635

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

FINAL REPORT

ON

INFLUENCE OF ORGANIC WASTE ON VEGETABLE PERFORMANCE AND HEALTHY LIVELIHOOD, MINNA NIGER STATE

PREPARED BY

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RESEARCH TEAM

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Submitted To the

Niger State Environmental Protection Agency (NISEPA), Minna

December 2013

Executive Summary

The increasing volume of waste generated, collected and disposed daily complicate adequate management of solid waste by relevant agency like Niger State Environmental Protection Agency (NISEPA). In addition, the impacts of waste on the natural environment and human livelihood require identification of cost-effective ways for sustainable municipal waste management in Nigeria. These signal the need for identifying environment-friendly initiative and local solution to address municipal solid waste problem for enhance environmental quality and human livelihood.

A research field was secured at Pago, Minna, Niger State which is located in the guinea savanna belt of Nigeria, within longitude located within longitude $6^{0}\ 36^{1}43^{11}$ - $45^{11}$and latitude $9^{0}\ 29^{1}$ 37.61^{11} - $.62^{11}$ N, Poultry droppings, decomposed household waste manure and NPK treatment were used. The experimental field was divided into three replications and four (4) treatments on each replication making a total of twelve (12) plots on the experimental field. The treatments were allotted using Randomized complete Block Design (RCBD).

The result depicts variation in plant height and number of leaves at 50% with different organic waste treatment. Poultry dropping records the highest height and number of leaves as waste manure competes fairly well with NPK fertilizer treatment. In addition, it was shown that the treatments do not devoid the concentrations of any nutritional components while the antinutritional analysis proved that NPK had higher oxalate content than control and organic treats.heavy metal reaffirms that lead and caldium are within safe limits while mercury is generally high beyond permissible value for the entire treatments.

Adoption of this organic manure for cultivation does not only enhance environment quality and attainment of food security but will contribute to local economic development, poverty alleviation and social inclusion as well as, healthy livelihood in particular. It's recommended to incooperate decomposed waste into inorganic manure and poultry dropping to minimize mercury levels in vegetable.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

LIST OF PLATE

1.0 INTRODUCTION

Globally, contemporary trend in population growth, urbanization, socio-economic development processes and civilization have led to increase waste generation in the urban cities. Since the creation of Niger state in 1976, the population of Minna have being increasing rapidly by 50% between 1976 to 1991 and 60% 1991- 2006, similar figures are recorded in most urban areas across the state. This coupled with the struggle for survival and increase in socio-economic development has amplified the rate of waste· generation, collection and disposal across the state. Generally, household waste form a larger proportion of waste generated across the state, accumulation of organic waste is an apparent problem and the existing dump sites could be overstress.

Generally, solid waste dumpsites serve as centres for incubation and proliferation of flies, mosquitoes and rodents which may constitute serious environmental and health problem to the inhabitant. This may perhaps lead to outbreak of epidemics and spread of infectious diseases resulting to spending valuable resource on drugs in addition to the huge amount of money budget for solid waste management annually. Vrijheid (2000) reported increase adverse health effects from residence near individual landfill sites. In addition, Salam (2010) reveals that both nearby and far away residences are affected by location of dumpsites close to settlement. Consequently, there is need to identify environment-friendly initiative such as waste reduction, reuse and recycling for solid waste in the state for effective solid waste management. Niger state has abundant arable land and water resources thus, should be one of the highest producers of agricultural crops in the country. However, the major challenge to agricultural sector today is loss of soil nutrient coupled with high cost of fertilizer.

Cultivation of crop in recent time particularly vegetables requires additional soil nutrient and mostly used are chemical fertilizers. Soil nutrient depletion, as a result of continuous cultivation is a major challenge to farmers (Okorie and Njoku 2013). Generally, increase use of this these chemical products have varying effects on the soil and is a threat to sustainability of soil components. Effects of chemical fertilizers in the soil lead to deterioration of the balance of the current element (Serpil 2012). Consequently, for high and sustainable quality of fruit yield and vegetables, the agronomic practices employed should be eco-friendly such that beneficial soil organisms would be safe and the management practices would go a long way towards helping stabilize vegetable production. Organic manure from different sources on the other hand helps in boosting vegetable crop growth, fruit and seed yield and quality as they contain most of the nutrients essential for plant growth and development (Mishra and Ganesh, 2005). Hence, adoption of this waste for agriculture will improve community economic well-being and sustainable livelihood across the state.

1.1 Aim of the Study

The aim of the study is to assess the effect of nutrient sources/eco-agriculture on fruit and vegetable performance and its anti-nutrition component for healthy livelihood and as an environment-friendly strategy for solid waste management.

