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Vegetation dynamic aassessment in three land use types system White Nile state, Sudan

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ABSTRACT

Recognized survey within a vast area of the semi arid zone conducted to identify the vegetation covers that inhabitant according to the soil and land use. From the survey, three types of plant communities were recognized and observed in a repeated manner all over the area in different dimension. The three sites identified were tree cover that extends along khores and low lands, the scatter trees; trees outside forests including open grazing land and the agricultural land. The main objective of the study is to identify the vegetation dynamics across three types of land use system and compare tree species composition above ground with soil seed bank of the communities developing on that site. The sampling area is one hectare in each site; then all trees counted and measured for frequency, abundance and dominance and soil seed banks .The study revealed that the type of land use is the main factors dictating the forest structure, plant cover could used as an indication to identify forest sites and communities. Ground cover and the seed bank showed an idea about the species persistency; species of high persistency may use as moderate seed rate.

Keywords: Vegetation dynamics, Land cover, Land use, Survey

INTRODUCTION

Vegetation dynamics is defined as the change in vegetation with time according to an appropriate scale of abundance [Austin, 1981], while changes caused by external factors such as human interventions are considered secondary factors [Miles, 1979]. Cover is the vertical projection of plant and tree material growing on site when viewed from above; For example, 10% cover indicates a view from above that reveals 10% of the surface area as vegetative material casting its shade on the ground with the remaining 90% as bare ground [FAO 2005].

Species composition regarded as an important indicator of ecological and management process at a site [B.L.M., 1996]; generally, it expressed as a percent, so that all species components add up to 100% [Barbour, 1987]. Frequency is simple vegetation attribute to measure because it only requires identification of the species in each sample unit, and does not require that individuals are distinguished, measured, or counted [Despain et al. 1991]. It describes the probability of finding a species within a particular area [Bonham, 1989]. John [2004] mentioned that, in natural forest management, it is necessary to understand and consider the factors and conditions that control the changes and dynamics of the forest to achieve the desired management outcomes. Understanding natural forest

dynamics in a particular region should be the foundation of every management action [Abdelsalam, 2004].

The dynamics of a seed bank evolves a series of events of seed from the bank, in relation to time [Simpson et al. 1989]. The soil seed bank is the life cycle origin for the annual species, being fundamentally the cause of persistence in perennials. Beside the seed bank, there is a bank of vegetative propagation like tubers, rhizomes and stolen [Fernandez-Quintanilla et al. 1991].

The seed reserve depends on the level of the seed input from the incidence of germination and probability of successful establishment [Priestely, 1986]. Gaiballa [1995] concluded that the seed found in the soil samples at onset of the rainy season might come from the plant of previous rainy season or dispersal from outside the area. The recruitment of new individuals from the seed bank may determine the composition and pattern of the regulation within the community [Dessaint, et al. 1991]. Hoper [1977] stated that seeds in the ground represent a source from which new regeneration may quickly arise when the existing stand destroyed. Barralis [1972] stated that in response to the dramatic decline of forests cover and the growing threat of deforestation. A forestry sector review was carried out by the World Bank [1986] leading to a number of legislative developments that had bearings on Sudan Forestry Sector. These include the statement of forest policy 1989, the prime objective of which was the reservation and development of forest resources for the purpose of environmental protection and meeting population's needs of forest production [Elsiddig et al. 2007].

The objective of this study is to assess the vegetation dynamics across three types of land use system, to compare tree species composition above ground with soil seed bank of the communities developing on the site and to investigate the vegetation changes result of different land use systems.

STUDY AREA:
The study has lies in central Sudan, west Elduiem town of the White Nile State. The area forms transitional zone between the bank of White Nile River and El Helba, which is mainly composed of natural rangeland with few scattered relics of the remaining natural forests and few scattered villages and semi-settled areas.

