	0	0
Echinochloa colonum	0	0	4.8	0	5	0	2	2	0	0
Eragrostis megastechya	0	0	4.5	0	7.2	0	0	0	0	3.2
Trianthem aportulacastum	0	0	4	0	0	0	0	2	0	0

Echinochloa colona	0	0	5.5	0	0	0	0	8	0	0
Cymbopogon nervatus	0	0	0	5	6	0	0	3	3.3	11
Cenchruse chinatus	0	0	0	2	4	0	0	0	1	0
Boerhavia erecta	0	0	0	1	0	0	0	0	0	0
Eriochloa nobica	0	0	0	0	16	0	0	0	0	4
Cuscuta hyalnia	0	0	0	0	1	0	6	2	0	5
Choloris parbata	0	0	0	0	0	0	0	4.7	0	0
Clitoria ternate	0	0	0	0	0	0	0	0	0	1

3.2 Herb frequency (F %) for the two seasons:

Species	2011- 2012					2012- 2013				
	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5
Commelina amplexicaulis	73.3	60	6.7	86.7	26.7	33.3	20	20	13.3	33.3
Justiciapalustris	53.3	60	20	46.7	6.7	46.7	26.7	6.7	73.3	0
Chloris virgata	40	13.3	6.7	0	13.3	33.3	46.7	13.3	13.3	13.3
Merremia emarginata	73.3	53.3	13.3	6.7	33.3	46.7	26.7	20	0	40
Acalyphe indica	93.3	60	6.7	93.3	6.7	0	6.7	6.7	0	0
Sorghum arundinaceum	33.3	40	0	0	13.3	33.3	26.7	0	0	0
Rottobeolla cochinchinensis	26.7	6.7	6.7	0	0	13.3	6.7	0	0	0
Ocimum basilicum	60	53.3	0	26.7	6.7	26.7	33.3	0	20	20
Cenchruse chinatus	13.3	26.7	6.7	0	0	20	26.7	6.7	0	13.3
Crotalaria senegalensis	53.3	46.7	6.7	33.3	33.3	33.3	26.7	20	13.3	20
Commelina kotschyi	40	60	6.7	93.3	33.3	20	20	26.7	46.7	13.3
Digera muricata	53.3	26.7	0	53.3	0	0	0	0	0	6.7
Rhynchosia memnonia	40	26.7	20	33.3	26.7	26.7	26.7	26.7	53.3	13.3
Indogofira pilosa	40	6.7	0	26.7	0	46.7	0	0	6.7	6.7

Phyllanthus madraspatensis	40	33.3	0	26.7	6.7	0	6.7	0	20	0
Dinebra retroflexa	20	20	0	40	0	20	6.7	0	20	0
Srtiga hermothica	26.7	13.3	0	0	6.7	26.7	20	6.7	0	6.7
Desmodium dichotomum	13.3	33.3	0	6.7	26.7	13.3	26.7	6.7	6.7	20
Abelmoschuse sculentus	20	13.3	0	40	26.7	13.3	26.7	0	0	6.7
Physalis angulate	6.7	6.7	0	13.3	0	0	6.7	6.7	0	0
Panicum repenslinn	20	20	0	13.3	0	0	0	0	0	0

Species	2011- 2012					2012- 2013				
	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5
Aeschynomene indica	13.3	6.7	0	0	0	0	0	0	0	0
Sesbania pachycarpa	20	0	0	0	0	0	0	0	0	0
Cyperus rotundus	13.3	20	6.7	0	0	0	6.7	13.3	0	0
Corchorous fasicularis	26.7	0	0	0	0	13.3	0	0	0	6.7
Euphorbia aegyptiaca	13.3	0	0	6.7	0	46.7	6.7	0	0	0
Soncuchus cornutes	13.3	0	0	0	0	0	0	0	0	6.7
Cucumis melo	26.7	6.7	0	0	0	6.7	6.7	6.7	13.3	6.7
Phyllonthus niruri	13.3	13.3	0	6.7	0	0	13.3	6.7	0	20
Solanum dubium	6.7	0	0	6.7	6.7	0	0	0	0	0
Penisetum pedicellatum	6.7	0	0	6.7	13.3	0	0	0	0	6.7
Brachairia ruciformis	6.7	6.7	6.7	73.3	6.7	6.7	26.7	6.7	80	26.7

