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A quantitative study of the structure of an abandoned cropland in Nigeria.

Afolayan, A.J. and K.S. Ayandele
Department of Biological Sciences, University of Ilorin, Ilorin, Nigeria.

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Abstract: A quantitative investigation of the structure of a three hectare parcel of abandoned cropland in the Nigerian Guinea Savanna produced the following results: Tree mean basal area was 6.92 m2 ha-1 with an average density of 76.24 ha-1. Shrub basal area was 4.95 m2 ha-1 and 1.20 m2 ha-1 with a density of 52.68 ha-1. Crown coverate for the trees and shrubs were 5.68 m2 ha-1 and 1.20 m2 ha-1 respectively. The ratio of aboveground to belowground biomass for the grass-forb component was 4.70:1, and there was a significant positive correlation (r = 0.76) between the two.

Key words: plant ecology, abandoned field, plant biomass.

Indiscriminate exploitation of Nigerian plant resources has increased the habit deterioration of the country's vegetation zones (Kassas 1970, 1978, Cloudsley-Thompson 1971, Grove 1974). Large areas of vegetation are still being cleared for cultivation, and when these cultivated fields are abandoned they are normally invaded by a dense mass of low vegetation dominated by a variety of grasses, forbs and shrubs.

Conservation efforts on these abandoned farmlands have focused on the planting of trees. Although the trees and some shrubs provide protective cover year-round, grasses and forbs also contribute protection against erosion.

An accurate knowledge of the structure and functions of an ecosystem, according to Odum (1975) is of fundamental importance in an attempt to use the holistic approach in its management. Trees, shrubs and grasses are major components of the vegetation of the Nigerian Guinea Savanna. The proper management of these life-forms is essential for maintaining ecological stability. Presently, quantitative information on the tree-shrub and grass-forb components of Nigeria's vegetation types is limited, yet such information is needed for effective decision-making in the formulation and implementation of management strategies.

The objective of this study is to quantify some structural relationships within the tree-shrub and grass-forb complex of an abandoned farmland on Nigerian Guinea Savanna vegetation. Similar work has been conducted on a Sudan Savanna ecosystem in Borno State of Nigera (Kinako *et al.* 1986).

MATERIAL AND METHODS

The study site: This study was conducted on three ha. farmland, which had been abandoned for about one year, 15 km east of Ilorin City. Previously, the crops were maize (*Zea mays* L.); Guinea corn (*Sorghum bicolor* (L) Moench) and cassava (*Manihot esculentus* Mill). Generally, trees were protected and during land cultivation trimming of shrubs and prescribed burning were conducted. The climate is tropical with a marked dry season from November to March and a raining period from April to October. In 1988, total precipitation was 1204 mm. The soil of the area is essentially sandloam and supports various forbs, shrubs, grasses and scattered trees.

A random sampling of trees and shrubs using twenty-five 30 m x 30 m sample plots was conducted in November, 1988. Data collected from each plot included tree and shrub density, crown diameter, diameter at-breast-height (dbh), percentage crown cover and basal area by species.

For the grass-forb community, fifty 30 cm x 30 cm sample plots were randomly located within a 10 m x 10 m area. Aboveground biomass (green and dead) of plant species within the sample plots was harvested (Milner and Hughes 1968). Belowground biomass was sampled by excavating the entire soil of each sample unit to a depth of 25 cm. The choice of 25 cm depth was based on previous sampling exercise which had shown that the concentration of the roots of the grass-forb components of the vegetation rarely exceeded 20 cm depth. Root were first hand-picked from each soil particles. Leaf and root materials were oven dried to constant weight at 80 °C.

RESULTS AND DISCUSSION

The quantitative description of the tree-shrub complex of the Guinea Savanna ecosystem presented in this paper is based on a population of 170 trees and 118 shrubs. Tree and shrub species richness of the study area were 10 and 5 respectively (Table 1). The apparent low level of species richness is probably due to the extensive harvesting of trees and shrubs for fuel-wood and overgrazing by livestock. Of the tree species, *Daniella oliverii* Rolfe and *Prosopis africana* L. were the most widely distributed, with frequencies of occurrence of 100 % and 80 % respectively.

Mean tree density was 76.24 ± 32.06 ha^{-1} whille shrub density was 52.68 ± 24.68 ha^{-1}. Mean tree basal area was 6.92 +-3.59 m2 ha-1 while shrubs had a basal area of 4.95 ± 2.47 m^2 ha^{-1}. The crown coverage of trees was 5.65 % ±1.80 ha-1 while that of shrubs was only 1.20 % ± 0.39 ha^{-1}; indicating a low tree-shrub cover.

Aboveground biomass harvested had accumulated over a period of one year, indicating that standing biomass was 6802.70 kg ha^{-1} yr^{-1}, while root production contributed 1447.80 kg ha^{-1} yr^{-1}. The total contribution of the grass-forb component to the biomass of the community at the end of growing season, therefore, amounted to 8250.50 kg ha^{-1} yr^{-1}.

