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FERTILITY RECLAMATION OF DEGRADED WATERSHED ECOSYSTEM

Nweke I.A.[1], Nnabude P.C.[2], Ekwealor K. U.[2], Igwe A. C.[1], and Anochie C.[1]

[1]Department of Soil Science Chukwuemeka Odumegwu Ojukwu University
[2]Department of Soil and Land Resource Management, Nnamdi Azikiwe University, Awka, Nigeria.
Email: nwekson@hotmail.com

ABSTRACT: *Clearing of vegetation decreases the watersheds capacity to capture moisture thereby increasing the amount of run-off and destabilizes the stream banks. Fertility reclamation efficiency of three contrasting manures on degraded watershed using amaranthus as test crop were evaluated in field and pot experiments conducted in randomized complete block design (RCBD) and randomized complete design (CRD) respectively. The details of treatments are; compost and poultry manure of 0tha^{-1}; 10tha^{-1}; 20tha^{-1}; 30tha^{-1} respectively and NPK fertilizer 15: 15: 15 at 150kgha^{-1}, with three replications. The findings from the study showed that fertility reclamation with different rates (10tha^{-1}, 20tha^{-1} and 30tha^{-1}) of compost and poultry manure and 150kgha^{-1} of NPK was very positive that resulted in significant increase in the growth and yield parameters of amaranthus. However, the best performance was more observed in three rates of poultry manure with highest in 30tha^{-1}. In slope 1 and 2 of the degraded watershed, compost at 10tha^{-1} produced non- significant increase in plant growth while in slope 3 and 4 compost at 20tha^{-1} and 30tha^{-1} produced increases in leaf area, fresh weight and dry weight of amaranthus respectively compared to the control plot. The amendment of the degraded watershed with NPK produced non-significant effect in growth parameter of amaranthus in slope 1, but higher productivity of amaranthus with NPK amendment was recorded in slope 2, 3 and 4 of the degraded watersheds. This study has been able to show that a well-managed watershed will encourage agriculture on a sustainable basis and promote water conservation.*

KEYWORDS: Amaranthus, Chemical Fertilizer, Growth, Leaf Vegetable, Organic Wastes, Reclamation, Watershed.

INTRODUCTION

Watersheds are naturally productive but most ecological vulnerable section of the landscape. Unplanned agricultural activities characteristics of Nigerian agricultural system strongly expose these watersheds to adverse climatic conditions and consequently, reduce the productivity of these watersheds. The decline in soil productivity and progressive deterioration of these natural resources have necessitated the need for methods to sustain crop production through more efficient nutrient recycling. Soil degradation and decreasing soil fertility from continuous cropping on slopping land such as the watersheds are responsible for the growing interest in developing farming systems based on the efficient use of the watersheds. The soils of southeast, Nigeria are very fragile and low in productivity. Erosion, which is one of the major problems of infertility, carries large amount of the top soil and nutrients down the stream. Soil erosion and sedimentation by water reduce crop land productivity, degrade water quality and clog water conveyance structures. Maintenance of the quality of the water sheds require restoration practices to reduce the impact of erosion that results from land use activities. Variation in soil across landscape effects on soil agricultural management systems also affects soil properties including OM content (Cambardella et al., 2004). Some degradation resulting from farming activities sometimes brings about soil erosion, sedimentation and leaching. Eroded soils are deposited in water systems leading to pollution and siltation which cause drastic reduction of water volume and quality and drying out of rivers, water reservoirs and dams. Relf (2001) stated that when there is too much water on the soil surface it fills surface depressions and begin to flow. Erosion though an intrinsic natural process but in many places, it is increased by human land use. Poor land use practices, depletion of soil productivity consequent to poor management, demographic pressure and environmental effects is threatening food security mostly in developing countries. Also, tillage reduces vegetation cover on the surface of the soil and disturbs both soil structure and plant roots that would otherwise hold the soil in place.