The population of the White Nile State in 1998 was around 1,401,895 persons, about 5.8% of the total country population .Those who live in rural centres were 474,682 (39%),those in the rural area were 900,437(64.2%) and the nomads 26,776 (1.9%). The most important tribes are Gemme, Bagara, Seliem, Hassania, Ahameda, Shekhnab, dar moharb (Sabaha and Bini Grare) Shwiahat, Most of the population practicing in the field of traditional farming and grazing, while a few of them practiced trade. The study area lies within two distinctive climatic seasons, the dry warm winter and hot moist summer. The Climate of the area characterized by a relatively long dry season and a short wet season and the rain ranges from 150 mm/annum in north to 500mm/annum in south. The mean annual rainfall ranges between 200- 300mm and within this range, rainfall increases south words [Gaiballa and Farah, 2004].

MATERIALS AND METHODS

Recognized survey within a vast area of the semi arid zone conducted to identify the vegetation cover that constituted according to the soil and land use system. From the survey conducted three categories of plant communities were recognized and observed, these communities were repeated themselves all over the area in different dimension. The three sites identified as category (I) which represents the tree cover that extends along khores and low lands, category (11) represents the scatter trees defined as trees outside forests including areas as open grazing land; category (111) is the agricultural land.

The sampling design was adopted to take an area of one hectare in each category to represent a sample size in which circular sample plot of 0.1 hectare were systematically located to represent the category area according to Mueller [1974].

All trees counted and measured for different parameters, these parameters recorded in forms for each species with their local names and number. Trees further tabulated in a way according to their height classes (layering) to represent different stories, total tree species density; relative density and crown area calculated for both individual species and for all species. Various aspects of tree cover measured to provide criteria for assessment of cover situation tree, frequency, abundance, and dominance and soil seed banks.

RESULTS AND DISCUSSION

The dynamic changes of tree growth parameters is a long term process which require investigations on trees species composition and densities per unit area in addition to abundance, frequencies, vertical profile, coverage and the interaction of these components with the ecological and social components. The study showed that the Acacia nilotica found on flood basins of the White Nile, Acacia Seyal forests extend on the White Nile upper banks in addition to Eldhara forests, which dominated by Acacia tortilis tree species in the north, and other Acacia Sp (Kitir and Talih).

Seven species recorded in the area and that do not indicate a wide biodiversity in a dry land area. In the Zone1, five species recorded (Table I). Acacia tortilis (seyal) and Acacia seyal (talih) are the most frequently distributed, being found in all sample plots in 100 percent frequency distribution, while other associates like Ziziphus spina-christi, Acacia mellifera and Calatropis procera occur in 50 percent, 25% and 25% of the sample plots respectively (Table 1)

Table 1. Species frequency distribution

Zone	Species	Local Name	Frequency/ percent	Relative Frequency	Frequency Class
I	*Acacia tortilis*	Seyal	100	51.0	V
	Acacia seyal	Talih	100	37.0	V
	Ziziphus spina-christi	Sidir	50	8.6	III
	Acacia mellifera	Kitir	25	1.7	II
	Calatropis procera	Tundub	25	1.7	II
II	*Acacia tortilis*	Seyal	100	54	V
	Acacia ehrenbergiana	Sumur	50	32.4	III
	Balanites aegyptiaca	Higleig	50	13.6	III
III	*Calatropis procera*	Tundub	50	100	V