Withania somnifra	6.7	0	0	0	0	6.7	0	0	0	0
Sida alba	6.7	6.7	0	0	6.7	6.7	13.3	13.3	0	0
Helieotroium sudanicum	6.7	53.3	6.7	0	0	0	0	0	0	0
Euphorbia acalyphoides	6.7	0	0	0	0	0	0	0	0	0
Vernonia amygdatina	6.7	0	0	0	13.3	0	6.7	6.7	0	6.7
Corchorus depressus	6.7	6.7	6.7	0	6.7	0	0	6.7	20	0
Pennistum purpureum	6.7	13.3	33.3	0	6.7	0	20	26.7	6.7	0
Acnthespermum hispidum	0	20	6.7	13.3	6.7	13.3	13.3	6.7	6.7	13.3

Species	2011- 2012					2012- 2013				
	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5
Oxygonum atriplicifolium	0	13.3	13.3	0	0	0	0	6.7	0	0
Ipomoea aquatic	0	13.3	0	0	0	0	133	0	0	0
Cassia occidentalis	0	6.7	53.3	6.7	20	0	13.3	60	33.3	46.7
Sesbania arabica	0	20	20	0	0	0	13.3	6.7	0	0
Indigofera oblongifolia	0	6.7	13.3	6.7	0	6.7	0	0	20	0
Digera alternifolia	0	6.7	13.3	13.3	0	0	0	20	13.3	0
Thunbergia annua	0	13.3	6.7	6.7	20	0	0	6.7	13.3	0
Ipomoea cordofana	0	6.7	0	6.7	6.7	6.7	0	0	20	6.7
Aristolochia bracteolate	0	6.7	0	0	0	0	0	0	0	0
Sporobolus pyramidatus	0	0	66.7	6.7	33.3	0	0	53.3	0	0
Dactyloctenium aegyptium	0	0	40	0	20	0	0	20	0	13.3
Tribulus terrestris	0	0	13.3	0	6.7	0	0	20	0	0
Echinochloa colonum	0	0	33.3	0	13.3	0	6.7	13.3	0	0
Eragrostis megastechya	0	0	26.7	0	33.3	0	0	0	0	33.3
Trianthem aportulacastum	0	0	26.7	0	0	0	0	6.7	0	0

Echinochloa colona	0	0	13.3	0	0	0	0	20	0	0
Cymbopogon nervatus	0	0	0	6.7	6.7	0	0	6.7	46.7	6.7
Cenchruse chinatus	0	0	0	6.7	6.7	0	0	0	6.7	0
Boerhavia erecta	0	0	0	6.7	0	0	0	0	0	0
Eriochloa nobica	0	0	0	0	6.7	0	0	0	0	6.7
Cuscuta hyalnia	0	0	0	0	6.7	0	6.7	6.7	0	13.3
Choloris parbata	0	0	0	0	0	0	0	20	0	0
Clitoria ternate	0	0	0	0	0	0	0	0	0	6.7

3.3 Herb diversity Indices (SiD):

3.3.1 Season (2011-2012):

Species	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5
Commelina amplexicaulis	10.76	25.16	1501.63	2.05	59.66
Justiciapalustris	33.73	35.46	8184.73	2690.93	66045
Chloris virgata	173.78	11676.68	6206.75	0	3002.05
Merremia emarginata	351.22	5666.63	26600.36	2429910	943.5
Acalyphe indica	366.91	270.41	35467.14	749.97	7076.25
Sorghum arundinaceum	431.01	138.48	0	0	33022.5
Rottobeolla cochinchinensis	571.73	77066.1	124135	0	0
Ocimum basilicum	722.36	853.45	0	86782.5	66045
Cenchruse chinatus	878.15	629.11	9548.85	0	0
Crotalaria senegalensis	941.42	3336.19	26600.36	53998	488.02
Commelina kotschyi	1926.29	277.72	248270	78.69	143.79
Digera muricata	2845.67	2568.87	0	20249.25	0
Rhynchosia memnonia	4623.11	3046.09	49654	6922.82	2177.31

Indogofira pilosa	5938.78	256887	0	44180.18	0
Phyllanthus madraspatensis	7907.95	2568.87	0	36816.82	0
Dinebra retroflexa	22765.32	128443.5	0	17866.99	0
Srtiga hermothica	33389.13	27523.61	0	0	5503.75
Desmodium dichotomum	33389.13	1771.63	0	0	1042.82
Abelmoschuse sculentus	41736.42	77066.1	0	17866.99	5503.75
Physalis angulate	41736.42	14012.02	0	809970	0
Panicum repenslinn	53661.11	256887	0	53998	0
Aeschynomene indica	71548.14	770661	0	0	0
Sesbania pachycarpa	71548.14	0	0	0	0
Cyperus rotundus	71548.14	285.32	248270	0	0
Corchorous fasicularis	150251.1	0	0	0	0
Euphorbia aegyptiaca	250418.5	0	0	0	0
Soncuchus cornutes	250418.5	0	0	0	0

