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ECOLOGICAL SURVEY OF PLANT SPECIES IN TWO CONTRASTING MANAGEMENT SYSTEMS OF WATERSHED ECOSYSTEM

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ABSTRACT: *Ecological characteristics of managed and unmanaged systems of watershed were evaluated in Amawbia southeast Nigeria. Measuring tape and pegs were used to map out an area of 1400m^2 (35mx40m) in the two experimental sites. Random sampling method was applied and two coordinate AB (35m) and BC (40m) were erected in the two-study area. Quadrat method of sampling was used for counting of the species. Result from the study showed that managed plot of the watershed recorded a population of 62 individual trees and shrubs with 84 individual weeds which were mostly broad leaf. There were three individual trees in the unmanaged plots and weed population of 189 individual species which was dominated by Imperata cylindrica with highest density in the upper slopes (slope 1and slope 2). Trees and shrubs retain the basic restorative attributes of the bush fallow through nutrient recycling, fertility regeneration and weed suppression and when combined with arable cropping possess the potential to allow the farmer to crop the land for an extended period as the processes occur concurrently on the same land.*

KEYWORDS: Alley, Ecology, Hedgerow, Plant Species, Watershed, Weed

INTRODUCTION

Watershed management seeks to make the best use of soil, water and vegetation within the constraints of watershed agro-climatic and topographic conditions to strengthen the natural resource base (soil, vegetative cover) and to increase agricultural productivity. Some of the critical watershed maintenance functions include management of conservation areas and buffer networks the quality of which requires some reforestation to reduce the impact of erosion that results from land use activities. Many human activities remove vegetation from an area making the soil easily eroded. Reforestation of large water shed increase stream discharge due to increase in run-off and inflow (Lal, 1992); some researchers argued that large scale deforestation may change rainfall amount and distribution pattern over the region. Salati and Vose (1985) proffered that on a regional scale deforestation influences the transportation of water out of the ecosystem. Heavy grazing as well can reduce vegetation enough to increase erosion. Leaf litter and low shrubs are an important part of the high infiltration rates of the water shed, the removal of which can increase erosion rates. Erosion induced reduction in crop yields can be attributed to loss of rooting depth, degradation of soil structure, decrease in plant available water resources, reduction in organic matter (OM) and nutrient imbalance. Clearing of vegetation decreases the water shed capacity to capture

moisture thereby increasing the amount of run-off and destabilizes stream banks. The root mass associated with healthy vegetation cover makes the soil more permeable and allows moisture to penetrate deep into the soil for storage. The maintenance of fertility of soil is the first condition for every permanent system of agriculture. Many people in the developing countries like Nigeria rely on the land to sustain their livelihood. Degraded landscape units due to previous mismanagement should be reverted back to planted fallows or quick growing man-made forest for restoration of their biological and ecological integrity (Salati and Vose, 1985, Brewbaker et al., 2012, Nweke, 2020). Information on fast growing nitrogen fixing trees and shrubs that can be pruned continuously and provide green mulch/manure even in dry season to reclaim the fertility of the degraded land have been propounded by NAS (2010, 2013). Thus, this study tends to survey the plant species in managed and unmanaged watersheds visa-vie their ecological challenges and impact in the ecosystem.

MATERIALS AND METHODS

Experimental Site

The research was carried out in Amawbia Anambra State, Nigeria. The area is a watershed, which lies between latitude 06°18 north and longitude 070°41 east. The temperature of the area is uniformly high with mean monthly minimum average of 26°C, with annual rainfall that ranges between 1500mm to 2500mm with its peak in the months of July and September. The soil used for this experiment was under heavy agricultural activities resulting to erosion of the watershed and loss of vegetation. Parts of this watershed in recent past have come under some kind of management programme initiated by State Government leaving the adjacent watershed area unmanaged. Hence, the watershed areas can be clearly categorized into managed and unmanaged watershed systems. This study was carried out under these two management systems. The managed system was characterized with terraces separated by earth bunds and stabilized by permanent trees forming hedgerows. This was established in June, 1995, and has been under management for over 20 years. The unmanaged system is neither terraced nor ridged for erosion control. The two management systems were subdivided in different slope gradients (slope 1, 34.8% gradient; slope 2, 29.6% gradient; slope 3, 23.8% gradient; slope 4 or plain, 0.52% gradient).