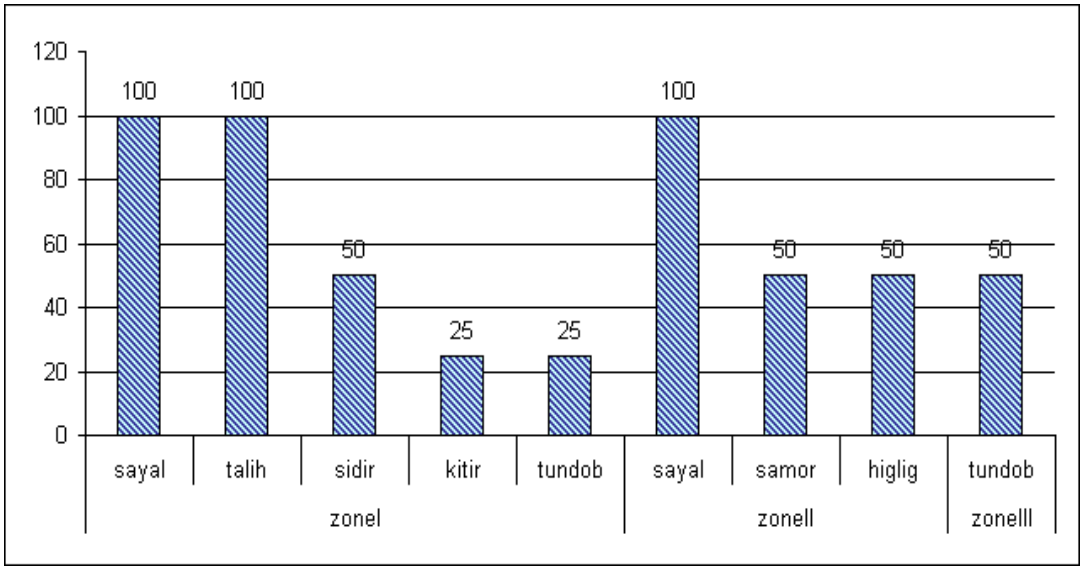

Figure.1. Species frequency across the three zones

In Zone II, three species persist. Still the Acacias are dominating the composition with dominancy of Acacia tortilis. In this Zone count, Acacia tortilis also indicates a wide distribution, found in all sample plots. However, Table (1) and Figure (1) indicate that, the existence of Acacia tortilis is greater in zone I than in Zone II, while in Zone III, Acacia tortilis is completely absent. Zone III contains only one single species, Calatropis procera (Tondub). The wide range of occurrence of Acacia tortilis in Zone I and Zone II and its absence in Zone III is agreed with finding

of Abdeslam [2004]. The absence of Acacia tortilis in Zone III can be as result of site characteristics such as soil, water requirements, and social interventions.

Table (2) indicates that Acacia tortilis have a high dominance value. Acacia tortilis accounts 51% of the total number of trees per unit area and Acacia seyal accounts 37%. That means only two-tree species account for 88% of the total number of trees per unit area. The rest of the three species accounts only 12%. Usually, the most abundant species have high frequency value characterized by regular horizontal distribution and the others tree are comparatively rare species.

Table 2. Species abundance in absolute and percent values

Zone	Species	Local name	Number of trees	Relative abundance
I	*Acacia tortilis*	seyal	72	51
	Acacia seyal	Talih	55	37
	Ziziphus spina-christi	Sidir	12	8.6
	Acacia mellifera	Kitir	2	1.7
	Calatropis procera	Tundub	2	1.7
II	*Acacia tortilis*	Seyal	20	54
	Acacia ehrenbergiana	Sumur	12	32.4
	Balanites aegyptiaca	Higleig	5	13.6
III	*Calatropis procera*	Tundub	5	100

Table (3) represents the values of abundance of each species and for selected groups of species in the three zones. Absolute abundance values provided for each species and for species groups.

Table 3. Species abundance in absolute and percent values

Zone	Species	Local name	Number of trees	Relative abundance %	abundance for species group %
I	*Acacia tortilis*	seyal	72	51.0	
	Acacia seyal	Talih	55	37,0	
	Acacia mellifera	Kitir	2	1.7	
	Species group totals		**129**		**89.7**
	Ziziphus spina-christi	Sidir	12	8.6	**8.6**
	Calatropis procera	Tundub	2	1.7	**1.7**
	Total of Zone I		**143**		**100**
II	*Acacia tortilis*	Seyal	20	54.0	
	Acacia ehrenbergiana	Sumur	12	32.4	
	Species group totals		**32**		**86.4**
	Balanites aegyptiaca	Higleig	5	13.6	
	Total of Zone II		**37**		**100**
III	*Calatropis procera*	Tundub	5	100	