Cucumis melo	250418.5	770661	0	0	0
Phyllonthus niruri	1502511	128443.5	0	0	0
Solanum dubium	1502511	0	0	0	0
Penisetum pedicellatum	1502511	0	0	404985	4403
Brachairia ruciformis	0	0	0	318.63	1651.13
Withania somnifra	0	0	0	0	0
Sida alba	0	770661	0	0	66045
Helieotroium sudanicum	0	8468.80	0	0	0
Euphorbia acalyphoides	0	0	0	0	0
Vernonia amygdatina	0	0	0	0	2177.31
Corchorus depressus	0	0	6206.75	0	0
Pennistum purpureum	0	293.25	865.05	0	33022.5
Acnthespermum hispidum	0	8468.802	744810	404985	0

Species	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5
Oxygonum atriplicifolium	0	21407.25	20689.17	0	0
Ipomoea aquatic	0	36698.14	0	0	0
Cassia occidentalis	0	51377.4	435.31	2429910	35.60
Sesbania Arabica	0	77066.1	124135	0	0
Indigofera oblongifolia	0	77066.1	3546.71	0	0
Digera alternifolia	0	128443.5	124135	404985	0
Thunbergia annua	0	256887	0	809970	7076.25
Ipomoea cordofana	0	0	0	2429910	0
Aristolochia bracteolate	0	0	0	0	0
Sporobolus pyramidatus	0	0	2.45	0	40.84
Dactyloctenium aegyptium	0	0	407	0	1887
Tribulus terrestris	0	0	1601.74	0	198135
Echinochloa colonum	0	0	2698.59	0	4403

Eragrostis megastechya	0	0	4868.04	0	314.5
Trianthem aportulacastum	0	0	6206.75	0	0
Echinochloa colona	0	0	13542	0	0
Cymbopogon nervatus	0	0	0	242991	13209
Cenchruse chinatus	0	0	0	2429910	33022.5
Boerhavia erecta	0	0	0	0	0
Eriochloa nobica	0	0	0	0	1651.12
Cuscuta hyalnia	0	0	0	0	0

3.3.2 Season (2011-2012):

Species	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5
Commelina amplexcaulis	37.81	27.93	178.33	1790.46	44.81
Justiciap alustris	5.73	221.07	161028	17.73	0
Chloris virgata	1711.43	478.16	16102.8	912.78	23002
Merremia emarginata	651.09	5550.12	161028	0	884.69
Acalyphe indica	0	155403	0	0	0
Sorghum arundinaceum	2303.85	672.74	0	0	0
Rottobeolla cochinchinensis	6417.86	51801	0	0	0
Ocimum basilicum	3267.27	908.79	0	3103.47	1916.83
Cenchruse chinatus	59900	261.18	1341.9	0	1916.83
Crotalaria senegalensis	1974.73	3453.4	5751	46552	4600.4
Commelina kotschyi	1711.43	172.09	636.47	11.12	884.69

Digera muricata	0	0	0	0	0
Rhynchosia memnonia	3993.33	1707.73	4473	604.57	69006
Indogofira pilosa	0	0	0	0	69006
Phyllanthus madraspatensis	0	155403	0	3103.47	0
Dinebra retroflexa	2303.85	0	0	46552	0
Srtiga hermothica	101.53	1480.03	0	0	11501
Desmodium dichotomum	11980	1707.73	161028	139656	3286
Abelmoschuse sculentus	17970	3453.4	0	0	0
Physalis angulate	0	155403	0	0	0
Panicum repenslinn	0	0	0	0	0

Species	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5
Aeschynomene indica	0	0	0	0	0
Sesbania pachycarpa	0	0	0	0	0
Cyperus rotundus	0	25900.5	10735.2	0	0
Corchorous fasicularis	710.28	0	0	0	0
Euphorbia aegyptiaca	29950	155403	0	0	0
Soncuchus cornutes	0	0	0	0	11501
Cucumis melo	1321.32	0	0	46552	0
Phyllonthus niruri	0	51801	161028	0	11501
Solanum dubium	0	0	0	0	0
Penisetum pedicellatum	0	0	0	0	0
Brachairia ruciformis	0	2354.59	0	40.06	403.54
Withania somnifra	0	0	0	0	0

