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# Ecological Assessment of the Wood Vegetation of Rashad District, Nuba Mountains, Sudan

*Ismail Mirghani Ismail*[1]* *and Alawia Abdalla ELawad*[2]

[1] Forestry and Gum Arabic Research Centre, Agricultural Research Corporation, P.O. Box 7089; Sudan
[2]Department of Environmental Sciences, Faculty of Sciences and Technology, Al Neelain University, Khartoum, P.O. Box 12702, Sudan

**Corresponding author:** Ismail Mirghani Ismail
**E-mail:** ismail.mirghani@yahoo.com

## ABSTRACT

The objective of the present study is to analyze the phytosociological characteristics and the diversity patterns of woody plants in Rashad district. The study was conducted in selected 6 vegetation sites. Important Value Index (IVI) and density were used to estimate the phytosociological characteristics, the Shannon index to measure the plant diversity and the Pielou index for species equitability. During the study period, a total of 64 species, representing 39 genera from 17 families, were recorded. The phytosociological characteristics revealed that *Dichrostachys cinerea, Balanites aegyptiaca* and *Vachellia seyal* var. *seyal* dominated woody species in sites of clay plains with IVI values 180.1, 128 and 116.4 respectively. While *Terminalia leiocarpa, Boswellia papyrifera* and *Adenium obesum* dominated woody species in hilly sites of rocky soil with IVI values (45.76), (45.38) and (43.97) respectively. The distribution pattern revealed that 54% species showed aggregated distribution, while 46% were randomly distributed. The highest density was 766 stem/ha recorded in site 6. Species richness varied through different sites; the highest number of species was 44, recorded in community 4. The highest values of Shannon diversity index and equitability index were in community 4. The highest similarity was recorded between site 3 and site 4 (50.9%) and the lowest (17.9%) between site 1 and site 2. Biodiversity indices relatively increased with increment of elevation.

**Keywords:** Beverages vegetation, Diversity, Equitability, Species, Plants, Taxonomy

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## INTRODUCTION

The natural vegetation is one of the renewable natural resources, which includes natural forests and natural pasture, both plays important role for rural communities. It provides fuel, famine food, medicines, building materials, gums and fodders; in addition to its environmental importance.

The Nuba Mountains is located in South Kordofan State, which bordered the Republic of South Sudan. It is a mountainous region, with topographic features dominated by isolated mountains that are dissected by seasonal *KHORS*. In addition to lowland plains, the region consists of some high plateaus, the greatest one is Rashad massif. Eastern Nuba Mountains Region selected for the present study exhibits wide topographical variations; which are reflected in vegetation diversity. There are no available detailed

studies on the floristic composition and vegetation status of the proposed area. The vegetation of this region like other parts of the Sudan is expected to be affected by the seventies and eighties drought periods, in-addition to the expanded agricultural practices and grazing.

Andrews (1948) classified the study area into two vegetation divisions as follow: *Acacia* tall grass forest where *Acacia* species are dominant in addition to *Terminalia* spp., *Combretum* spp., *Guiera senegalensis*, and *Tamarindus indica*. Smith, (1949) classified the area as *Acacia* tall grass country similar to that of (Andrews, 1948) with slight modification. Harrison and Jackson, (1958), classified the area as low rainfall woodland savannah on clay where *Acacia mellifera* thorn-land on hill soil formed *in situ* associated with *Commiphora africana* and *Boscia senegalensis* and as special areas of low rainfall wood land savanna under Hill catena's. These hills have a characteristic vegetation of their own generally much moister in character than surrounding plain and showing erosion catena development. Between the groups forming the Nuba Mountains are extensive plains of dark cracking clays carrying *Vachellia seyal - Balanites aegyptiaca* savanna.

This study is aimed at assessing the vegetation composition and forecasting the future behavior of plant composition and regeneration power through studying natural regeneration in the study area.

## MATERIAL AND METHODS

### *Description of the study area*

The study area is located in the northern part of eastern Nuba Mountains of South Kordofan State and including two localities (Rashad and Alabassia), extending from latitude 11° 33` to 12° 33` N and from longitude 31°08` to 31° 18` E (Fig. 1). Most of the area under study is covered by scattered isolated hills and it is dissected by many seasonal watercourses (*KHORS*). Study area occupies a total area of 7872 km$^2$ (UNDP, 2003). The study area belongs to low rainfall woodland savanna (Harrison and Jackson, 1958).

### *Vegetation sampling*

Six vegetation communities were selected, based on observed variations in vegetation types, topographical feature and soil types to represent most of the study area (Table 1). For vegetation assessment within the natural stands 70 circular 0.1 ha (17.84m in radius) sample plots modified from Adam and Eltayeb (2008). 14 transect were made to cover the whole study area. Along each transect 5 circular 0.1 plot were conducted for studying trees and shrubs. The first plot was established randomly, the number of trees and shrubs species and the number of individual of each species per/plot were counted.