Soils are protected by litter layer and organic layer these two layers protect the soil by absorbing the impact of rain drops. The intact of soil with its layers of leaf litter and organic matter absorbs the impact of rainfall. Depending on soil properties and the degree of degradation adverse effects of erosion on crop yields can be mostly compensated for by additional inputs of macronutrients inform of NPK fertilizer and organic matter inform of crop wastes, animal manure and compost. These materials have the capacity to rejuvenate the physical, chemical and biological characteristics of a degraded land. Manures supply plant nutrients to the soil and also are important in soil protection by improving the structure of the soil thereby increasing its capacity to hold water and soluble nutrients. When applied OM slowly releasing balanced nutrients during decomposition, enhance the proliferation of soil microbes with profound effect on the soil conditions, crop growth and yields. These simple technologies with its basic concepts and principle clearly understood by farmers will make strong impact for sustained erosion control, water conservation and nutrient recycling for short- and long-term economic returns thereby compensating for labour costs and loss of production areas. As a well-managed watershed will encourage agriculture on a sustainable basis and promote water conservation and check erosion problems. It is against this background that the study is designed to evaluate the fertility reclamation efficiency of three different types of manure on a degraded water shed ecosystem.

MATERIALS AND METHODS

The study was conducted in Anambra State Market Garden, Amawbia. The area is a watershed, which lies between latitude 06°181 north and longitude 070°41 east. The temperature of the area is uniformly high with mean monthly minimum average of 26°C, maximum temperature of 30°C - 35°C ± 1°C is obtained in March but temperature may reduce to 24°C - 27°C in October (AMA, 2006). Annual rainfall ranges between 1500mm to 2500mm with its peaks in the months of July and September. The soil used for this experiment is a well-drained sand-loam (typic paleudult) that 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 Anambra State Government leaving the adjacent watershed area unmanaged. Hence, the watershed areas can be clearly categorized into managed and non-managed watershed systems. This study was carried out under non-managed watershed system (degraded). The managed system was characterized with terraces separated by earth bunds and stabilised by permanent trees forming hedgerows. This section of the watershed was established in June, 1995, and has been under management for over 20 years. The non-managed system (degraded section) is neither terraced nor ridged for erosion control. The site of the experiment, non-management system was subdivided into 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). Reclamation programme for the unmanaged system was conducted using pot experiment where by perforated polythene bags of dimension 25cm x 30cm containing soil sample weighing 5kg were used. Compost manure and poultry manure were applied at the rates of $0tha^{-1}$, $10tha^{-1}$, $20tha^{-1}$ and $30tha^{-1}$ and NPK was applied at the rate of $150kgha^{-1}$ considering the low fertility status of the soil. Plant height, stem girth and leaf area were measured using ropes and ruler while fresh weight and dry weight were determined using electric oven and electric weighing balance. The field experiments were arranged in a randomized complete block design (RCBD) while the pot experiments were arranged in a completely randomized design (CRD). Results were subjected to analysis of variance (ANOVA) and significant differences among treatment means were separated using least significant difference (LSD).

RESULTS

Properties of compost and Poultry Manure

The result in Table 1 showed that compost and poultry manure varied in their nutrient content. OC, TN, and Ca content were higher in compost than their content in poultry; both were equally relatively rich in available P. Hence the two manures are considered rich in these essential plant nutrient elements. Therefore, it is expected that the studied soil will benefit from their application. The pH values of the two manures were slightly acidic; in fact, their pH values tend to be almost neutral.

Table 1 Property of Compost and Poultry Manure

Sample	pH H_2O	OC gkg^{-1}	TN gkg^{-1} →	Avail. P $Mgkg^{-1}$	Ca ← $Cmolkg^{-1}$	K
Compost	6.62	36.5	2.63	12.11	16.65	0.52
Poultry	6.86	15.15	3.48	12.42	15.13	0.66

Response of Amaranthus to Main Effect of Treatment in Slope one

The result presented in Table 2 indicated significant ($P < 0.05$) differences among the treatments except for the number of leaves. The effect of poultry on the growth and yield parameter of amaranthus was more effective as it recorded higher value in all the parameters assessed compared to the recorded values of compost treatment. Increase in yields value of fresh weight and dry weight of amaranthus recorded in poultry relative to compost were 61.03% and 87.31% respectively.