Sida alba	179700	5550.12	26838	0	0
Helieotroium sudanicum	0	0	0	0	0
Euphorbia acalyphoides	0	0	0	0	0
Vernonia amygdatina	0	15540.3	0	0	0
Corchorus depressus	0	0	161028	23276	0
Pennistum purpureum	0	34.81	206.45	0	0
Acnthespermum hispidum	59900	7400.14	161028	139656	11501
Oxygonum atriplicifolium	0	0	10735.2	0	0
Ipomoea aquatic	0	817.91	0	0	0
Cassia occidentalis	0	155403	1052.47	1163.8	6.26
Sesbania Arabica	0	1142.67	0	0	0
Indigofera oblongifolia	0	0	0	23276	0
Digera alternifolia	0	0	7668	816.70	0
Thunbergia annua	0	0	0	139656	0
Ipomoea cordofana	0	0	0	46552	69006

Aristolochia bracteolate	0	0	0	0	0
Sporobolus pyramidatus	0	0	4.86	0	0
Dactyloctenium aegyptium	0	0	131.45	0	1045.55
Tribulus terrestris	0	0	10735.2	0	0
Echinochloa colonum	0	155403	26838	0	0
Eragrostis megastechya	0	0	0	0	575.05
Trianthem aportulacastum	0	0	161028	0	0
Echinochloa colona	0	0	583.44	0	0
Cymbopogon nervatus	0	0	53676	552	1254.66
Cenchruse chinatus	0	0	0	0	0
Boerhavia erecta	0	0	0	0	0

Species	LINE 1	LINE 2	LINE 3	LINE 4	LINE 5
Eriochloa nobica	0	0	0	0	11501
Cuscuta hyalnia	0	10360.2	161028	0	1533.47
Choloris parbata	0	0	1769.54	0	0
Clitoria ternate	0	0		0	0

3.4 Herb Density for the two seasons:

sp.	2011- 2012					2012- 2013				
	lin1	line 2	line 3	line 4	line 5	lin1	line 2	line 3	line 4	line 5
Commelinaamplexcaulis	30.51	19.97	2.62	69.84	13.02	16.33	19.00	7.57	2.46	53.33
Justiciapalustris	17.24	16.83	1.15	1.95	0.48	41.83	6.81	0.35	23.82	0.00
Chloris virgata	7.61	0.97	1.31	0.00	1.90	2.50	4.66	0.88	3.40	0.00
Merremiaemarginata	5.36	1.37	0.66	0.09	3.33	4.00	1.43	0.35	0.00	13.33
Acalypheindica	5.25	6.12	0.57	3.67	1.27	0.00	0.36	0.18	0.00	0.00
Sorghum arundinaceum	4.84	8.53	0.00	0.00	0.63	2.17	3.94	0.00	0.00	0.00
Rottobeollacochinchinensis	4.21	0.40	0.33	0.00	0.00	1.33	0.54	0.00	0.00	0.00
Ocimumbasilicum	3.75	3.46	0.00	0.36	0.48	1.83	3.41	0.00	1.89	26.67
Cenchrusechinatus	3.40	4.03	1.06	0.00	0.00	0.50	6.27	2.82	0.00	0.00
Crotalaria senegalensis	3.29	1.77	0.66	0.45	4.60	2.33	1.79	1.41	0.57	0.00
Commelinakotschyi	2.31	6.04	0.25	11.29	8.41	2.50	7.71	4.05	30.06	0.00
Digeramuricata	1.90	2.01	0.00	0.73	0.00	0.00	0.00	0.00	0.00	0.00
Rhynchosiamemnonia	1.50	1.85	0.49	1.22	2.22	1.67	2.51	1.58	4.16	0.00

Indogofirapilosa	1.33	0.24	0.00	0.50	0.00	0.17	0.00	0.00	0.19	0.00
Phyllanthusmadraspatensis	1.15	2.01	0.00	0.54	0.16	0.00	0.36	0.00	1.89	0.00
Dinebraretroflexa	0.69	0.32	0.00	0.77	0.00	2.17	0.18	0.00	0.57	0.00
Srtigahermothica	0.58	0.64	0.00	0.00	1.43	10.00	2.69	0.18	0.00	0.00
Desmodiumdichotomum	0.58	2.42	0.00	0.14	3.17	1.00	2.51	0.35	0.38	0.00
Abelmoschusesculentus	0.52	0.40	0.00	0.77	1.43	0.83	1.79	0.00	0.00	0.00
Physalis angulate	0.52	0.89	0.00	0.14	0.00	0.00	0.36	0.18	0.00	0.00
Panicumrepenslinn	0.46	0.24	0.00	0.45	0.00	0.00	0.00	0.00	0.00	0.00
Aeschynomeneindica	0.40	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sesbaniapachycarpa	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cyperusrotundus	0.40	5.96	0.25	0.00	0.00	0.00	0.72	1.06	0.00	0.00
Corchorousfasicularis	0.29	0.00	0.00	0.00	0.00	3.83	0.00	0.00	0.00	0.00
Euphorbia aegyptiaca	0.23	0.00	0.00	0.05	0.00	0.67	0.36	0.00	0.00	0.00
Soncuchuscornutes	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cucumismelo	0.23	0.16	0.00	0.00	0.00	2.83	0.18	0.18	0.57	0.00