The pattern of distribution of plant biomass in the aerial and underground compartments of a terrestrial ecosystem is an important aspect of its ecology Rodin and Brazilevich (1967) observed that mesophytic vegetation types tend to apportion their biomass in favour of the aerial compartment while xerophytic types tend to favour the underground compartment. Our study agrees with their observation. Biomass in the

TABLE 1

Tree and shrub frequiency in a 3ha.Guinea Savanna community in Kwara State, Nigeria

Species	Frequency %
Trees:	
Piliostigma thonningi Schum.	28
Vittelaria paradoxa Gaertn	36
Prosopis africana L.	80
Vitex doniana Sweet	12
Afzelia africana Sm.	16
Burkea africana Hook	8
Parkia biglobosa Jack R. B.	36
Daniella oliverii Rolfe	100
Azadirachta indica A. Juss.	20
Ficus sur Forssk	8
Shrubs	
Gardenia ternifolia Schum & Thonn	16
Psychotria obscura Benth	4
Vernolia colorata Willd	12
Psychotria vogeliana Benth	8
Vitex simplicifolia Oliv.	4

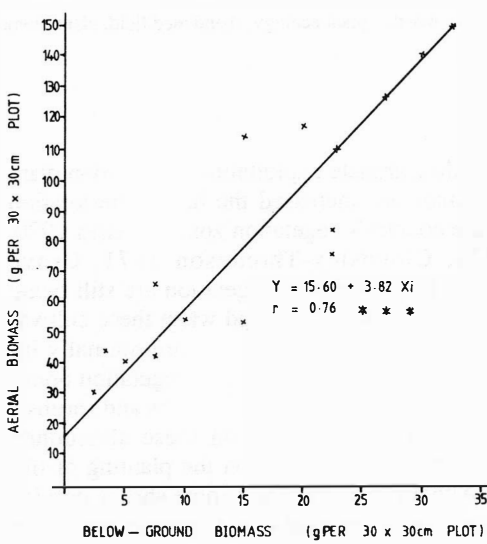

Fig. 1. Relationship between above and belowground biomass of the grass-forb component one year after abandonment of a Guinea Savanna farmaland in Kwara State, Nigeria.

aerial compartment was about 5 times that of the undesrground. A highly significant positive correlation ($p< 0.05$) between aerial biomass accumulation and root biomass was demonstrated (Figure 1).

Information on the pattern of biomass distribution in grass-forb communities is of ecological and economic importance. Plant species that produce foliage profusely easily provide good cover for the habitat and forage for livestock and wildlife. Kinako *et al.* (1986) have suggested that grass and forb species should be screened not only for drought tolerance but also for a high aerial to underground biomass ratio and used in ecological conservation work in Nigeria. Although the trees and shrubs provide a protective cover year-round, grasses and forbs also contribute to habitat protection and should be considered for use in abandoned farmalands. In order to improve a build-up of vegetation cover and promote habitat stability in the ecosystem, there is the need for the government to channel more resources into forest conservation work in the area.

RESUMEN

Se estudió cuantitativamente una parcela de tres hectáreas de un cultivo abandonado en una zona de Savana de Guinea en Nigeria, con los siguientes resultados: Area basal media de los árboles 6.92 m2 ha^{-1} con una densidad media de 76.24 ha^{-1}; area basal de matorral 4.95 m^2 ha^{-1} con una densidad de 52.68 ha^{-1}; cobertura de "copa" 5.68 m^2 ha^{-1} y 1.20 m^2 ha^{-1} para árboles y matorral, respectivamente. La proporción de biomasa sobre y bajo suelo para la parte de zacatal fue 4.70:1 y hubo una correlación positiva ($r = 0.76$) entre ambos.

REFERENCES

Cloudsley - Thompson, J.L. 1971. Recent expansion of the Sahara. J. Environm. Sci. 2: 35-39.

Grove, A.T. 1974. Desertification in the African environment. African Affairs 73: 135-151.

Kassas, M. 1970. Desertification versus potential for recovery in the circum - Saharan territories, *In* H.E. Dregne (ed.). Arid lands in Transition. Amer. Assoc. Adv, Sci. Publication No. 90. Washington, D.C.

Kassas, M. 1978. A barren year in the deserts. West African Magazine, Dec. 19: 2548 - 2549.

Kinako, P.D.S., M. Yusuf & M. Umar. 1986. Some quantitative aspects of the structure of the vegetation of the Sudan Savanna Ecosystem in Borno State. Ife J. of Sci. 1(1): 40-48.

Milner, C. & R.E. Hughes. 1968. Methods for the measurement of the primary production of Grassland. I.B.P. Handbook No. 6. Blackwell Sci. Public. Oxford.

Odum, E.P. 1975. Ecology. Holt Rinehart and Winston, London.

Rodin, L.E. & N.I. Brazilevich. 1967. Production and mineral cycling in Terrestrial Vegetation. Oliver & Boyd, Edinburgh.