Table 2: Response of Amaranthus to Main Effect of Treatment in Slope one

Treatment	Plant height (cm)	Stem girth (cm)	No. of Levels	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)
COMPOST	46.30	2.72	51.80	62.68	192.42	100.63
POULTRY	54.06	3.34	52.27	76.59	309.85	188.49
LSD 0.05	10.80	1.85	NS	10.22	131.25	63.73

Response of Amaranthus to Main Effect of Sub-Treatment in Slope one

The result of growth and yield parameters of amaranthus presented in Table 3 showed significant differences ($P < 0.05$) among the treatments. This indicates that the various treatments studied influenced the values obtained for the parameters of amaranthus studied. The $30tha^{-1}$ treatment recorded the highest value in all the parameters assessed except for fresh weight and dry weight of amaranthus of which the highest value was recorded by NPK. Among the three rates of poultry studied $10tha^{-1}$ recorded the least value in the parameters studied, while the control among the treatments studied recorded the least value in all the parameters of amaranthus assessed.

Table 3: Response of Amaranthus to Main Effect of Sub-Treatment in Slope one

Sub-treatment	Plant height (cm)	Stem girth (cm)	No. of Levels	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)
$30tha^{-1}$	85.55	4.15	88.50	108.45	324.33	167.25
$20tha^{-1}$	59.55	3.95	65.50	98.23	251.25	161.75
$10tha^{-1}$	31.13	1.85	31.17	54.16	120.06	68.73
NPK	54.60	3.70	64.0	74.81	550.12	320.48
CONTROL	20.21	1.50	11.0	12.74	10.26	5.14
LSD 0.05	28.55	2.65	23.0	23.43	73.08	98.52

Response of Amaranthus to Combined Effect of Treatment and Sub-Treatment in Slope one

With the exception of stem girth in Table 4, all the parameters assessed showed significant differences ($P < 0.05$) among the treatments. Values increased with attendant increase in the rates of compost and poultry applied. In comparison of sub-treatments higher values were recorded in rates of poultry compared to rates of compost and NPK, except for fresh weight and dry weight of amaranthus where the NPK sub-treatment recorded higher values relative to rates of compost and rates of poultry. The main treatments which are compost and poultry differed much in their recorded values of the parameters tested. Poultry recorded higher values in all the parameters tested in the study and in some parameters over 100% increases relative to the recorded value of compost. For example, the percentage increases in fresh and dry weight of amaranthus in poultry relative to compost were 145.84% and 249.36% respectively. Control soil recorded very poor result in all the parameters visa-via the recorded values of other sub-treatments and main treatments.

Table 4: Response of Amaranthus to Combined Effect of Treatment and Sub-Treatment in Slope one

Treatment	Sub-treatment	Plant height (cm)	Stem girth (cm)	No. of Levels	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)
COMPOST	30tha-^{1}	81.10	3.52	82.0	112.48	252.16	110.38
	20tha-^{1}	55.10	3.48	78.0	96.16	110.08	53.42
	10tha-^{1}	20.50	1.56	24.0	17.56	40.27	15.83
	Mean	52.23	2.85	61.23	75.40	134.17	59.88
POULTRY	30tha-^{1}	90.0	4.80	95.0	104.52	396.67	224.56
	20tha-^{1}	64.24	4.53	53.0	100.47	392.50	270.52
	10tha-^{1}	41.53	2.20	38.33	90.50	200.35	122.47
	Mean	65.26	3.84	62.08	98.48	329.84	209.18
	NPK	54.61	3.74	64.0	74.83	550.12	320.12
	CONTROL	20.20	1.50	11.0	12.70	10.26	5.14
LSD 0.05		26.01	NS	20.17	33.65	110.0	93.02

Response of Amaranthus to Main Effect of Treatment in Slope two

The parameters assessed in Table 5 shows non-significant difference among treatments of which poultry recorded the highest value compared to the compost. However, compost recorded a marginal increase against poultry in plant height and number of leaves of which are 3.65% and 10.31% respectively.