Using a classification system by IUFRO [1958], Table (4) shows that highest number of species occurs in the middle story followed by the lower story. The upper story shows the smallest spectrum of species. Figure (2) and Table (4) provides a clear picture of the three layers in each of the three zones and the differences in species densities for each height value. Zone I shows the highest density composed mainly of Acacia tortilis (seyal) and Acacia seyal (Talih), they constitute 40 stems and 27 stems per hectare respectively. The highest density in the upper layer is in Zone I for Acacia seyal, (Talih), which counts 25 stems per hectare.

Table.4. Species composition in the three layers across the three zones

Zone	Species	Upper layer	Middle layer	Lower layer	Number of trees
I	*Acacia tortilis*	2	40	30	72
	Acacia seyal	25	27	3	55
	Ziziphus spina-christi	0	5	7	12
	Acacia mellifera	0	2	0	2
	Calatropis procera	0	2	0	2
	Total	**27**	**76**	**40**	**143**
II	*Acacia tortilis*	0	13	7	20
	Acacia ehrenbergiana	0	6	6	12
	Balanites aegyptiaca	3	0	2	5
	Total	**3**	**19**	**15**	**37**
III	*Calatropis procera*	0	0	5	5

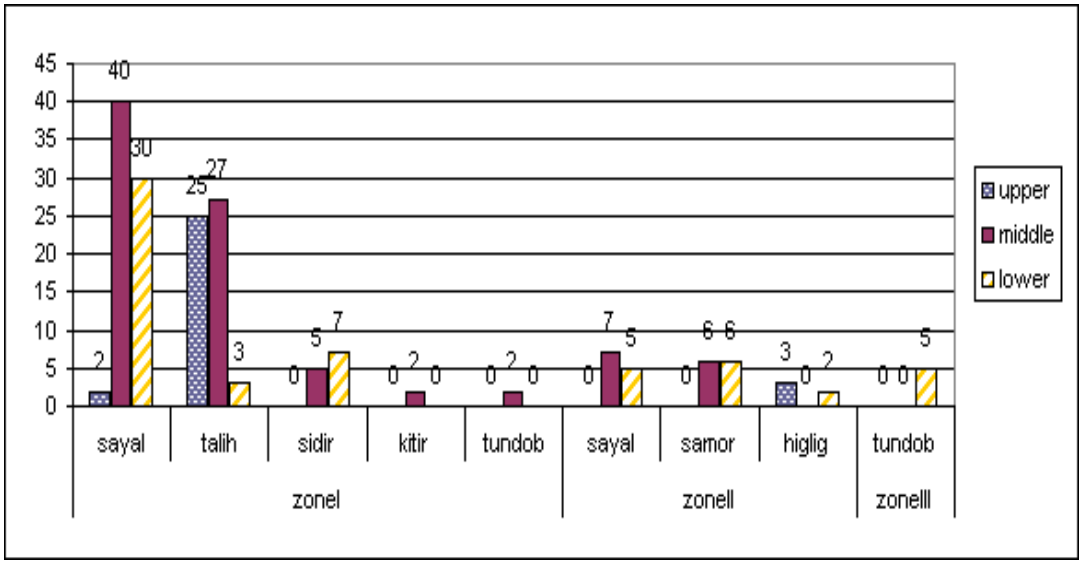

Figure.2. Vertical distribution of tree species across the three zones 5.2.3.

Table (5) shows diameter distribution of dominant tree species in Zone I, II and III as stems per hectare, the distribution of the diameter of all species along the diameter class profile does not indicate a sustainable system.