Phyllonthusniruri	0.12	0.32	0.00	0.05	0.00	0.00	0.54	0.35	0.00	0.00
Solanumdubium	0.12	0.00	0.00	0.05	0.16	0.00	0.00	0.00	0.00	0.00
Penisetumpedicellatum	0.12	0.00	0.00	0.18	1.59	0.00	0.00	0.00	0.00	0.00
Brachairiaeruciformis	0.06	0.08	0.08	5.62	2.54	0.17	2.15	0.18	15.88	0.00
Withaniasomnifra	0.06	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
Sida alba	0.06	0.16	0.00	0.00	0.48	0.33	1.43	0.70	0.00	0.00
Helieotroiumsudanicum	0.06	1.13	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Euphorbia acalyphoides	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vernoniaamygdatina	0.06	0.00	0.00	0.00	2.22	0.00	0.90	0.18	0.00	0.00
Corchorusdepressus	0.06	0.08	1.31	0.00	0.16	0.00	0.00	0.35	0.76	0.00
Pennistumpurpureum	0.06	5.88	3.44	0.00	0.63	0.00	17.03	7.04	0.19	0.00
Ipomoea sinensis	0.00	1.13	0.16	0.18	0.16	0.50	1.25	0.35	0.38	0.00

Acnthespermumhispidum	0.00	1.13	0.41	0.00	1.27	0.00	0.72	0.00	0.00	0.00
Oxygonumatriplicifolium	0.00	0.72	0.74	0.00	0.00	0.00	0.00	1.06	0.00	0.00
Ipomoea aquatic	0.00	0.56	0.00	0.00	0.00	0.00	3.58	0.00	0.00	0.00
Cassia occidentalis	0.00	0.48	4.83	0.09	16.83	0.00	0.36	3.17	3.02	0.00
Sesbaniaarabica	0.00	0.40	0.33	0.00	0.00	0.00	3.05	0.18	0.00	0.00
Indigoferaoblongifolia	0.00	0.40	1.72	0.05	0.00	0.17	0.00	0.00	0.76	0.00
Digeraalternifolia	0.00	0.32	0.33	0.18	0.00	0.00	0.00	1.23	3.59	0.00
Thunbergiaannua	0.00	0.24	0.08	0.14	1.27	0.00	0.00	0.18	0.38	0.00
Ipomoea cordofana	0.00	0.08	0.00	0.09	0.16	0.17	0.00	0.00	0.57	0.00
Aristolochia bracteolate	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eragrostisdiplochnoides	0.00	0.00	63.96	0.05	15.71	0.00	0.00	45.42	0.00	0.00
Dactylocteniumaegyptium	0.00	0.00	5.00	0.00	2.38	0.00	0.00	8.80	0.00	0.00

Tribulusterrestris	0.00	0.00	2.54	0.00	0.32	0.00	0.00	1.06	0.00	0.00
Echinochloacolonum	0.00	0.00	1.97	0.00	1.59	0.00	0.36	0.70	0.00	0.00
Eragrostismegastechya	0.00	0.00	1.47	0.00	5.71	0.00	0.00	0.00	0.00	0.00
Trianthemaportulacastum	0.00	0.00	1.31	0.00	0.00	0.00	0.00	0.35	0.00	0.00
Echinochloacolona	0.00	0.00	0.90	0.00	0.00	0.00	0.00	4.23	0.00	0.00
Cymbopogonnervatus	0.00	0.00	0.00	0.23	0.95	0.00	0.00	0.53	4.35	0.00
Cenchrusechinatus	0.00	0.00	0.00	0.09	0.63	0.00	0.00	0.00	0.19	0.00
Boerhaviaerecta	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00
Eriochloanobica	0.00	0.00	0.00	0.00	2.54	0.00	0.00	0.00	0.00	0.00
Cuscutahyalnia	0.00	0.00	0.00	0.00	0.16	0.00	1.08	0.35	0.00	0.00
Cholorisparbata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.46	0.00	0.00
Clitoria ternate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.67