Table 5 Response of Amaranthus to Main Effect of Treatment in Slope two

Treatment	Plant height (cm)	Stem girth (cm)	No. of Levels	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)
COMPOST	63.56	3.20	81.33	77.34	276.33	174.44
POULTRY	61.33	3.44	73.73	80.10	354.33	202.09
LSD 0.05	NS	NS	NS	NS	NS	NS

Response of Amaranthus to Main Effect of Sub-Treatment in Slope two

The result presented in Table 6 showed significant difference among the sub-treatments studied in all the parameters assessed. Among the sub-treatments NPK recorded higher values in all the parameters except for plant height where the 30tha^{-1} manure recorded higher (90.95cm) value compared to sub-treatments. For the rates of manure applied, the result indicated that values recorded for the parameters increased as the rates of manure application increased. The result obtained from the control indicated lower values in all the parameters relative to other sub-treatments.

Table 6: Response of Amaranthus to Main Effect of Sub-Treatment in Slope two

Sub-treatment	Plant height (cm)	Stem girth (cm)	No. of Levels	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)
30tha-[1]	90.95	4.45	101.50	111.84	475.13	276.91
20tha-[1]	73.33	3.45	81.67	93.56	330.57	219.15
10tha-[1]	44.75	2.60	44.50	40.72	110.11	53.13
NPK	74.60	4.50	144.0	134.81	646.09	387.13
CONTROL	28.60	1.60	16.0	12.84	15.13	5.05
LSD 0.05	17.62	2.85	28.50	41.31	94.87	167.98

Response of Amaranthus to Combined Effect of Treatment and Sub-treatment in Slope two

The rates of compost and poultry in sub-treatment show a result variation of $30tha^{-1}$ > $20tha^{-1}$ > $10tha^{-1}$ in all the parameters tested (Table 7). NPK among the sub-treatment recorded higher values in number of leaves (144), leaf area ($134.85cm^2$), fresh weight (646.05g) and dry weight (387.13g) of amaranthus relative to rates of compost and poultry and control treatments. In comparison of main treatments, compost and poultry the result of plant height and number of leaves showed higher values of 214.6cm and 246.67 respectively in compost relative to poultry; while the rest of the parameters tested indicated higher values in poultry as against their values in compost. The leaf area, fresh weight and dry weight were observed to increase 5.29%; 54.05%; and 28.75% respectively in poultry relative to compost.

Table 7: Response of Amaranthus to Combined Effect of Treatment and Sub-treatment in Slope two

Treatment	Sub-treatment	Plant height (cm)	Stem girth (cm)	No. of Levels	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)
COMPOST	$30tha^{-1}$	90.10	4.30	115.0	104.0	350.17	260.52
	$20tha^{-1}$	82.0	3.10	98.67	88.50	250.78	165.82
	$10tha^{-1}$	42.50	2.50	32.0	45.86	120.05	54.27
	Mean	71.53	3.30	82.22	79.45	240.33	160.28
POULTRY	$30tha^{-1}$	91.80	4.60	88.0	118.84	600	293.83
	$20tha^{-1}$	64.67	3.80	64.67	98.53	410.32	272.56
	$10tha^{-1}$	47.0	2.70	56.0	35.67	100.15	52.38
	Mean	67.82	3.70	69.56	83.65	370.22	206.26
	NPK	74.60	4.50	144.0	134.85	646.05	387.13
	CONTROL	28.60	1.60	16.0	12.88	15.13	5.36
LSD 0.05		NS	NS	NS	NS	171.07	48.13

Response of Amaranthus to Main Effect of Treatment in Slope three

The result presented in Table 8 showed significant difference among the treatment in all the parameters assessed except for the result of leaf area. The values obtained from the parameters measured indicated that poultry recorded superior values by the virtue of higher values it recorded against compost in all the parameters assessed. The percentage increase in plant height, leaf area, fresh weight and dry weight in poultry relative to compost were 15.13%, 5.31%, 32.24% and 26.29% respectively.