An area of 1400m^2 (35mx40m) was mapped out in the two experimental sites with the aid of a measuring tape and pegs, random sampling methods was applied and two coordinate AB (35m) were also erected in the two study areas. Quadrat points were determined by selecting random numbers from a pack of card for each coordinate, care was taken to discard numbers that fall at the edge of the plots. Counting was made when the coordinate point is at the centre of the quadrat. Quadrat method of sampling was used for counting the species. 4m x4m (16m 2) quadrat was used and a total of 15 random points were scheduled in each of the two sites to give about 17.1% sampling intensity of each of the two plots.

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RESULTS

Result presented in Table 1 showed the different weed species present in the managed plot of the watershed. Observation showed that the species are mostly broad- leaf weeds and are few in number. *Calauden bicolor* was the dominant weed species with population 21 individuals and percentage frequency of 66.67% in the managed plot of the watershed. *Sida acuta* also recorded high population while *Assystasia gangetica* was the least in population. Total number of weeds captured in the quadrat was seven (7) species and also the sample recorded total population of 84 weeds in the managed plot.

Table 1: Weed species in the managed plot of the watershed

S/N	Specie/Quadrat	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	%FRQ
1	*Chromolaena Odorota*	2	-	-	1	3	-	2	-	-	-	2	1	-	-	-	11	40
2	*Assystasia Gangetica*	2	2	-	-	-	-	-	1	-	-	-	-	-	-	-	5	20
3	*Alteranthera brasilliana*	-	1	-	1	-	-	-	2	-	-	2	2	-	-	1	9	40
4	*Phyllanthus nirurii*	1	-	-	-	-	3	2	-	1	1	-	-	2	-	3	13	45.67
5	*Calapagonium mucunoides*	-	-	2	4	1	-	-	-	2	-	-	-	-	-	-	9	26.67
6	*Sida acuta*	5	-	3	-	-	-	-	3	1	-	-	-	-	3	1	16	33.33
7	*Calaudem bicolor*	3	4	1	3	-	-	2	-	-	2	1	1	2	2	-	21	66.67

% FRQ =Percentage Frequency ***GRAND TOTAL 84***

The result in Table 2 showed different tree species most of which were planted as management option in stabilizing the devastated watershed. Highest in number was *Clausinea anisata* which formed most of the hedgerows in the managed plot. *Gmelina arborea* was observed to have relatively high population in managed plot and this was followed by *Phyllanthus discoidens, Carapa procera, Anthocleista djalonesis*, and *Mangifera indica* which recorded the same number in the sampling. The least tree species was *Croton zambezicus*. Total number of trees captured in the quadrat was thirteen (13) species with total population of sixty-two (62) trees in the managed plot of the watershed.

Table 2: Tree/shrub species in the managed plot of the watershed

S/N	Species/Quadrat	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	%FRQ
1	*Clausinea anisata*	2	1	2	2	2	-	1	1	-	-	-	2	-	2	2	17	66.67
2	*Phyllanthus discoidens*	-	1	1	-	-	-	1	-	1	-	-	-	1	-	-	5	33.33
3	*Carapa procera*	-	-	1	1	-	-	-	1	1	-	-	1	-	-	-	5	33.33
4	*Tectona grandis*	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2	13.33