3.5 Herb abundance, frequency, diversity and density for the two seasons:

sp.	2011- 2012				2012- 2013			
	A	F	SiD	Density	A	F	SiD	Density
Commelinaamplexcaulis	486.2	100	8.37	34.57	63.2	100	69.3	11.81
Justiciapalustris	113.6	100	153.52	8.08	104.25	80	39.77	18.37
Chloris virgata	43	80	1681.01	2.45	13.4	100	1560.04	2.82
Merremiaemarginata	28.2	100	2504.66	2.01	11.75	80	3190.79	1.59
Acalypheindica	52.6	100	717.53	3.74	1	60	1149750	0.13
Sorghum arundinaceum	64.67	60	1320.49	2.76	17.5	40	5797.06	1.54
Rottobeollacochinchinensis	27.3	60	7443.84	1.17	5.5	40	62713.65	0.48
Ocimumbasilicum	29.75	80	3521.0	1.69	12.25	80	2933.04	1.94
Cenchrusechinatus	40.67	60	3349.28	1.73	15.75	80	1766.13	2.38
Crotalaria senegalensis	25.2	100	3139.17	1.79	8.2	100	4206.4	1.54
Commelinakotschyi	84	100	280.95	5.97	50.6	100	108.2	10.57
Digeramuricata	24.67	60	9152.54	1.05	1	20	0	0.00
Rhynchosiamemnonia	19.2	100	5421.27	1.37	11.4	100	2161.19	2.42

Indogofirapilosa	12.3	60	37118.61	0.53	1	80	574875.2	0.09
Phyllanthusmadraspatensis	14.5	80	14955.23	0.82	6	40	52261.38	0.53
Dinebraretroflexa	11	60	46820.07	0.47	5.67	60	25362.14	0.75
Srtigahermothica	9	60	70430.19	0.38	20	80	1091.55	3.35
Desmodiumdichotomum	15.75	80	12657.96	0.90	6.2	100	7417.74	1.06
Abelmoschusesculentus	10	80	31693.58	0.57	5.3	60	28743.76	0.66
Physalis angulate	7.67	60	97711.45	0.33	1.5	40	1149750	0.13
Panicumrepenslinn	7	60	117719	0.30	0	0	0	0.00
Aeschynomeneindica	4.5	40	686694.3	0.13	0	0	0	0.00
Sesbaniapachycarpa	7	20	1177190	0.10	0	0	0	0.00
Cyperusrotundus	28	60	7091.51	1.19	5	40	76650.02	0.44
Corchorousfasicularis	5	20	2472100	0.07	12	40	12497.29	1.01
Euphorbia aegyptiaca	2.5	40	2472100	0.07	3	40	229950.1	0.26
Soncuchuscornutes	4	20	4120166	0.06	4	20	574875.2	0.00
Cucumismelo	3	40	1648066	0.09	4.6	100	13633.4	0.97

Phyllonthusniruri	2.3	60	1177190	0.10	2.25	80	95812.53	0.22
Solanumdubium	1.3	60	4120166	0.06	0	0	0	0.00
Penisetumpedicellatum	5.3	60	206008.3	0.23	1	20	0	0.00
Brachairiaeruciformis	28.6	100	2434.85	2.03	23.4	100	508.29	4.32
Withaniasomnifra	1	20	0	0.01	1	20	0	0.04
Sida alba	2	60	1648066	0.09	4.67	60	37903.86	0.62
Helieotroiumsudanicum	5.3	60	206008.3	0.23	0	0	0	0.00
Euphorbia acalyphoides	1	20	0	0.01	0	0	0	0.00
Vernoniaamygdatina	7.5	40	235438.1	0.21	2.3	60	164250	0.26
Corchorusdepressus	4.75	80	144567.2	0.27	3	40	229950.1	0.26
Pennistumpurpureum	30	80	3462.32	1.71	45.3	60	375.74	5.99
Ipomoea sinensis	5.25	80	117719	0.30	3.6	100	22544.12	0.62
Acnthespermumhispidum	9	60	70430.19	0.38	3.3	60	76650.02	0.18
Oxygonumatriplicifolium	9	40	161575.1	0.26	6	20	229950.1	0.26
Ipomoea aquatic	7	20	1177190	0.10	20	20	18153.95	0.88