Table 8: Response of Amaranthus to Main Effect of Treatment in Slope three

Treatment	Plant height (cm)	Stem girth (cm)	No. of Levels	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)
COMPOST	71.14	3.60	117.40	101.81	300.98	187.78
POULTRY	87.90	4.20	135.40	107.22	398.03	237.14
LSD 0.05	7.55	0.85	25.0	NS	38.39	83.70

Response of Amaranthus to Main Effect of Sub-Treatment in Slope three

The effect of sub-treatment in slope three amaranthus recorded in Table 9 indicated significant differences ($P < 0.05$) among the sub-treatments. The $30tha^{-1}$ sub- treatment among the other sub-treatments showed higher values in plant height (103.40cm), stem girth (4.70cm) and number of leaves (173.0); while NPK showed superior values in leaf area (134.90cm^2) fresh weight (652.5g) and dry weight (385.44g). In comparison of the rates of manure, the result obtained indicated attendant increase in value with increase in rates of manure application. The control soil showed very much lower values in all the parameters assessed.

Table 9: Response of Amaranthus to Main Effect of Sub- Treatment in Slope three

Sub-treatment	Plant height (cm)	Stem girth (cm)	No. of Levels	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)
$30tha-^1$	103.40	4.70	173.0	132.65	501.13	323.10
$20tha-^1$	100.05	4.55	169.0	131.25	355.07	239.43
$10tha-^1$	68.15	3.90	108.0	74.58	213.7	104.26
NPK	92.50	4.0	148.0	134.90	652.5	385.44
CONTROL	33.50	2.30	34.0	49.20	25.13	10.25
LSD 0.05	35.25	1.60	21.0	58.07	146.07	62.33

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Response of Amaranthus to Combined Effect of Treatment and Sub-treatment in Slope three

The main treatment and sub-treatment in slope three, their effect on amaranthus recorded in Table 10 indicated significant difference ($P < 0.05$) in all the parameters in both main and sub-treatments. The main treatment poultry showed higher values in the parameters; plant height (313.50cm); stem girth (14.70cm); number of leaves (495); leaf area (352.17cm^2); fresh weight (1232.56g) and dry weight (790.28g) compared to the values obtained from main treatment compost. Also, higher values were recorded in all the rates of poultry compared to the values obtained from the rates of compost in all the assessed parameters. In both rates of compost and poultry, the result in Table 10 indicated that values increased as the rates of compost / poultry application increased. Among the sub-treatments NPK recorded higher values in fresh weight (652.50g) and dry weight (385.44g) respectively relative to the other sub-treatments. The control soil recorded lower values in all the parameters studied relative to the other treatments.

Table 10: Response of Amaranthus to Combined Effect of Treatment and Sub-treatment in Slope three

Treatment	Sub-treatment	Plant height (cm)	Stem girth (cm)	No. of Levels	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)
COMPOST	30tha^{-1}	90.80	4.30	145.0	120.82	360.27	256.70
	20tha^{-1}	88.60	4.30	148.0	135.11	320.05	228.63
	10tha^{-1}	50.30	3.10	112.0	69.17	147.22	58.24
	Mean	76.57	3.50	135	108.37	275.85	181.19
POULTRY	30tha^{-1}	116.0	5.20	201.0	144.53	642.02	389.56
	20tha^{-1}	111.50	4.80	190.0	127.56	390.13	250.24
	10tha^{-1}	86.0	4.70	104.0	80.08	280.41	150.48
	Mean	104.50	4.90	165	117.35	410.85	263.43
	NPK	92.50	4.0	148.0	134.92	652.5	385.44
	CONTROL	33.5	2.30	34.0	49.24	25.13	10.25
LSD 0.05		31.90	2.45	40.0	25.38	287.43	94.06

Response of Amaranthus to Main Effect of Treatment in Slope four

The main effect of compost and poultry on amaranthus presented in Table 11 indicated significant difference among the treatments in all the studied parameters except for stem girth and leaf areas. Apart from the result of leaf area, poultry recorded higher values in all the studied parameters compared to the values of the parameters obtained from compost treatment. The percentage increase in fresh weight obtained from poultry relative to compost is 15.09%.