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5	*Milicia exelsa*	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	2	13.33
6	*Terminalia catapa*	-	-	-	-	1	-	1	-	-	1	-	1	-	-	-	4	26.67
7	*Anthocleista djalonesis*	1	-	-	-	-	-	-	1	1	-	1	-	-	1	-	5	33.33
8	*Morinada lucida*	-	1	1	-	-	-	-	-	-	-	-	-	-	-	1	3	20
9	*Croton zambezicus*	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	6.67
10	*Treculia africana*	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2	13.33
11	*Gmelina arborea*	2	-	1	1	-	1	-	-	-	1	-	-	-	-	1	7	40
12	*Azodiracta indica*	-	-	1	-	1	-	-	-	1	-	-	1	-	-	-	4	26.67
13	*Mangifera indica*	1	1	-	1	-	-	-	1	-	-	-	-	-	1	-	5	26.67

GRAND TOTAL 62

Result presented in Table 3 showed the number of weed species present in the unmanaged plot of the watershed. The area which experienced high weed infestation has *Imperata cylindrica* as the highest and dominant weed with 100% frequency. Apart from *Imperata cylindrica*, *Calopogonium mucuniodes* and *Mimosa pygra* also recorded high presence in unmanaged plot. The least weed specie recorded was *Tridax Procumbens*. The unmanaged plot recorded sixteen (16) weed species with total population of one hundred and eighty-nine (189) individual weeds.

Table 3: Weed species in the unmanaged plot of the watershed

	Species/Quadrat	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	%FRQ
I	*Imperata cylindrica*	25	##	13	36	##	##	13	##	28	##	8	15	##	##	22	##	100
2	*Mimosa pygra*	5	3	-	1	3	2	4	1	-	3	4	2	-	1	3	32	80
3	*Anthephora ampullacea*	-	3	2	-	-	6	-	6	2	4	-	3	-	3	-	29	53.38
4	*Euphorbia hirta*	-	4	-	2	1	2	-	-	1	1	2	-	3	5	1	22	66.67
5	*Adropogon tectorum*	8	2	3	3	-	-	2	-	6	3	3	2	-	-	2	34	66.67
6	calopogonium *Mucunoides*	3	-	5	9	-	1	3	-	-	4	-	-	-	3	-	28	46.67
7	*Sida acuta*	-	4	3	-	3	5	-	-	3	6	2	-	3	3	1	33	66.67
8	*Tridax Procumbens*	3	-	-	1	1	-	-	2	-	-	-	-	2	2	-	11	40

Species covered about 100% of the quadrat ***GRAND TOTAL= 189***

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Tree species found in the unmanaged plot was shown in Table 4. Observation showed that the plot has very few trees. Trees found are *Ficus carpenis*, *Mangifera indica* and *Gmelina arborea*. Tree species in the unmanaged plot recorded a total population of eight (8) trees *Mangifera indica* and *Gmelina arborea* being the highest in number. *Euphorbiaceae* recorded the highest (3) number of species in the managed plot (Table 5) *Meliaceae* and *Moraceae* also recorded two species respectively. A total of 16 families were sampled in the managed plot. In the unmamaged plot, *Poaceae* with three species was most dominant (Table 6) in the plot. Other families such as *Euphorbiace*, *Asteraceae* and *Fabaceae* recorded one species respectively. A total of 9 families were sampled in the unmanaged plot.

Table 4: Tree / shrub species in the unmanaged plot of the watershed

	Species/Quadrat	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	%FRQ
1	*Ficus carpensis*	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	2	13.33
2	*Mangifera indica*	-	1	-	-	-	-	-	-	1	-	1	-	-	-	-	3	20
3	*Gmelina arborea*	-	-	-	-	-	1	-	-	-	-	-	1	-	-	1	3	20