Table 5. Diameter distribution of dominant tree species in Zone I and II as stems per hectare

Diameter class of *Acacia tortilis* (seyal)	Number of stems Zone I	Number of stems Zone II	Diameter class of *Acacia seyal* (talih)	Number of stems Zone I
7.0 – 11.9	0.0	0.0	7.0 – 11.9	0.0
12 – 16.9	70	0.0	12 – 16.9	30
17 – 21.9	100	0.0	17 – 21.9	110
22 – 26.9	60	30	22 – 26.9	60
27 – 31.9	30	20	27 – 31.9	10
32 – 36.9	40	0.0	32 – 36.9	0.0

The counts of regeneration are shown in Table (6) and Figure (3) for any of the species and were complemented by soil samples for seed stock concerning each of the species in the three Zones.

Table 6. Regeneration per hectare of tree species in the three zones

Zone	Species	Local name	Regeneration counts per hectare	Relative to all species %
I	*Acacia tortilis*	seyal	0	0
	Acacia seyal	Talih	0	0
	Ziziphus spina-christi	Sidir	0	0
	Acacia mellifera	Kitir	0	0
	Calatropis procera	Tundub	0	0
II	*Acacia tortilis*	Seyal	23	100
	Acacia ehrenbergiana	Sumur	0	0
	Balanites aegyptiaca	Higleig	0	0
III	*Calatropis procera*	Tundub	0	0
	Acacia tortilis	seyal	40	83.3
	Ziziphus spina-christi	Sidir	8	16.7

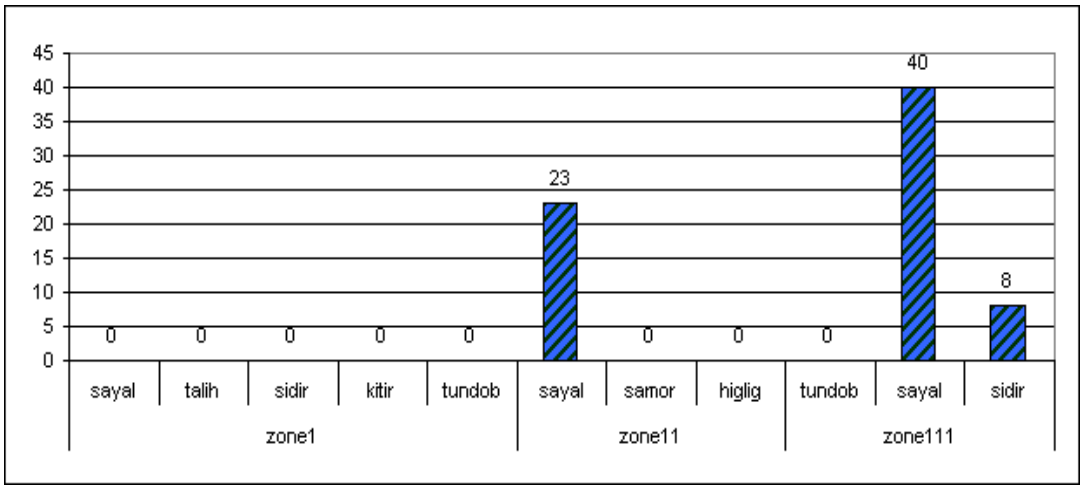

Figure.3. Regeneration per hectare of tree species in the three zones

Table 7. Seed stock of tree species across the three Zones

Zone	Species	Local name	Live seeds	% of Total	Dead seeds	% of Total
I	*Acacia tortilis*	seyal	200	12	1500	88
	Acacia seyal	Talih	0	0	500	100
	Ziziphus spina-christi	Sidir	0		0	
	Acacia mellifera	Kitir	0		0	
	Calatropis procera	Tundub	0		0	
	Balanites aegyptiaca	Higleig	0		0	
	Acacia ehrenbergiana	Sumur	0		0	
II	*Acacia tortilis*	Seyal	100	25	300	75
	Acacia seyal	Talih	0		0	
	Ziziphus spina-christi	Sidir	0		0	
	Acacia mellifera	Kitir	0		0	
	Calatropis procera	Tundub	0		0	
	Acacia ehrenbergiana	Sumur	0		0	
	Balanites aegyptiaca	Higleig	0		0	
III	*Acacia tortilis*	seyal	1300	40	2000	60
	Acacia seyal	Talih	0		200	100
	Ziziphus spina-christi	Sidir	0		0	
	Acacia mellifera	Kitir	0		0	
	Calatropis procera	Tundub	0		0	
	Acacia ehrenbergiana	Sumur	0		0	
	Balanites aegyptiaca	Higleig	0		0	