Table 11: Response of Amaranthus to Main Effect of Treatment in Slope four

Sub-treatment	Plant height (cm)	Stem girth (cm)	No. of Levels	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)
COMPOST	93.29	4.54	164.40	134.68	463.59	299.63
POULTRY	106.03	4.92	172.80	128.76	523.56	311.56
LSD 0.05	13.27	NS	11.0	`NS	58.13	65.67

Response of Amaranthus to Main Effect of Sub-treatment in Slope four

The effect of sub-treatments in slope 4 on amaranthus presented in Table 12 indicated significant differences ($P < 0.05$) among the treatments in all the parameters assessed. Among the rates of manure recorded values increased as the rates of manure application increased, hence $30tha^{-1}$ rate of manure recorded higher values in all the assessed yield and yield component of amaranthus. When NPK and rates of manure are compared higher values in stem girth (5.60cm), leaf area (154.64cm^2), fresh weight (652.44g) and dry weight (421.15g) respectively were obtained from NPK compared to their values obtained from rates of manure.

Table 12: Response of Amaranthus to Main Effect of Sub-treatment in slope four

Sub-treatment	Plant height (cm)	Stem girth (cm)	No. of Levels	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)
$30tha\text{-}^1$	112.60	5.35	191.0	153.05	585.93	363.75
$20tha\text{-}^1$	108.63	5.0	164.0	135.33	527.81	298.08
$10tha\text{-}^1$	95.37	4.50	156.0	129.25	466.75	293.12
NPK	97.50	5.60	180.0	154.54	652.44	421.15
CONTROL	84.20	3.20	152.0	86.43	235.11	151.93
LSD 0.05	11.13	0.85	27.0	17.75	119.18	57.36

Response of Amaranthus to Combined Effect of Treatment and Sub-treatment in Slope four

The result presented in Table 13, indicated that apart from the result of leaf area (144.18cm^2) that compost recorded higher value, poultry showed higher values in all the other parameters; plant height (116.16cm), stem girth (5.27cm), number of leaves (117.33), fresh weight (576.84g) and dry weight (328.27g) respectively. Also, among the rates of compost and poultry, higher values were recorded in almost all the rates of poultry studied compared to their values obtained from compost rates. Among the sub-treatments $30tha^{-1}$ rate of poultry recorded higher values in all the parameters studied; plant height (128.60cm), stem girth (5.80cm), number of leaves (215), leaf area (160.42cm^2), fresh weight (683.41g) and dry weight (422.52g) respectively compared to their values obtained from the other sub-treatments. Apart from the result of plant height, the next in rank of higher values of the parameters were obtained from NPK relative to the other sub- treatments while the least values recorded for the parameters were obtained from the control soil.

Table 13: Response of Amaranthus to Combined Effect of Treatment and Sub-treatment in Slope four

Treatment	Sub-treatment	Plant height (cm)	Stem girth (cm)	No. of Levels	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)
COMPOST	$30tha^{-1}$	96.60	4.90	167.0	145.73	488.47	305.16
	$20tha^{-1}$	95.80	4.80	167.0	148.34	480.62	310.12
	$10tha^{-1}$	92.33	4.20	156.0	138.46	461.55	310.03
	Mean	94.91	4.63	163.33	144.18	476.88	308.44
POULTRY	$30tha^{-1}$	128.60	5.80	215.0	160.42	683.41	422.52
	$20tha^{-1}$	121.47	5.20	161.0	122.33	575.0	286.07
	$10tha^{-1}$	98.40	4.80	156.0	120.15	472.12	276.22
	Mean	116.16	5.27	177.33	134.30	576.84	328.27
	NPK	97.50	5.60	180.0	154.63	652.44	427.14
	CONTROL	84.20	3.20	152.0	86.42	235.06	151.93
LSD 0.05		17.23	NS	35.0	23.80	66.47	70.63