### Data analysis

### *Phytosociological analysis*

Species encountered in each quadrate were counted. From count data, density (D), abundance (A), frequency (F %), relative density (RD %), relative abundance (RA %), relative frequency (RF %) and importance value index (IVI) were calculated for each species in each site using the following formulas as used by Dangoli and Shivakoti (2001) and Chaudhry et al. (2006).

$$\text{Density (D)} = \frac{\text{number of plant of a certain species}}{\text{Total area sampled}}$$

$$\text{Relative density (RD \%)} = \frac{\text{Density of species}}{\text{Total density of all species}} \text{X100}$$

$$\text{Abundance (A)} = \frac{\text{Total number of individual}}{\text{No. of quadrate where species occur}}$$

$$\text{Relative abundance(RA\%)} = \frac{\text{Abundance of species}}{\text{Tatal abundance of all species}} \text{ x 100}$$

$$\text{Frequency (F\%)} = \frac{\text{No.of quadrate where species occur}}{\text{Total numbers of quadrate}} \text{ x 100}$$

$$\text{Relative frequency (RF\%)} = \frac{\text{frequency of species}}{\text{Total frequency of all species}}$$

Importance value index (IVI) = RD% + RA% + RF%

### *Diversity indices*

Species richness was determined as the total number of species present in the studied site. The Shannon diversity index applied to estimate woody plant species diversity along the study area (Shannon, 1949). This index was calculated by the equation Hs = -Σpi In pi. Where, pi is the proportion of individuals found in the ith species and 'In' denotes the natural logarithm. Pielou index used for estimation of species evenness (E) after (Pielou, 1966). This index was calculated by the equation E = H/lnS. Where: H' is the Shannon-Wiener diversity measure, S is Number of species. Species distribution pattern test and Comparisons of woody plant species composition between different plots were estimated using single linkage cluster analysis based on Jaccard similarity, Biodiversity Pro version 2 (Mc Aleece, 1998).

**Table 1: Selected Vegetation Communities**

| community | Area | Latitude | Longitude | Elevation | Topography |
|---|---|---|---|---|---|
| 1 | Um fakareen area | 12° 33` N | 31° 18` E | 500 m | Cracking clay plain |
| 2 | AlAbassia area | 12° 10` N-11° 57` N | 31° 15` E-31° 12` E | 826.5 m | Hill (Rocky soil) |
| 3 | Rashad area | 11° 52` N-11° 49` N | 31° 08` E-31° 03` E | 871.5 m | Hill (Rocky soil) |
| 4 | South Rashad area | 11° 45` N-11° 43` N | 31° 02` E-31°03` E | 722.5 m | Hill (Rocky soil) |
| 5 | Tandek area | 11° 42` N | 31°02` E | 695 m | Cracking clay plain |
| 6 | Dibekkir area | 11° 33` N | 31°08` E | 618 m | Cracking clay plain |