Objectives are:

- To assess the effect of organic waste on vegetable yield (okra, tomatoes and garden egg)
- Determine the antinutritional component of varying nutritional sources
- Examine the effect and suitability of nutrient source on human health

1.3 Statement of Problem

The increasing volume of waste generated, collected and disposed daily complicate adequate management of solid waste by relevant agency like Niger State Environmental Protection Agency (NISEPA). Use of organic amendment applied to soil not only enhance the nutrient status but also reduce the pest incidences (Esawy, 2008). Consequently, the need to identify cost-effective environment-friendly initiative for reducing and reusing vast proportion of solid waste generated in the state for enhance livelihood and attainment of food security.

1.4 Justification of Research Problem

The wide spread dumpsite across the State may constitute environmental hazard to the local community; apparently no inhabitant will want landfill, dumpsite, incinerator, composite plant in the neighbourhood. Despite the fact that Niger State has abundant landmass, there will be a time that the State will run out of dumpsite. Then, the questions are; do will leave until vast proportion of arable land to dumpsites? Or allow the valuable resources to be spent on waste management/health problems resulting from increasing dumpsite?

The increase in the rate of waste generation signals the need for identifying local solution to address municipal solid waste problem as well as improve farmer's soil nutrient need through development of strategies for sustainable environmental protection, food security, and poverty eradication for attainment of sustainable development. Today, the major challenge of agriculture is loss of soil fertility, this compel the farmers to use fertilizers which as a result of poverty is rarely available and it prolong utilization may constitute hazard to the natural environment. Despite the importance of inorganic manures, its use is limited due to scarcity, high cost, nutrient imbalance and negative residual effects on soils (Akande *et al.*, 2010). Consequently, assessment of the effect of nutrient sources on vegetables performance is

2.0 SOLID WASTE GENERATION, IMPACT, AND CHALLENGES IN DEVELOPING NATIONS

In Minna, urbanization is putting immense pressure on municipal waste management services thus; sustainable management of solid waste has being a major concern of the agency. Municipal solid waste management constitutes one of the most crucial health and environmental problem facing African cities (Rotich *et.al* 2006 Kadafa *et.al* 2013). In developing countries the rapid population, industrialization, urbanization and growth of economic contribute to increasing solid waste (SW) generation (Latifah et.al 2009 and Yeny and Yulinah 2012). In addition, Tenbi and Mardina (2002) reveal that for over the past two to three decades, rapid industrialization and economic development have caused a tremendous increase in solid waste generation. Similarly, (Babayemi and Dauda 2009) indicates that the quantity and generation rate of solid wastes in Nigeria have increased at an alarming rate over the years with lack of efficient and modern technology for the management of the wastes. Generally, Population growth rate in Africa is greater than in other regions of the world, this with attendant urbanization, increase socio-economic activities have aggravate solid waste generation. Most of municipal solid waste comes from residential areas, commerce and other sources (Shekdar2009). In addition, Rotich et.al (2006) identified that main component of solid waste is decomposable organic waste which has a range of 42% to 80.2%. The waste aggregate necessitate the identification of environment-friendly initiatives for effective solid waste management at individual and community level.

Martin (2010) concludes that insufficient collection and inadequate disposal generate significant pollution problems and risks to human health and the environment. The current practice of the illegal dumping of solid waste on the river banks has created a serious environmental and public health problem (Pokhrel and Viraraghavan 2005). Illegal dumping of house hold waste is a common feature in most cities across the country which has continues to complicate waste management problems. Nigatuet.al (2011) relates that solid waste creates health and environmental problems in Addis Ababa, due to proper waste management. One of the most important environmental problems in cities is the production and containment of urban solid waste (Buenrostro and Bocco 2003 Pokhrel and Viraraghavan 2005). The ever-increasing rate, volume of waste generation and its impacts on the natural environment and human livelihood require identification of cost-effective ways for sustainable municipal waste management in Nigeria.

The complexity of solid waste generation is a challenge for waste managers particularly in developing countries (Agamuthu et.al 2009). Growth in urbanization Municipal solid waste services are becoming one of the most challenges which if not properly and sustainably dealt with will adversely impact all other development sectors (Imad 2011 and Dong et.al 2010). Moreover, Kadafa et.al (2013) concluded that municipal solid waste management is a serious issue due to its human health and environmental sustainability implications, which has yet to be properly addressed within the FCT Abuja. Solid waste generation and its implication for people and the environment are critical issue for sustainable livelihood. Accurate prediction of waste generation trends facing many fast-growing regions is quite challenging (Brain and Ni-Bin 2005). Hence, its vital to identify the best approach for dealing with solid waste through sustainable management approach that ensures the good health of the society and the environment as well as the active participation of the society.

648

3.0 MATERIALS AND METHODS

An experimental farm was secured by Niger State Environmental protection Agency (NISEPA) at Pago, Minna Niger State for the research and the study was carried out in collaboration with Environmental Management Programme, Department of Geography Federal University of Technology.