DISCUSSION

Fertility Reclamation of Degraded Ecosystem

Reclamation of the degraded ecosystem with compost manure, poultry manure and NPK resulted in nutrient improvement of the watershed with positive responses in growth and yield parameters of amaranthus to different levels of applied amendments. Amaranthus responded differently to the three rates of poultry and compost and NPK amendments in each slope of the plot. In slope 1, amaranthus responded significantly better to poultry manure amendment than compost and NPK. Compost at $10tha^{-1}$ recorded similar values in plant height and stem girth with the control. This may be attributed to the severity of erosion impact which was more on the upper slopes such as slope 1. As a result of this $10tha^{-1}$ of compost produced little or no amendment to the highly impoverished slope. In slope 2 main effects of compost and poultry manures were not significant since both amendments recorded the same notable improvements in nutrient status and increases in plant height, stem girth, number of leaves and leaf area of amaranthus compared to the control although $30tha^{-1}$ poultry manure produced slightly higher growth parameters than $30tha^{-1}$ compost and NPK. It was found that compost at $20tha^{-1}$ produced significant increase in plant height and number of leaves than poultry at $20tha^{-1}$. The ability of compost to encourage greater plant growth in slope 2 may be attributed to the moisture and nutrient retention ability of organic matter (OM) as the severity of the flood become less down the slope. Tsai (1989) had indicated that leafy vegetable can be more economically grown with compost at $10tha^{-1}$ – $20tha^{-1}$. Application of compost raised the pH of the acidic soil thereby encouraging nutrient availability.

The soil organic carbon (OC) content may have been increased by the compost amendments hence it should have made P available for plant growth by reducing its fixation (Parffit, 1978). Soil OC is the seat of cation exchange capacity and nutrient retention in highly weathered soils. NPK although non-significant increased plant growth in number of leaves and leaf area but significantly produced greater fresh weight and dry weight than different rates of compost and poultry manure. Nitrogen and phosphorus are key elements in the production of leafy vegetables as they enhanced leafy yield by promoting cell division and expansion in leaves and root development. Fawusi (1983) reported that application of nitrogen fertilizer increased the yield and nutritional value of *corchorus olitorius*. Bandyopadhyay (2003) also reported that application of calcium and magnesium containing fertilizers improved the development of fibre, as well as yield and quality of *corchorus olitorius*. Abdel – Mawgoud et al. (2005) reported that increasing the level of NPK resulted in a positive response in the vegetative growth length, marketable yield and head yield of cabbage. Soil OC content increased further in slope 3 with the addition of compost and poultry manure coupled with the reduction in depletion of the top soil and the gradual deposition of the nutrients carried from the upper slopes. Okoli and Nweke (2015a) and Tindall (1975) reported that amaranthus required soil with high organic content which favoured the production of leaf number, leaf area and fresh weight. The main effect of compost and poultry amendments produced significantly greater plant height, stem girth, number of leaves, fresh and dry weight in poultry manure. Increase in productivity was obtained in different rates ($30tha^{-1}$, $20tha^{-1}$, and $10tha^{-1}$) of compost and poultry as well as NPK. Also, greater plant growth was recorded in the control of slope 3 more than in slope 1 and two. The increase in OC down the slope may be responsible for increased growth parameters witnessed in the control of slope 3. In slope 4 which is plain close to the stream, OM content may be higher than the upper slopes. Poultry manure recorded greater growth performance than compost and NPK.