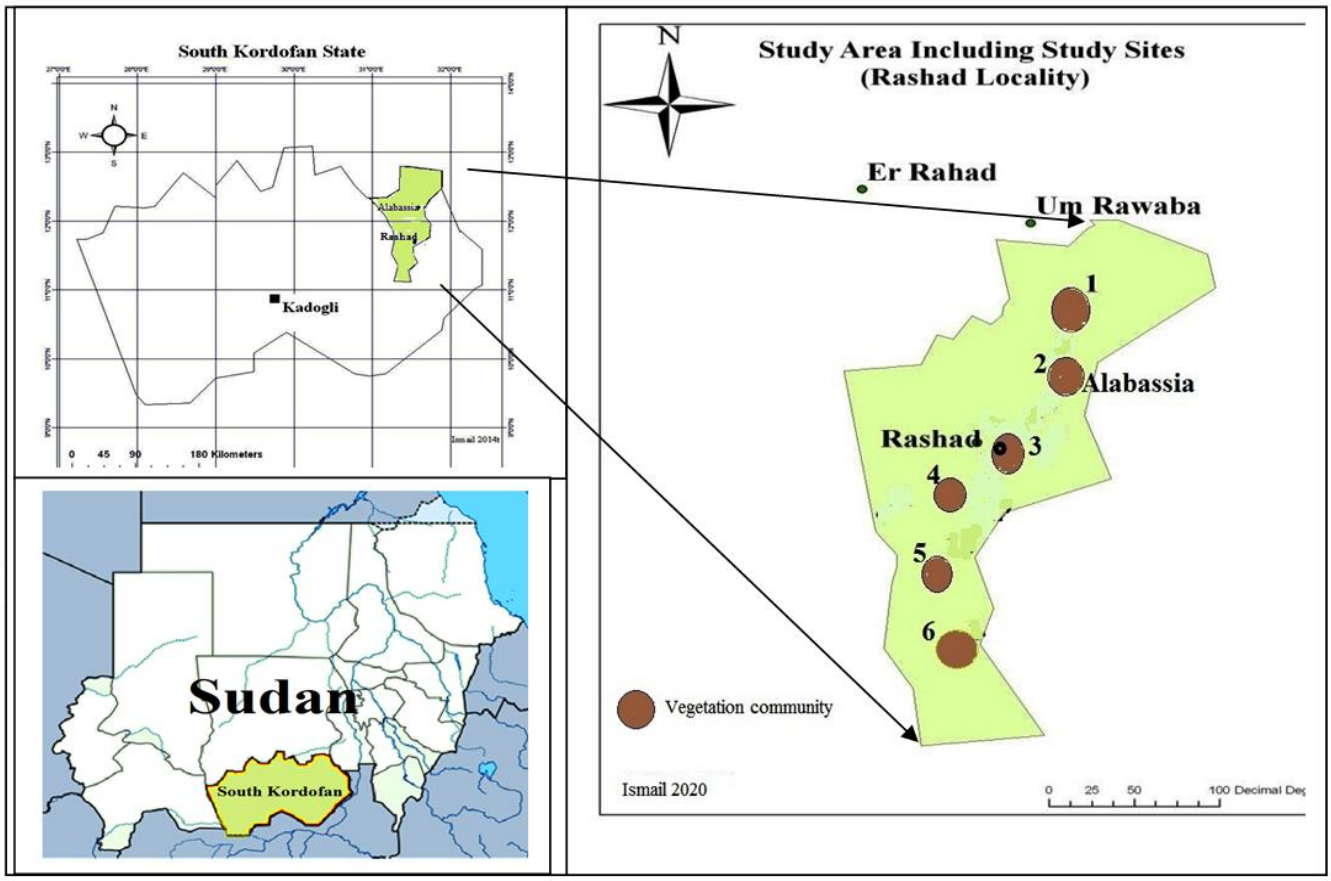



**Figure 1: Map of the Study Area**

## RESULTS

### *Taxonomy*

A total of 64 species, representing 39 genera from 17 families, were recorded from the studied sample plots. Fabaceae was the dominant family with 15 species, followed by Combretaceae (8), Malvaceae (6), Moraceae and Rubiaceae (5 species each), Anacardiaceae and Capparaceae (4 species each), while the other 9 families were represented by less than 3 species (Table 2).

### *Dominance*

The topography and soil types play an important role in dominance and distribution of species. The dominance of species was assigned based on the calculated IVI values. *Dichrostachys cinerea* which dominated community 6 that located in clay plain, was recorded a highest value of IVI (180.1) in the study area. *Balanites aegyptiaca* dominated

community 5 in clay soil with IVI value (128) where the. *Acacia seyal* var. *seyal* dominated community 1which described as clay plain with IVI value with (116.4). While community (4) in rocky soil was dominated by more than on species which are *Terminalia leiocarpa, Boswellia papyrifera* and *Adenium obesum* with IVI values (45.76), (45.38) and (43.97) respectively. *Combretum glutinosum* dominated community (3) with IVI value (31.32) and community (2) was dominated with *commiphora africana* and *Balanites aegyptiaca* with IVI (36.76) and (27.52) respectively. The above mention results relatively agreed to distribution map of Harrison and Jackson (1958).

***Density***

The highest density of woody plants was recorded in community 6 (766 plant/ha.), followed by community 3 (262 plants /$m^2$), while community 5 showed the lowest density (48 plant /ha.) (Fig. 2). *Dichrostachys cinerea* in community 6 showed the highest relative density (85.12%) of woody plants in whole the study area, followed by *Balanites aegyptiaca* in community 5and *Vachellia seyal* var. *seyal* in community 1 with relative density (58.33%) and (54.4%) respectively, *Vachellia oerfota* with relative density (29.8%) and *Ziziphus spina-christi* (20.83%) in community all above mentioned communities located in clay plains. But in communities of hilly sites, *Boswellia papyrifera* in community 4 showed highest relative density (25.20%) followed by *Terminalia leiocarpa* (23.09%) in the same community, and *Commiphora africana* (17.86%) in community 2. While the rest species their relative density ranging between 0.38% -11.02 percent (Table 2).

***Species Distribution Patterns***

Distribution of plant species was assessed and result revealed that 29 species (47%) were randomly distributed and 33 species (53%) were aggregated (Table 2). It is Obviously from the above results that most (53%) of the species were aggregately distributed this may due to that their regeneration close to seed sources, vegetative regeneration or the occurrence in safe site‟ (Augspurger, 1984), or on traces of animal movement or in catchment are especially the case of *Dichrostachys cinerea.*While (47%) of the species encountered during the sampling were randomly distributed and this indicates that the environment in which these plant species grow is homogeneous and has many factors acting on the population (Ewusie, 1980), these factors includes seed dispersal and anthropogenic factors.

***Species richness and diversity indices***

The composition among the different communities in terms of species richness showed that the highest species diversity was observed in community 4 (44 species) in hilly sites,, while the least values of richness (6 species) was observed in communities 1 and 5, both located in clay plains.

The highest Shannon diversity index was 3.05 in community 4, followed by 2.88 in community 2 and 2.74 in community 3, whereas the least Shannon diversity index was 0.69 in community 6. The highest species equitability index (J) was recorded in community 2 was (0.806), whereas the least evenness index was 0.302 in community 6 (Fig. 3).

## DISCUSSION

Overall population species diversity index, evenness, richness and density of all species through different communities increased with an increment of elevation and also affected by soil type. The quantitative inventory of plant species diversity showed considerable diversification in vegetation component throughout different communities.