Table (7) and Figure (4) indicate that, the stock of seeds for Acacia tortilis (seyal) was very rich in each of the three Zones, this can explaining the opportunities for regeneration in these zones (Table 6). However, the majority of seeds of Acacia tortilis (seyal) were dead. The situation of viable seeds in zone III is much better indicating good chance for regeneration

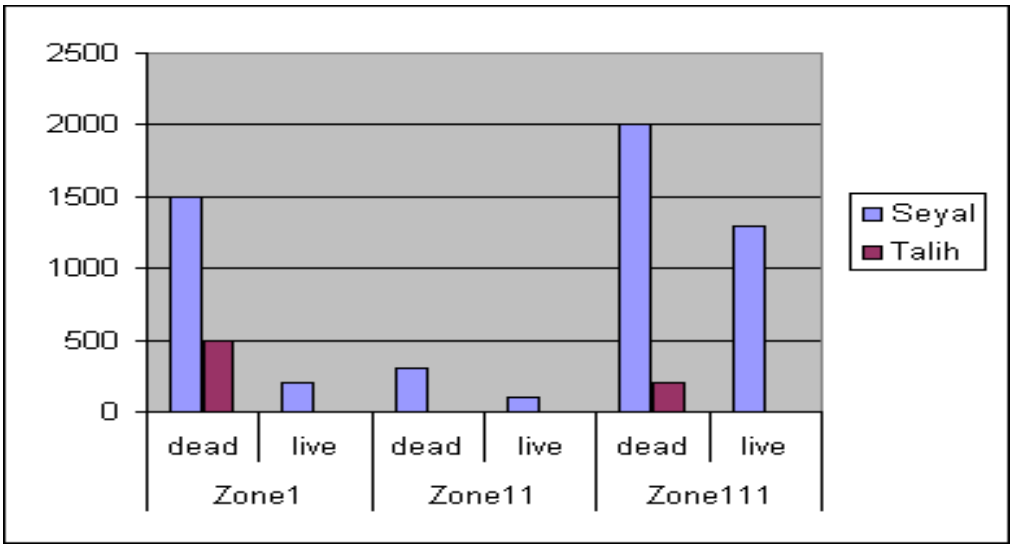

Figure 4. Seed stock of tree species across the three Zones

CONCLUSION

The study is investing the system of natural forest and the integration of different components to try to draw a picture or a design that could direct the effort toward natural forest management according to prescribed adjectives.

The study reveals that the type of land use is the main factors dictating the forest structure plant cover and could be used as an indication to identify forest sites and communities ground cover assessments.

Tallih species is declining in the lower layers, which may indicate that either decreased with competition process or subjected to intensive utilization.

The seed bank investigation gives an idea of the total seed pool; showed an idea about the species persistency; species of high persistency may use with moderate seed rate, but those with low persistency should apply with a big dose since many seed may be lost. Species such as seyal showed and existence in flora as well as in the seed bank which indicate their good suitability and potentially. Seed bank at different intervals could give a clear picture about relationship between the seed tank and above flora.

Based on these finding the following recommendation can stated:
1. The lack of management is the major factor for the lack of sustainable development, so new policies and practices in the field of sustainable development should be adopted.
2. Developing of national policies for grazing and forest protection.
3. Encourage of people to work for the protection of the natural environment
4. Governments should adopt national studies protect forests such as this study.

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