3.1 Study Area (Location)

This study was carried out on a research field at Pago, Minna, Niger State which is located in the guinea savanna belt of Nigeria, within longitude located within longitude 6^0 36^143^{11} - $45^{11}$and latitude $9^0\,29^1\,37.61^{11}$ - $.62^{11}$ N (Fig.3.1). Pago is a small Gbagyi settlement characterized with about six months of dry season and six months of rainy season, the annual rainfall has been estimated to be between 1200mm and 1300mm.The temperature is generally beyond 27^0 Celsius and relative humidity is about 80% during the rainy season. The cultivation was done during dry weather condition (Table 3.1); low relative humidity, high temperature and little or no rainfall condition (dry season farming).

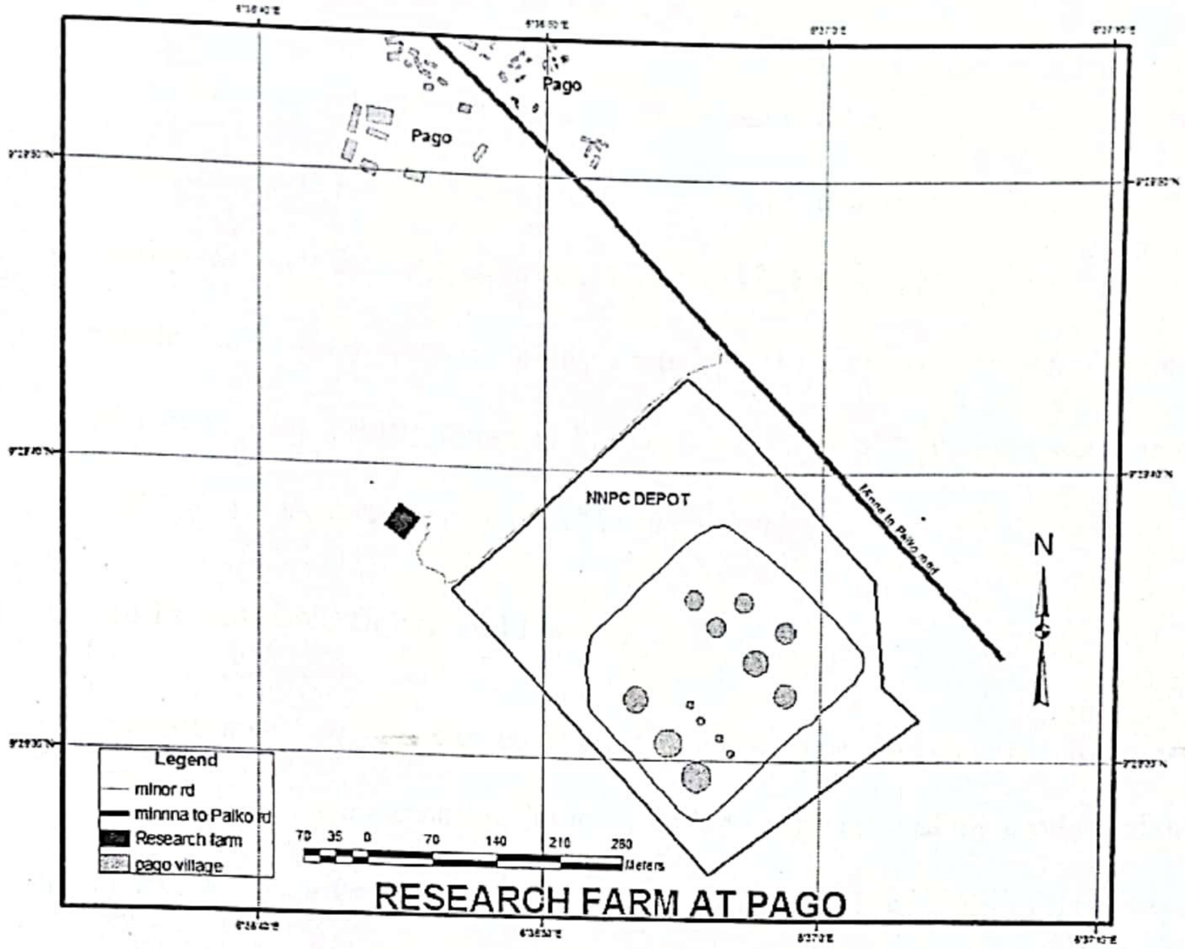


Fig. 3.1 Research Farm

Table: 3.1 Weather condition September – December 2012

Months	Relative humidity (%)	Temperature (C)	Rainfall (mm)
September	82	29.8	339.2
October	76	31.7	158.0
November	58	35.5	0
December	22	36.4	0

3.2 Source of Planting Materials and Organic Waste

Seeds of three vegetable landraces: *Hibiscum esculantun* (okra), *Lypersicum esculantun* (Tomatoes) and *Solanum indicon* (Garden egg) were sourced from farmers around Minna. Tomatoes and garden egg nurseries were established on 1st October 2012 to provide seedlings for transplanting after three weeks. Poultry droppings (P) were collected from Yandeyi commercial battery cage poultry house at Pago and decomposed household waste manure was collected from refuse dump sites within Minna Township.