The lowest elevations of clay plains (communities I, 5 and 6) are characterized by the fast growing species, specially *Vachellia seyal*, *Senegalia senegal* and *Senegalia mellifera* in community one, and *Balanites aegyptiaca, Vachellia nilotica* and *Vachellia seyal* in community two, while community three is characterized by the dominance of *Dichrstachys cinnerea and Vachellia seyal.* These communities agreed with zone of *Vachellia seyal* – Balanities in cracking clay plains of low rainfall woodland savanna which stated by Harrison and Jackson, (1958). While the other three Communities (2, 3 &4) are characterized by the species of hill catena`s which fall under the special areas of the low rainfall woodland savanna zone, such as *Sterculia setigera, Sclerocarya birrea, Strychnos innocua* in addition to other savanna tree species, (Harrison and Jackson, 1958).

Fabaceae, Combretaceae, Malvaceae, Moraceae and Rubiaceae are well represented in all six communities. On the other hand the number of species included by Fabaceae, Combretaceae,

Malvaceae increased in hilly communities (2, 3 and 4), with the increment of elevation and the dominance of gravelly soil.

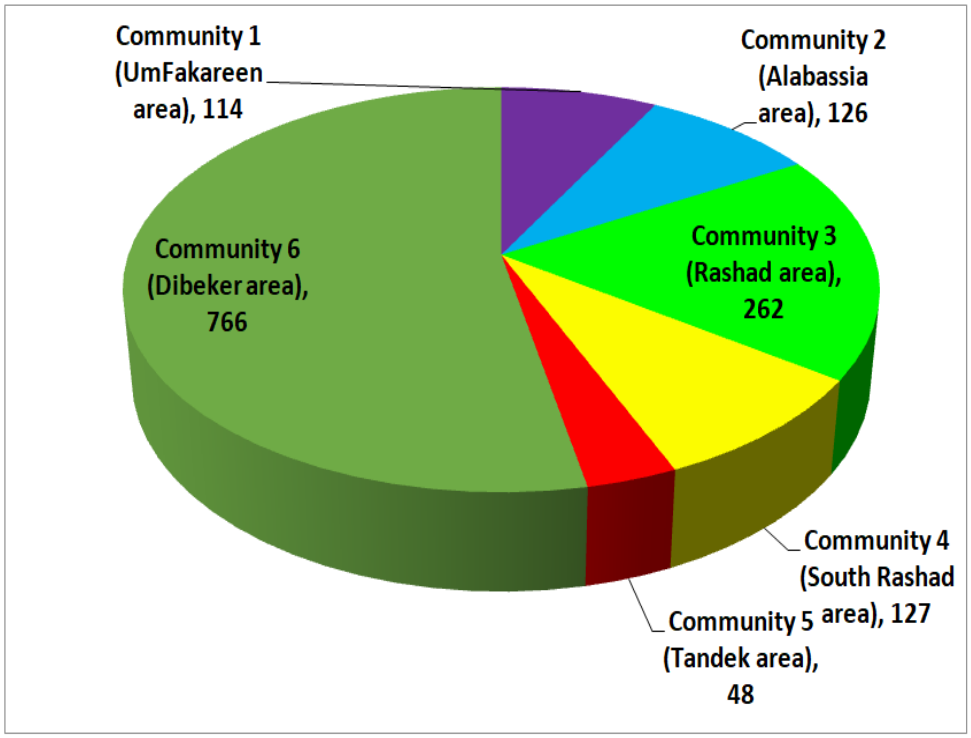
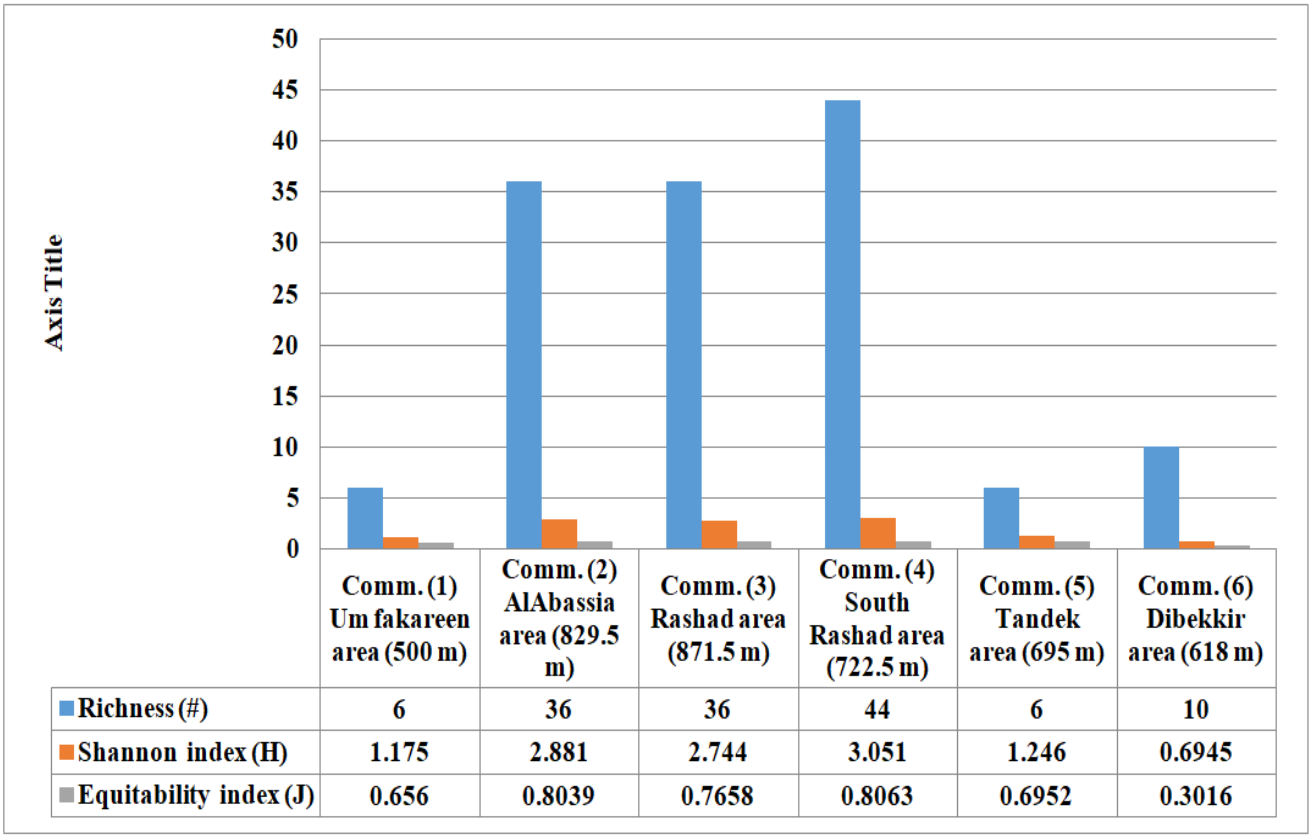