GRAND TOTAL = 8

Table 5: Families and Species in the managed plot

Families	**Species**
ASTERACEAE	*Chromolaena odorota*
ACANTHACEAE	*Assystasia gangetica*
AMARANTHEACEAE	*Alteranthera brasilliana*
EUPHORBIACEAE	*Phyllanthus nirurii*
	Phyllanthus discoidens
	Croton zambezicus
FABACEAE	*Calo Calopogonium mucunoides*
MALVACEAE	*Sida Sida acuta*
ARACEAE	*Col Colodium bicolor*
RUTACEAE	*Cla Clausinea anisata*
RUBIACEAE	*Mor Morinda lucida*
MELIACEAE	*Car Carapa procera*
	Azadirachta indica
VERBENACEAE	*Tectona grandis*
MORACEAE	*Milicia excelsa*
	Treculia africana
COMBRETACEAE	*Terminalia catappa*
LOGANIACEAE	*Anthocleista djalonensis*
VERBENACEAE	*Gmelina arborea*
ANACARDIACEAE	*Mangifera indica*

Table 6 Families and Species in the unmanaged plot

Fanilies	Species
POACEAE	*Imperata cylindrica*
	Anthephora ampullaceae
	Andropogon tectorum
MIMOSACEAE	*Mimasa pygra*
EUPHORBIACEAE	*Euphorbia hirta*
FABACEAE	*Calapognium mucunoides*
MALVACEAE	*Sida acuta*
ASTERCEAE	*Tridax procumbens*
MORACEAE	*Ficus carpensis*
ANACARDIACEAE	*Mangifera indica*
VERBENACEAE	*Gmelina arbonea*

DISCUSSION

Ecological survey of the plant species in the managed and unmanaged plots of the watershed

Seven weeds species were captured in the managed plot. *Caladion bicolor* was found to be the highest in population and *Assystasia gangetica* was the least. Most of the weeds found in the managed plot were broad-leaf. This may be attributed to the effect of the canopy provided by the vegetation used in alley as stabilizing structure against erosion in the managed plot. Rachie (1983) reported significant change towards more broad leaf weeds after alley cropping with *Leucena* and *Dactyladenia*. Also, Gonzales and Cooperband (2002) indicated that organic matter provided by pruning from hedgerow species may affect weed population dynamics through modification of soil physical properties, soil water holding capacity, bulk density, aggregate stability and nutrient content. Hence traditional farmers tend to retain certain trees and shrubs in their crop production systems to restore soil fertility exhausted by cropping (Moormann and Greenland 2010). Anoka et al. (1991) found that the shoot biomass of *Imperata cylinderica* decreased by about 80% under uncut hedgerow of *Gliricida* and *Leucena*. There were 13 tree species in the managed plot. *Clausinea anisata* which formed the bulk of the hedgerows was the highest in the population and *Croton zambezicus* was the least. There were 12 families in the managed plot comprising mostly of trees. When these trees are used in crop production systems and pruned periodically during the cropping season to prevent shading provide green manure and mulch for the companion crop thus improves the traditional bush – fallow cultivation (Hartmaus 2011, Kang and Juo 2011, Kang et al., 2012, Nweke, 2020). After five seasons of continuous cropping Akobundu (2010) found increase in crop yield in plots with live mulch than bare plots under minimum or conventional tillage.

In the unmanaged plot were 8 weed species, *Imperata cylindrica* was highest in population and *Tridax procumbens* was the least. *Mimosa pygra* was as successful as *Imperata cylindrica* but less in population. Akobundu (1987) regarded these weeds as very obnoxious weeds. The presence of these species of weeds was an indication that the unmanaged plot had suffered severe degradation and may have lost most of its nutrients through excessive land use and subsequent erosion. There were 3 tree species in the unmanaged plot such as *Mangifera indica* and *Gmelina arborea* and *Ficus carpensis*. Also 9 families were found in the unmanaged plot majority of which were weeds. This showed that the unmanaged plot produced very high population of weeds and few tree species.

CONCLUSION

The findings from the study are of evidence that management of the watershed enhanced the species diversity with increase in the population of tree and shrub species and reduction in weed infestation. Weed species encountered in the managed watershed were mostly broad leaf unlike tough (obnoxious) weed population in unmanaged watershed.

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