3.3 Land Preparation, Design and Planting

The experimental site was cleared of vegetation using hoes and cutlasses. Ridges were constructed 75cm apart each measuring 2m long. Each plot comprise of eight ridges giving a unit area of $10.5m^2$. Okra was planted on 23rd October 2012 and seedlings of tomatoes and garden egg were transplanted on 24th October 2012. The experimental field was divided into three replications and four (4) treatments on each replication making a total of twelve (12) plots on the experimental field. The treatments were allotted using Randomized complete Block Design (RCBD).

3.4 Treatment Experimental Design and Sowing

The study is a Fertilizer by Variety factorial experiment with four (4) treatment combinations. The four treatments used in the study are;

i 8 tons of poultry manure/ha (P8)

ii 8 tons of house waste manure/ha (HW8)

iii NPK fertilizer (100 kg/ha N, 50 kg/ha P_2O_5 and 50 kg/ha K_2O) (F)

iv NO Manure and no fertilizer (control) (C)

3.5 Organic manure incorporation

Two weeks prior to sowing, properly cured organic manures (poultry droppings and house waste manure) were incorporated into the ridges manually, following which the seeds were sown to plant spacing of 50cm on ridges made 75cm apart for okra, tomatoes and garden egg.

3.6 Agronomic Practices

Manual weeding was done manually at three (3) weeks after sowing for all the vegetables. Fertilizer application was done immediately after weeding for the concern plots. The rate of 8 t ha^{-1} of organic manure was used in this study based on the recommendations of 5-6 t ha^{-1} and 5 t ha^{-1} giving by FAO (1992) and Alasiri and Ogunkeye (1999) respectively. Also the recommendation of 100kg N ha^{-1}, 50kg P ha^{-1}, 50kg K h¯1given by Zubairu *et al.* (2009), was used for the fertilizer treatments. The control plots did not receive neither organic nor inorganic fertilizers.

3.7 Irrigation

Irrigation was adopted using watering cans to supply water requirement of the vegetables after cessation of rain.

3.8 Soil and Organic Manure Analysis

Soil samples were collected, air dried and sieved and then analyzed for some chemical and physical properties using standard laboratory methods. Data was obtained on pH, percentage of organic matter, total nitrogen, available phosphorus (ppm), percentage sand, silt and clay, exchangeable Na^+, K^+, Ca^{2+} and Mg^{2+}. to ascertain the type and status of the soil of the experimental site prior to the study.

Similarly, the poultry droppings and house waste manure used were also analyzed for Mn, Fe, Cu, Zn, available P, Ca, Na, K and Mg constituents before their incorporation into the soil to ascertain their initial status (contents).

3.9 Plant growth and Yield Assessment

Data was collected on plant height and number of leaves at 50% flowering. In addition, species yield weight was determined after each harvest from the four middle rows for each plot, this was done using a salter balance for fruit yield capability for five consecutive weeks during harvest.

3.10 Determination of Nutritional and Anti-nutritional component

The yield samples were subjected to proximate analysis to determine the nutritional and anti-nutritional component.

3.11 Statistical Analysis

Data collected was analyzed using SPSS software and Randomized complete Block Design means were compared.

4.0 RESULT AND DISCUSSION

4.1 Chemical Properties of Soil and Organic Waste

The chemical properties analysis showed that soil of the study had low organic carbon/ total nitrogen content and the general nutrient composition of the soil is less than those of organic waste added (Table 4.1).

Table: 4.1 Chemical Compositions of Soil and Organic Waste

Samples	Soil	Poultry Dropping	Decompose Waste
O/C / TN %	.20/.26	.48/.40	.32/.2
P (mg kg)	11.77	15.0	14.68
Na^+	.12	.31	.21
K+	.19	.34	.38
Mg+	.99	.75	1.84
Ca+	.49	.88	.96
pH/H_2O $CaCl$-1_2	6.0/5.3	-	6.0/4.2

The soil composition is about 80.6% sandy, 7.1% silt and 12.3% clay and textural class is sand-loamy while decomposed waste had 75% sandy, 8.3% silt and 16.3% clay also the textural class is sand-loamy (Table 4.2).

Table 4.2 Composition of Soil and Decomposed Waste

Soil Composition	Sand	Silt	Clay	Texture
Soil	80.6%	7.1%	12.3%	sand-loamy
Waste	75.3%	8.3%	16.3%	sand-loamy

4.2 Assessment of Vegetable Growth

Field experiment conducted between September and December 2012 unveil the efficacy of various growth performances and nutritional composition of some vegetable. Comparison Vegetable height and number of leaves at 50% flowering depict variation in plant height and number leaves with different organic waste treatment. Poultry dropping records the highest height and number of leaves. Waste manure competes fairly well with NPK fertilizer treatment while control records the lowest height and least no of leaves (Fig. 4.1 and 4.2).