**Figure 2: Showed stem density (plant/ha.)**




| | Comm. (1) Um fakareen area (500 m) | Comm. (2) AlAbassia area (829.5 m) | Comm. (3) Rashad area (871.5 m) | Comm. (4) South Rashad area (722.5 m) | Comm. (5) Tandek area (695 m) | Comm. (6) Dibekkir area (618 m) |
|---|---|---|---|---|---|---|
| Richness (#) | 6 | 36 | 36 | 44 | 6 | 10 |
| Shannon index (H) | 1.175 | 2.881 | 2.744 | 3.051 | 1.246 | 0.6945 |
| Equitability index (J) | 0.656 | 0.8039 | 0.7658 | 0.8063 | 0.6952 | 0.3016 |

**Figure 3: Showed Richness and Diversity indices**

The increment of plant species diversity in communities of higher elevation may attribute to different ecological factors such as differences in temperature between different elevations and differentiation of soils. The effect of elevation gradient in the species richness pattern is commonly explained by similar factors to the altitudinal gradient such as climatic factors, productivity, and other energy-related factors, (Richerson and Lam, 1980; Lomolino, 2001). Lomolino (2001) pointed out that many components of climate and environmental factors (e.g: temperature, precipitation, seasonality and disturbance regime) vary along elevation gradients and ultimately create the variation in species richness. Elevation gradients create varied climates, along with resultant soil differentiation; promote the diversification of plant species (Brown, 2001; Lomolino, 2001). In addition to intensive human activities such as shifting cultivation and collection of fire wood in lower elevations (community I, 5 & 6), decreased the plant species diversity. Human activities largely impact the natural rate of change in biodiversity by influencing species invasion, displacement and extinction rates, (Sala *et al,* 2000). Accordingly the difficulty of accessing the higher elevations, play an important role for conserving species diversity in higher elevations (communities 2, 3 & 4).

It is obviously that all communities located in sites of dark cracking clay soil and of low elevations are dominated by one species; while the other communities of hilly soil and high elevation are dominated by several species; these findings agreed with the fact that the dominance of only one or few species in trees and shrubs layer resulting in the decrease of the values of diversity indices in clay plains of low elevations; on the other hand dominance of several species resulting in the increment of the values of diversity indices in mountainous sites of high elevation (Ismail and ElAwad, 2017).

The multiple-similarity measures indicated that the higher percentage of similarity (more than 45%) was recorded between Community 3 and community 4 (Figure 4). this might be explained by the fact that these plots have similar altitudes and environment characteristics.