Plant height, number of leaves, fresh weight and dry weight were significantly higher in poultry manure. The rates ($30tha^{-1}$, $20tha^{-1}$ and $10tha^{-1}$) of poultry manure amendments produced growth parameters higher than that of compost and NPK. The superiority of poultry manure over other organic manures has been confirmed by the works of Okoli and Nweke (2015b), Follet et al. (1995) and Hsich and Hsu (1993). Nweke et al. (2014) and Reddy and Reddi (1995) affirmed that poultry manure is an important source of plant nutrients and in addition to releasing nutrients to the soil, also improves the chemical and physical properties of the soil. The productivity of amaranthus in compost, poultry manure and NPK was increased in slope 4. Plant growth was observed to be higher in the control plot of slope 4 than what was obtained in the upper slopes. The increased growth as recorded in the control of slope 4 may be attributed to the lack of vegetation barriers which was as a result of poor land use leading to flooding which deprived the upper slopes (1, 2 and 3) of their nutrients status and deposited some of the nutrients in the lower slope such as slope 4 while carrying them into the streams where most of the nutrients were lost.

CONCLUSION

The findings from the study showed that productivity restoration of the degraded watershed recorded great significant improvement under poultry manure, NPK and compost manure in decreasing order of impact. Amendments of the upper slopes (slope 1 and 2) of the watershed were not as effective in compost manure and NPK respectively as in poultry manure, however compost manure and NPK fertilizer significantly increased number of leaves, leaf area, fresh weight and dry weight in leafy vegetable like the studied amaranthus in the lower slopes (3 and 4). The study have been able to show that with proper design management system, degraded lands can be rejuvenated, and reclaimed for sustainable crop production activities.

REFERENCE

Abdel – Mawgoud NHM, El-Desuki M, Salman SR and Hussein SD (2005). Performance of some snap bean varieties as affected by different levels of mineral fertilizers Journal of Agronomy 4: 242-247

AMA (2006). Anambra meteorological agency Annual Report P. 4

Bandyopadhyay PK (2003). Lime and magnesium induced yield of jute (Chorchorus capsularis) and nutrient availability in acid tarai soil of eastern India Food, Agriculture and Environment 1(3&4): 194-196

Cambardella CA, Moorman TB, Andrew SS, and Karlen DL (2004). Watershed scale assessment of soil quality in the loess hills of south west Iowa Soil Tillage Resources 78: 237-247

Fawusi MOA (1983). Quality and compositional changes in *Corchorus olitorus* as influenced by N fertilization and post-harvest handling Sciencia Horticulturae 21: 1-7

Follet RH, Murphy LS and Donahue RL. (1995). Fertilizer and soil amendments Prentice Hall Inc. Englewood Cliffs, USA Pp 250

Hsich CF and Hsu KN (1993). An experiment on organic farming of sweet corn and vegetable soya beans Bull Taichung District Agriculture 39: 29-39

Nweke IA, Okoli PSO, and Enyioko CO. (2014), Effect of different rates of poultry droppings and plant spacing on soil chemical properties and yield of cucumber. Elixir Journal of Agriculture, 70(2014): 23934-23940

Okoli, P. S. O. and Nweke, I. A. (2015a). Effect of Different Rates of Poultry Manure on Growth and Yield of Amarathus (Amarathus Cruentus). Journal of Agriculture and Veterinary Science (IOSR-JAVS) Volume 8(2): 73-76. DOI: 10.9790/2380-08227376

Okoli, P. S. O. and Nweke, I. A. (2015b). Effect of poultry manure and mineral fertilizer on the growth performance and quality of cucumber fruits, Journal of Experimental Biology and Agricultural Sciences 3(4): 362-367. DOI: http://dx.doi,org/10.18006/2015

Parffit RL (1978). Anion adsorption by soil and soil materials Advanced Agronomy 30: 1-50

Reddy TY and Reddi GH (1995). Principles of Agronomy 2nd edition Kalyani Publishers New Delhi 223pp

Relf D (2001). Reducing erosion and runoff, Virginia Cooperative Extension Blacksburg VA

Tindall HD (1975). Commercial vegetable growing Oxford Tropical Hand Book Oxford University Press 415pp

Tsai TC (1989). Regional agriculture and livestock complex farming Lumpei cattle faeces treatment centre an analysis of its input-output and management Division of Agriculture Economics Department of Agriculture and Forestry, Taiwan 99pp