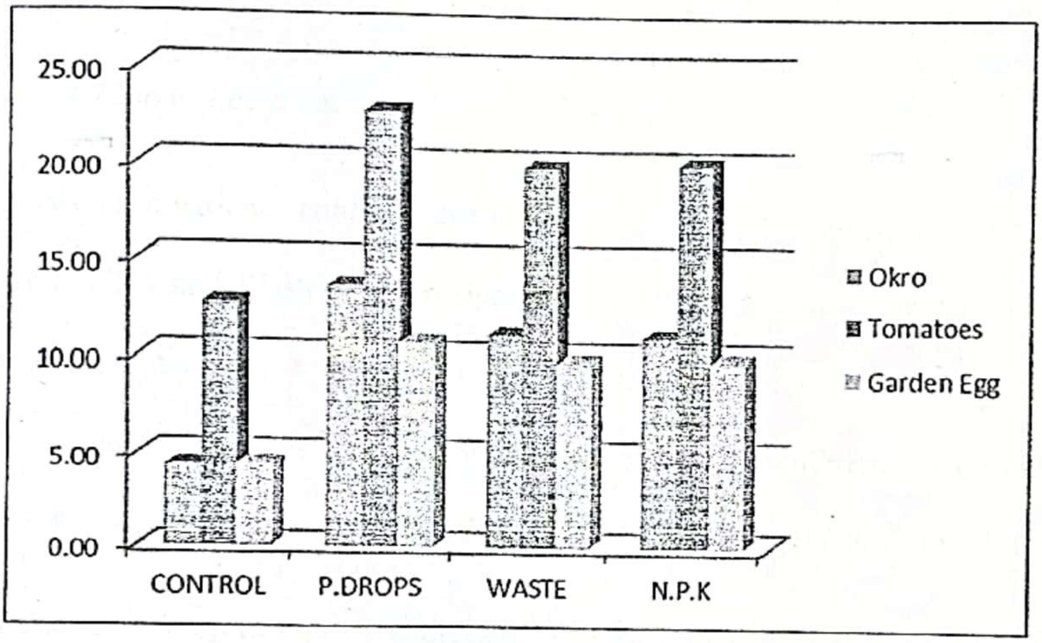


Fig.4.1 Vegetable Height at 50% Flowering

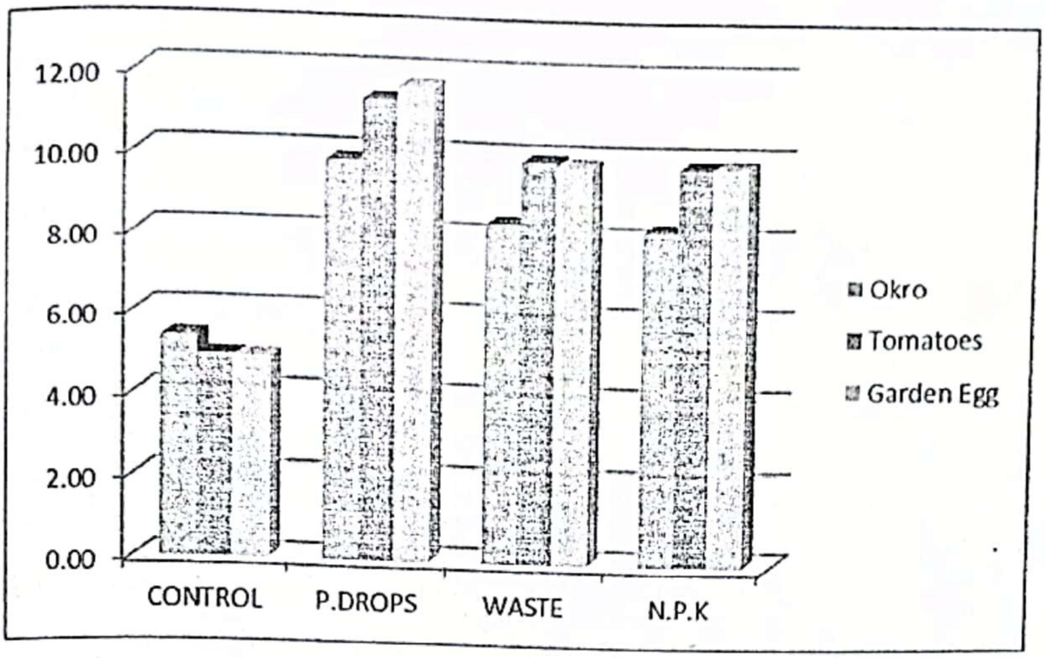


Fig. 4.2 No of Leaves at 50% flowering

Analysis of variance confirms that poultry droping have signicantly higher height than others while NPK and Waste have no significant differences in height as control had significantly least height (Table 4.3). Similar result is recorded for leave concentration; poultry have significantly higher leave concentration, no significant sifference between waste and NPK and conrol had the least number of leaves for the three vegetables(Table 4.4).