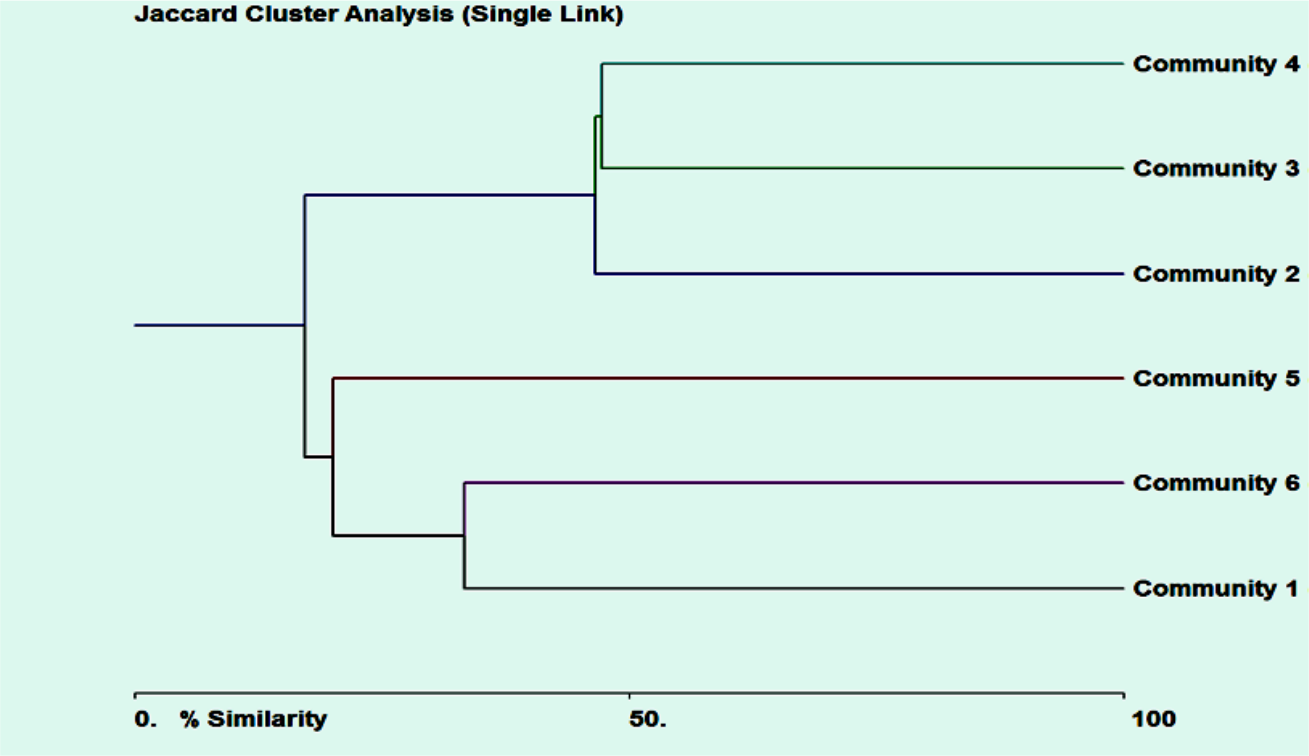



**Figure 4: similarity between different communities**

## CONCLOSION

The quantitative inventory of plant species diversity showed that a considerable variation in vegetation components throughout different communities.The communities of lowest elevation and clay plains (1, 5, 6) is characterized by the fast grown species of Acacia seyal –Balanites in dark cracking clay plain sub-zone of low rainfall woodland savanna, such as *Vachellia seyal, Senegalia mellifera, Senegalia senegal, Balanites aegyptiaca* and *Dichrstachys cinnarea.* While the communities of higher elevations (2, 3 & 4) characterized by the species of high rainfall woodland savanna zone, such as *Sterculia setigera, Sclerocarya birrea, Strychnos innocua*in addition to other savannah tree species.

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**Table 2: Analysis of Phytosociological Parameters and Distribution Pattern Along Six Vegetation Communities**