sp.	2011- 2012				2012- 2013			
	A	F	SiD	Density	A	F	SiD	Density
Cassia occidentalis	43.25	80	1661.58	2.46	46.25	80	202.6587	1.59
Sesbaniaarabica	4.5	40	686694.3	0.13	9	40	22544.12	0.79
Indigoferaoblongifolia	9	60	70430.19	0.38	2.5	40	344925.1	0.22
Digeraalternifolia	4	60	374560.5	0.17	13	40	10613.08	1.15
Thunbergiaannua	3.75	80	235438.1	0.21	1.5	40	1149750	0.13
Ipomoea cordofana	1.3	60	4120166	0.06	2	60	229950.1	0.18
Aristolochia bracteolate	1	20	0	0.01	0	0	0	0.00
Eragrostisdiplochnoides	293.67	60	63.77308	12.53	258	20	104.0404	11.37
Dactyloctenіumaegyptium	38	40	8674.034	1.08	31	40	1824.035	2.20
Tribulusterrestris	16.5	40	46820.07	0.47	6	20	229950.1	0.26
Echinochloacolonum	17	40	44065.95	0.48	3	40	229950.1	0.26
Eragrostismegastechya	27	40	17275.33	0.77	16	20	28743.76	0.00
Trianthemaportulacastum	16	20	206008.3	0.23	2	20	3449251	0.09

Echinochloacolona	11	20	449472.7	0.16	24	20	12497.29	1.06
Cymbopogonnervatus	5.5	40	449472.7	0.16	18.5	40	5179.056	1.15
Cenchrusechinatus	3	40	1648066	0.09	1	20	0	0.04
Boerhaviaerecta	1	20	0	0.01	0	0	0	0.00
Eriochloanobica	16	20	206008.3	0.23	4	20	574875.2	0.00
Cuscutahyalnia	1	20	0	0.01	6	60	22544.12	0.35
Cholorisparbata	0	0	0	0	7	40	37903.86	0.62
Clitoria ternate	0	0	0	0	1	20	0	0.04

4. Number of trees in the study area for the two seasons:

sp.	2011- 2012						2012- 2013					
	line 1	line2	line 3	line 4	line 5	Total	line 1	line2	line 3	line 4	line 5	Total
Acacia seyal var seyal	322	22	17	60	9	430	117	12	2	166	0	297
Ziziphus spina chiristi	92	32	5	30	0	159	9	12	0	16	1	38
Acacia senegal	21	24	54	310	1	410	11	12	10	639	0	672
Dichrostachys cinerea	8	59	0	0	0	67	0	0	0	0	0	0
Balanites aegyptica	4	19	50	52	130	255	3	14	65	110	123	315
Acacia nilotica	1	60	63	0	0	124	0	187	5	0	0	192
Combretum hatmannianum	0	0	5	2	1	8	0	0	2	1	0	3
Sterculia setigera	0	0	1	0	0	1	0	0	1	0	0	1
Cephalucroton cordofanus	0	0	0	43	0	43	0	0	0	0	0	0
Acacia polyacontha	0	0	0	3	5	8	0	0	0	2	4	6
Adansonia digitata	0	0	0	1	0	1	0	0	0	0	0	0

Anogeissus leiocarpus	0	0	0	1	0	1	0	0	0	0	0	0
Hyphaene thebaica	0	0	0	0	0	0	0	0	1	0	0	1
Acacia seyal var fistula	0	0	0	0	0	0	0	0	0	4	4	8
Delbergia melanoxylon	0	0	0	0	0	0	0	0	0	3	0	3
Total	448	216	195	502	146	1507	140	237	86	941	132	1536

4.1 Trees density for the two seasons:

sp.	2011- 2012					2012- 2013				
	line 1	line2	line 3	line 4	line 5	line 1	line2	line 3	line 4	line 5
Acacia seyal var seyal	71.88	10.19	8.72	11.95	6.16	83.57	5.06	2.33	17.64	0.00
Ziziphus spina chiristi	20.54	14.81	2.56	5.98	0.00	6.43	5.06	0.00	1.70	0.76
Acacia senegal	4.69	11.11	27.69	61.75	0.68	7.86	5.06	11.63	67.91	0.00
Dichrostachys cinerea	1.79	27.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Balanites aegyptica	0.89	8.80	25.64	10.36	89.04	2.14	5.91	75.58	11.69	93.18
Acacia nilotica	0.22	27.78	32.31	0.00	0.00	0.00	78.90	5.81	0.00	0.00

Combretum hatmannianum	0.00	0.00	2.56	0.40	0.68	0.00	0.00	2.33	0.11	0.00
Sterculia setigera	0.00	0.00	0.51	0.00	0.00	0.00	0.00	1.16	0.00	0.00
Cephalucroton cordofanus	0.00	0.00	0.00	8.57	0.00	0.00	0.00	0.00	0.00	0.00
Acacia polyacontha	0.00	0.00	0.00	0.60	3.42	0.00	0.00	0.00	0.21	3.03
Adansonia digitata	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00
Anogeissus leiocarpus	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00
Hyphaene thebaica	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.16	0.00	0.00
Acacia seyal var fistula	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.43	3.03
Delbergia melanoxylon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00