Table 4.3 Effects of nutrient sources on plant heights

Treatment	Okra	Tomato	Garden egg
Control	4.4 ± 0.1[c]	12.8 ± 0.6[c]	4.5 ± 0.2[c]
Poultry dropping	13.7 ± 1.9[a]	22.8 ± 0.3[a]	10.8 ±0.4[a]
NPK	11.1 ± 0.6[b]	20.1 ± 0.9[b]	9.8 ± 0.2[b]
Waste	11.2 ± 0.5[b]	19.9 ± 0.8[b]	9.7 ±0.2[b]

Means followed by the same letter in a column are not significantly different at p=0.05

Table: 4.4 Effects of nutrient sources number of leaves per plant

Treatment	Okra	Tomato	Garden egg
Control	5 ± 0.1^{c}	5 ± 0.1^{c}	5 ± 0.3^{c}
Poultry dropping	10 ± 0.2^{a}	12 ± 0.6^{a}	12 ± 0.5^{a}
NPK	8 ± 0.2^{b}	10 ± 0.1^{b}	10 ± 0.1^{b}
Waste	8 ± 0.5^{b}	10 ± 0.2^{b}	10 ± 0.1^{b}

Means followed by the same letter in a column are not significantly different at $p=0.05$

4.3 Vegetable Yield Assessment

Generally, nutrient treatments significantly increase vegetable yield, as the conrol (non treatment) records the least yield for the three vegetables; 5.90, 48.67 and 23.09 in that order for okro, tomatoes and garden egg (Fig. 4.3). Poultry dropping treatment records the highest yield for the three vegetables; 39.94, 189.19 and 263.13kg/hec respectively for okro, tomatoes and garden egg. However, despite the apparent competition of vegetable height and number of leaves at 50% flowering between waste and NPK treatment, there is significant difference between yield of the two treatement. Decomposed household treatment records significantly higher yield than NPK. The visualization of the vegetable yield under varying treatment confirms that fact additional nutrient application significantly increase vegetable yield (plate 1). Therefore, the result reaffirms fact that the soil of study area cannot give significantly reasonable yield to support local farmers livelihood without treatment thereby, endangering sustainable socio-economic development and attainment of food security.