| Family | Species | Vernacular name | Canopy layer | | | | | | | | | | | | Distribution Pattern |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Comm. 1 | | Comm. 2 | | Comm. 3 | | Comm. 4 | | Comm. 5 | | Comm. 6 | | |
| | | | Rd | IVI | Rd | IVI | Rd | IVI | Rd | IVI | Rd | IVI | Rd | IVI | |
| Zygophyllaceae | *Balanites aegyptiaca* (L.) Delile | Hijlij | 2.26 | 25.4 | 13.095 | 27.52 | 1.91 | 7.94 | | | 58.33 | 128.7 | 3.66 | 20.62 | Aggregated |
| Fabaceae Subfamily Caesalpinoideae | *Bauhinia rufescens* Lam. | Kulkul | | | | | 1.72 | 6.79 | | | 4.17 | 22.69 | | | Aggregated |
| | *Bauhinia reticulata* DC. | Kharoub | | | 0.4 | 2.91 | 0.76 | 3.25 | | | | | | | Aggregated |
| | *Tamarindus indica* L. | Aradeib | | | 0.40 | 2.90 | 0.76 | 3.25 | 1.05 | 5.25 | | | | | Random |
| Subfamily Mimosoideae | *Vachellia gerrardii* (Benth.) P.J.H.Hurter | Salgam | | | | | 0.19 | 1.43 | 1.31 | 5.68 | | | 2.6 | 7.61 | Random |
| | *Senegalia mellifera* (Vahl) Seigler & Ebinger. | Kitir | 7.02 | 31.8 | 12.3 | 25.77 | 0.76 | 2.77 | | | | | 2.6 | 7.61 | Aggregated |
| | *Vachellia nilotica* subsp. *adstringens* (Schumach.) Kyal & Boatwr. | Sunt | | | | | | | | | 8.33 | 34.7 | | | Random |
| | *Vachellia oerfota* (Forssk.) Kyal & Boatwr. | Laot | 29.8 | 95.11 | 1.98 | 7.39 | | | | | | | 2.35 | 15.3 | Aggregated |
| | *Senegalia polyacantha* (Willd.) Seigler & Ebinger. | Kakamut | | | 0.40 | 2.90 | | | | | | | | | Random |
| | *Senegalia senegal* (L.) Britton. | Hashab | | | 1.98 | 7.39 | 1.15 | 4.92 | 2.62 | 9.19 | | | 1.57 | 15.4 | Random |
| | *Vachellia seyal* (Del.) P.J.H.Hurter | Talih | 54.4 | 116.4 | | | 0.38 | 2.39 | 0.53 | 3.38 | | | 3.66 | 23.1 | Aggregated |
| | *Acacia sieberiana* (DC.) Kyal & Boatwr. | Kuk | | | | | 6.11 | 14.52 | 1.05 | 5.25 | | | | | Aggregated |
| | *Albizia amara* | Arad | | | 0.79 | 4.22 | 0.38 | 2.10 | 2.10 | 6.76 | 4.17 | 22.69 | | | Random |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | subsp.sericocephala (Benth.) Brenan. | | | | | | | | | | | | | | |
| | *Albizia anthelmintica* (A. Rich.) Brongn | Um-Takirna | | | 1.98 | 7.39 | 0.38 | 2.39 | 1.05 | 5.41 | | | | | Aggregated |
| | *Dichrostachys cinerea* (L.)White & Arn. | Kadad | | | 0.79 | 4.89 | 0.76 | 3.69 | 0.53 | 3.38 | | | 85.12 | 180.1 | Aggregated |
| | *Anonychium africanum* (Guill. & Perr.) C.E.Hughes & G.P.Lewis | Abu-Suruj | | | | | 0.38 | 2.10 | | | | | | | Random |
| Subfamily papilionoideae | *Dalbergia melanoxylon* Guill. & Perr. | Babanos | | | 3.18 | 10.31 | 1.53 | 6.11 | 4.72 | 13.29 | | | | | Aggregated |
| | *Erythrina abyssinica* DC. | Hab Elaroos | | | 0.79 | 4.22 | 0.19 | 1.43 | 0.53 | 3.38 | | | | | Random |
| | *Mundulea sericea* (Willd.) A. Chev. | Abu-Galinga | | | | | 0.19 | 18.46 | | | | | | | Aggregated |
| Rhamnaceae | *Ziziphus abyssinica* Hochst. ex A. Rich. | Nabag Elfeel | | | | | 0.38 | 1.62 | 1.57 | 7.13 | | | | | Aggregated |
| | *Ziziphus spina-christi* (L.) Wild.. | Sidir | | | 2.38 | 9.48 | 1.91 | 7.94 | 1.57 | 6.53 | 20.83 | 68.98 | 2.35 | 20.34 | Random |
| Moraceae | *Ficus abutilifolia* Miq. | Gumaiz | | | | | 0.19 | 1.43 | | | | | | | Random |
| | *Ficus glumosa* Del. | Gumaiz (Umbalil) | | | 0.79 | 4.22 | 0.38 | 2.39 | | | | | | | Random |
| | *Ficus platyphylla* Del. | Gumaiz | | | | | 0.19 | 1.43 | | | | | | | Random |
| | *Ficus populifolia* Vahl. | Gumaiz | | | 0.4 | 2.91 | 0.57 | 2.77 | | | | | | | Random |
| | *Ficus thonningii* Blume. | Gumaiz (Hadana) | | | | | | | 0.53 | 3.38 | | | | | Random |
| Euphorbiaceae Subfamily Euphobioideae | *Euphorbia candelabrum* Welw. ex Hiern | Zagoom | | | | | 1.15 | 4.92 | | | | | | | Aggregated |
| Passifloraceae Subfamily Passifloroideae | *Adenia venenata* Forssk. | | | | 0.40 | 2.90 | | | | | | | | | Random |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Combretaceae | *Terminalia leiocarpa* (DC.) Baill. | Sahab | | | 5.16 | 14.11 | 3.05 | 8.40 | 23.09 | 45.76 | | | | | Aggregated |