4.2 Trees abundance, frequency, diversity and density for the two seasons:

sp.	2011- 2012				2012- 2013			
	A	F%	SiD	Density	A	F	SiD	Density
Acacia seyal var seyal	86	100	12.30	28.53	59.4	100	26.8	19.34
Ziziphus spina chiristi	39.75	80	90.34	10.55	9.5	80	1676.9	2.47
Acacia Senegal	82	100	13.53	27.21	168	80	5.2	43.75
Dichrostachys cinerea	33.5	40	513.24	4.45	0	0	0	0.00
Balanites aegyptica	51	100	35.04	16.92	63	100	23.8	20.51
Acacia nilotica	41.33	60	148.80	8.23	96	40	64.3	12.50
Combretum hatmannianum	2	80	40527.54	0.53	1.5	40	392960	0.20
Sterculia setigera	0.5	40	0	0.07	1	20	0	0.07
Cephalucroton cordofanus	21.5	40	1256.67	2.85	0	0	0	0.00
Acacia polyacontha	2.67	60	40527.54	0.53	3	40	78592	0.39
Adansonia digitata	0.5	40	0	0.07	0	0	0	0.00

Anogeissus leiocarpus	0.5	40	0	0.07	0	0	0	0.00
Hyphaene thebaica	0	0	0	0	1	20	0	0.07
Acacia seyal var fistula	0	0	0	0	4	40	42102.9	0.52
Delbergia melanoxylon	0	0	0	0	3	20	392960	0.20

5. Number of shrubs in the study area for the two seasons:

	2011- 2012						2012- 2013					
sp.	line 1	line2	line 3	line 4	line 5	Total	line 1	line2	line 3	line 4	line 5	Total
Acacia oerfota	345	411	401	47	552	1756	24	247	502	55	210	1038
Acacia mellifra	25	51	2	45	2	125	7	23	15	70		115
Combretum aculeatum	4	1	0	47	1	53	0	0	0	18	0	18
Capparis decidua	0	2	7	0	1	10	2	1	4	0	0	7
Cadaba forinosa	0	8	0	1	0	9	0	0	0	0	0	0
Grewia tenax	0	0	4	0	0	4	0	1	6	0	0	7
Calotropis procera	0	0	1	0	0	1	0	0	1	0	0	1
Aerva jovanica	0	0	0	1	0	1	0	0	0	0	0	0

Stereospermum kunthianum	0	0	0	0	0	0	0	0	0	0	6	6
Total	374	473	415	141	556	1959	33	272	528	143	210	1192

5.1 Shrubs density for the two seasons:

	2011- 2012					2012- 2013				
sp.	line 1	line2	line 3	line 4	line 5	line 1	line2	line 3	line 4	line 5
Acacia oerfota	92.25	86.89	96.63	33.33	99.28	72.73	90.81	95.08	38.46	100.00
Acacia mellifra	6.68	10.78	0.48	31.91	0.36	21.21	8.46	2.84	48.95	0.00
Combretum aculeatum	1.07	0.21	0.00	33.33	0.18	0.00	0.00	0.00	12.59	0.00
Capparis decidua	0.00	0.42	1.69	0.00	0.18	6.06	0.37	0.76	0.00	0.00
Cadaba forinosa	0.00	1.69	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00
Grewia tenax	0.00	0.00	0.96	0.00	0.00	0.00	0.37	1.14	0.00	0.00
Calotropis procera	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.19	0.00	0.00
Aerva jovanica	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00
terospermum kunthiamum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.86

5.2 Shrubs abundance, frequency, diversity and density for the two seasons:

sp.	2011- 2012				2012- 2013			
	A	F	SiD	Density	A	F	SiD	Density
Acacia oerfota	351.2	100	1.3	89.64	207.6	100	1.3	87.08
Acacia mellifra	25	100	247.5	6.38	23	100	108.3	9.65
Combretum aculeatum	13.3	80	1391.8	2.71	9	40	4639.5	1.51
Capparis decidua	3.3	60	42619.1	0.51	2.3	60	33801.7	0.59
Cadaba forinosa	4.5	40	53273.9	0.46	0	0	0	0.00
Grewia tenax	4	20	319643.5	0.20	3.5	40	33801.7	0.59
Calotropis procera	1	20	0	0.05	1	20	0	0.08
Aerva jovanica	1	20	0	0.05	0	0	0	0.00
Stereospermum kunthianum	0	0	0	0	6	20	47322.4	0.50