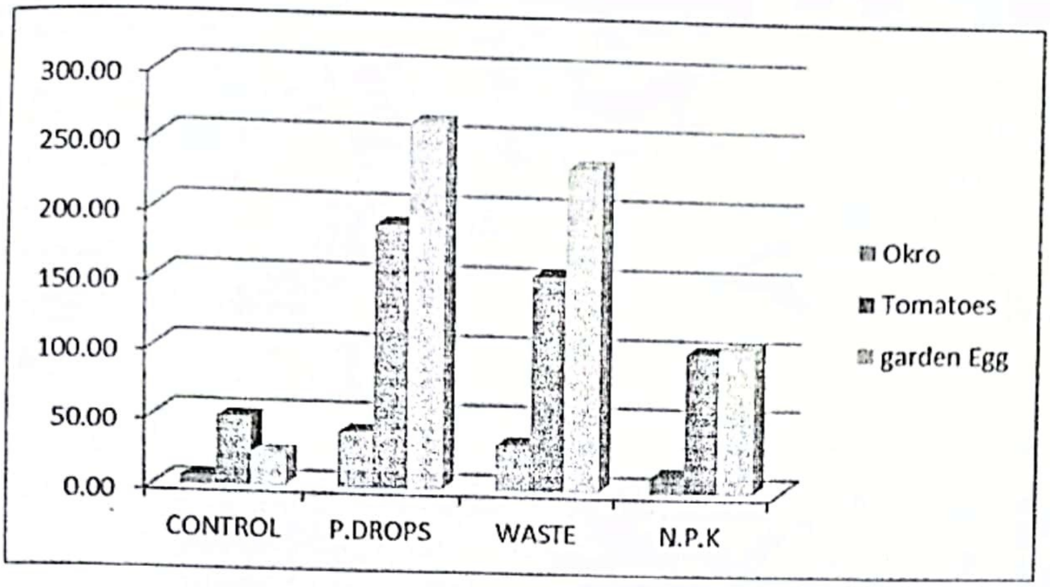


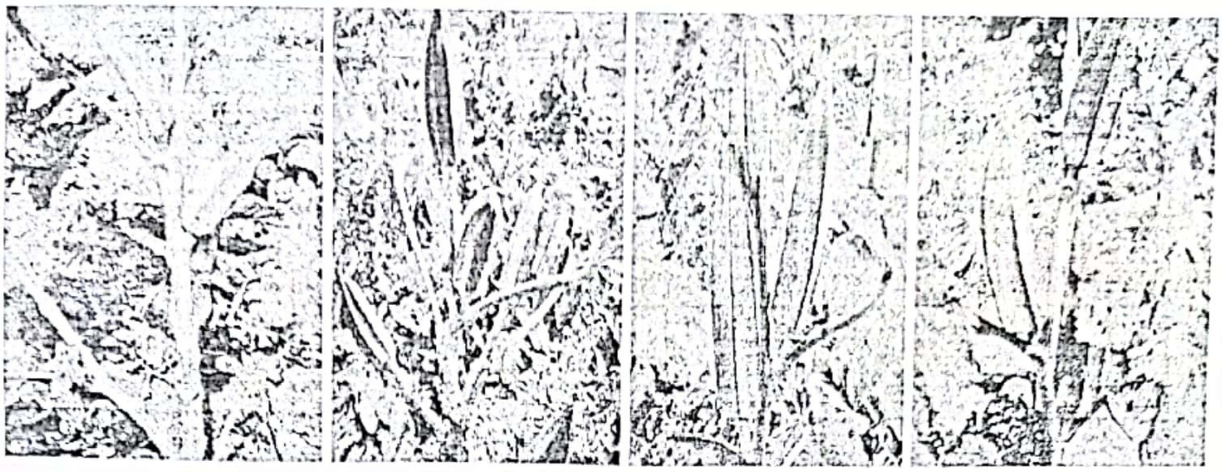
Fig.4.3 Mean Vegetable Yields (Kg/hec)

The variance analysis reaffirms the fact that additional nutrient treatment is inevitable for cultivation of vegetables and mostly significantly poultry dropping have significantly higher yield, followed by waste treatment which record significantly higher yield than NPK and control significantly records the least yield (Table 4.5). This indication that additional treatments produced significantly higher yield and justify the adoption of chemical fertilizer for cultivation in recent term despite the fact that organic treatment (poultry and waste) have significantly higher yield.

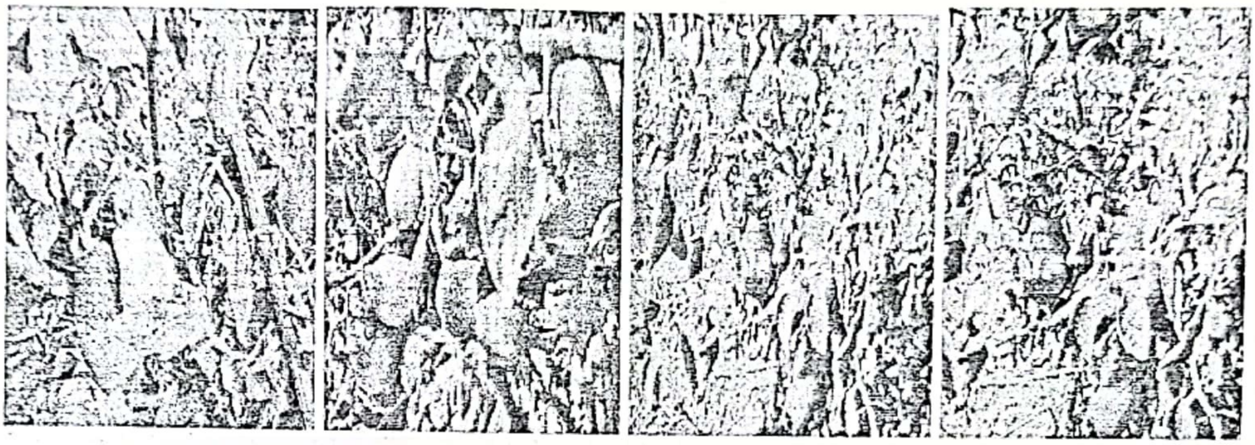
Table: 4.5 Effects of nutrient sources on yield

Treatment	Okro	Tomato	Garden egg
Control	5.9 ± 3.8^{d}	48.7 ± 7.2^{c}	23.1 ± 6.9^{b}
Poultry dropping	39.9 ± 3.2^{a}	189.2 ± 21.3^{a}	263.1 ± 74.9^{a}
NPK	12.0 ± 2.1^{c}	101.5 ± 18.2^{b}	105.2 ± 56.7^{b}
Waste	33.0 ± 2.3^{b}	155.3 ± 35.4^{a}	232.8 ± 110.3^{a}

Means followed by the same letter in a column are not significantly different at p=0.05



Control Poultry Waste NPK



Control Poultry Waste NPK

Control Poultry Waste NPK

Plate 1 Vegetable Yield under Varying Treatment

4.4 Nutritional Component Assessment

Proximate analysis of the vegetable nutritional component reveals the mean and standard deviation of the samples nutritional content from varying treatment (Table 7). Okra moisture content analysis indicates that poultry and waste treatment sample had no significant differences in there moisture content and have significantly less moisture content with standard deviation within ± 1. The protein content of okra had no significant difference for the three samples while control had significantly had high protein content. Similarly, waste treatment sample had higher fibre content than the other three samples which had no significant difference in their content. There is no significant difference between the ash content of the control, waste and poultry treatment samples but NPK had significant less ash content. Carbohydrate content varies with varying treatment, though control had significantly less carbohydrate content. Interestingly, Vitamin A content of poultry dropping and waste treatments are higher and differs significantly with control and NPK. Apparently, NPK treatment sample had the least vitamin A content. Also, there no significant differences between Vitamin C content of control, poultry dropping and waste while NPK had significantly higher vitamin C content than other samples. Generally, the treatments do not deny the samples concentration of any of the nutritional components as it's only the amount that varies.