| | *Combretum aculeatum* Vent. | Siheit | | | 9.13 | 19.86 | 4.58 | 16.85 | | | | | | | Aggregated |
| | *Combretum collinum* subsp. *binderianum* (Kotschy) Okafa. | Habeel | | | | | 0.38 | 2.10 | | | | | | | Aggregated |
| | *Combretum glutinosum* Perr. ex DC. | Habeel | | | 1.59 | 6.45 | 17.37 | 31.32 | 2.10 | 9.51 | | | | | Aggregated |
| | *Combretum hartmannianum* Schwein f. Beitr. | Habeel | | | | | | | 0.53 | 3.38 | | | 0.52 | 9.37 | Random |
| | *Guiera senegalensis* J. F. Gmel. | Ghibeish | | | | | 3.82 | 9.30 | | | | | | | Random |
| | *Terminalia brownii* Fresen | Subagh | | | 1.98 | 7.64 | 1.91 | 6.16 | | | | | | | Aggregated |
| | *Terminalia laxiflora* Engl. | Daroat | | | | | 0.19 | 1.43 | | | | | | | Random |
| Burseraceae | *Boswellia papyrifera* Hochst. | Taragtrag - Luban | | | 0.40 | 2.90 | | | 25.20 | 45.38 | | | | | Aggregated |
| | *Commiphora africana* (A. Rich) Engl. | Gaffal | | | 17.86 | 36.76 | 2.29 | 6.50 | 1.05 | 5.25 | | | | | Aggregated |
| Anacardiaceae | *Lannea fruticosa* Engl. | layon | | | 1.59 | 6.45 | | | 1.05 | 5.25 | | | | | Aggregated |
| | *Lannea humilis* Engl. | layon | | | | | | | | | | | 2.6 | 7.61 | Random |
| | *Lannea schimperi* Engl. | Layon (Mileis) | | | | | 1.15 | 5.54 | 0.53 | 3.38 | | | | | Aggregated |
| | *Sclerocarya birrea* Hochst. | Himeid | | | 0.79 | 4.22 | 0.57 | 3.34 | 1.57 | 7.13 | | | | | Random |
| Sapindaceae | *Allophylus africanus* P. Beauv. | | | | 1.59 | 6.60 | 4.77 | 11.83 | | | | | | | Aggregated |
| Meliaceae | *Khaya senegalensis* A. Juss. | Mahogani | | | | | 0.19 | 1.43 | 3.15 | 10.36 | | | | | Aggregated |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Trichilia emetica* Vahl. | Dimso | | | | | 0.57 | 2.77 | | | | | | | Random |
| Malvaceae Subfamily Bombacoideae | *Adansonia digitata* L. | tabaldi | | | 0.40 | 2.90 | | | | | | | | | Random |
| Malvaceae Subfamily Grewiodeae | *Grewia flavescens* Juss. | Khlekhsan | | | | | 3.63 | 10.79 | 5.77 | 15.31 | | | | | Aggregated |
| | *Grewia mollis* Juss. | Basham | | | | | 1.91 | 7.29 | | | | | | | Aggregated |
| | *Grewia tenax* (Forsk.) Fiori. | Gudeim | 1.75 | 14.2 | 3.57 | 11.1 | 0.19 | 1.43 | 1.05 | 5.25 | 4.17 | 22.69 | | | Aggregated |
| | *Grewia villosa* Willd. | Gregdan | | | 2.38 | 9.35 | 1.34 | 5.23 | 1.05 | 5.41 | | | | | Aggregated |
| Subfamily Sterculiodeae | *Sterculia setigera* Del. | Tartar | | | 5.95 | 16.87 | 0.38 | 2.39 | | | | | | | Aggregated |
| Capparaceae | *Boscia angustifolia* A. Rich. | Sarah, Sireih | | | 0.4 | 2.91 | 4.01 | 14.84 | | | | | | | Aggregated |
| | *Boscia senegalensis* Lam. | Mikheit, | - | - | 0.79 | 4.89 | | | | | | | | | Random |
| | *Cadaba rotundifolia* Forssk. | Kurmut | 1.75 | 14.2 | | | | | | | | | | | Random |
| | *Capparis tomentosa* Lam. | | | | 0.40 | 2.90 | 0.19 | 1.43 | | | | | | | Random |
| Ebenaceae | *Diospyros mespiliformis* Hochst. ex A.DC. | Joghan | | | | | 0.38 | 2.39 | | | | | | | Aggregated |
| Rubiaceae Subfamily Cinchonoideae | *Nauclea latifolia* Sm. | Karmadoda | | | | | 0.38 | 2.10 | | | | | | | Random |
| Subfamily Ixoroideae | *Catunaregam nilotica* (Stapf.) Tirveng. | Shigart Elmarfaeen | | | 0.79 | 4.22 | 2.29 | 6.69 | 1.05 | 5.41 | | | | | Aggregated |
| | *Feretia apodanthera* Del. | Shegart ElShai | | | | | 2.29 | 8.81 | 2.10 | 7.81 | | | | | Aggregated |
| | *Meyna tetraphylla* (Schweinf. ex Hiern) Robyns. | Simeim | | | | | | | 0.53 | 3.38 | | | | | Random |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Vangueria madagascariensis* J.F.Gmel. | Kirkir | | | 0.79 | 4.22 | | | | | | | | | Random |
| Loganiaceae | *Strychnos innocua* Del. | Um Bikhesa | | | | | 0.19 | 1.43 | 11.02 | 43.97 | | | | | Random |
| Apocynoideae Subfamily Apocynoideae | *Adenium obesum* (Forssk.) Roem & Schult. | Shigart Elsim | | | 2.38 | 8.31 | 0.76 | 3.25 | | | | | | | Aggregated |