Table 4.6: Okra Nutritional Contents Variance

Nutritional Components	Control	Droppings	Waste	N.P.K
Moisture	88.9250 ± 0.5529^{a}	87.5500±0.4622^{b}	87.2500±0.6008^{b}	88.2750±0.5864^{c}
Proteins	5.4675 ±0.3691^{a}	5.1250 ±0.2091^{b}	5.0392 ±0.1913^{b}	5.2367 ±0.3045^{a,b}
Fibre	3.5975±0.2905^{a}	3.7033±0.3108^{a}	4.1042±0.1541^{b}	3.4900±0.2798^{a}
Fat	0.1183±0.0134^{a}	0.1642±0,0300^{b}	0.1525±0.0280^{b}	0.1475±0.0253^{b}
Ash	0.2025 ±0.0160^{a}	0.1900±0.0181^{a}	0.2092±0.0211^{a,b}	0.1800±0.0209^{b}
Carbohydrate	1.6608±0.3735^{a}	3.2400±0.6260^{b}	3.3675±0.7257^{c}	2.5925±0.5228^{c}
Vitamin A	226.2850±37.3931^{a}	350.9825±43.0646^{b}	377.6075±48.6843^{b}	192.8450±70.0424^{a}
Vitamin C	8.1900±0.7901^{a}	8.8933±0.5246^{a}	8.9150±0.6839^{a}	10.3117±0.9028^{b}

Means followed by the same letter in a row are not significantly different at p=0.05

Tomatoes proximate analysis (Table: 4.7) indicates no significant differences in the moisture content of the three treatments while control had significantly less water content. Similarly, there is no significant difference between protein content of waste and NPK treatment samples as control had significantly higher protein content. Control sample had significantly higher fibre content, there is significant difference between poultry and waste fibre content while NPK had significantly less fibre content. Generally, there is no significant difference in the fat and vitamin A content of the four samples. Ash analysis signifies that there is no significant difference in poultry and waste treatment ash content as NPK significantly contains least ash content. Similarly, carbohydrate content analysis of control, poultry dropping and waste treatment sample indicates no significant difference whereas NPK significantly contain least carbohydrate content. Vitamin C proximate analysis reveals no significant differences between poultry and waste treatment samples while NPK contains significantly higher vitamin C content. Fundamentally, the high nutritional content of organic waste reveals the need for it's adopted for enhance livelihood.

Table 4.7: Tomatoes Nutritional Contents Variance

Nutritional Components	Control	Droppings	Waste	N.P.K
Moisture	87.1633 ± 0.7743^a	91.2617 ± 0.8671^b	90.7242 ± 0.7167^b	91.5717 ± 1.7485^b
Proteins	5.4283 ±0.6336^a	2.3492 ±0.1891^b	3.1325 ±0.2881^c	2.8083 ±0.2823^c
Fibre	4.1467±0.1201^a	3.3450±0.1930^b	3.2275±0.1812^b	1.7950±0.2610^c
Fat	0.1975 ±0.0142^a	0.3917±0.5891^a	0.2250±0.0193^a	0.1992±0.0162^a
Ash	0.2100±0.0222^a	0.1708±0.0222^b	0.1942±0.0363^{a,b}	0.1108±0.0257^c
Carbohydrate	2.7983±0.7410^a	3.4825±1.8364^a	2.6358±1.1225^a	1.3075±0.6365^b
Vitamin A	273.2683±46.1867^a	260.8675± 79.8738^a	244.2950± 76.1443^a	261.4067± 94.4877^a
Vitamin C	2.6675±0.2660^a	2.1275±0.0955^b	2.2583±0.0827^b	3.0925±0.0875^c

Means followed by the same letter in a row are not significantly different at p=0.05

Garden Egg proximate analysis (Table: 4.8) demonstrate a significant difference in the moisture content of poultry and waste treatment samples as NPK had significantly least moisture content. Protein content analysis shows that there is no significant difference between control and NPK. Also, there is significant difference in fibre and ash content of control, waste and NPK treatments when poultry dropping had least fibre content. Furthermore, there is no significant difference in fat and vitamin A content of the four samples. Similarly, there is no significant difference in the carbohydrate and vitamin C content of control, poultry, and waste treatment samples whereas NPK significantly contains high carbohydrate and vitamin C content. Fundamentally, the treatments do not devoid the concentration of any nutritional components.

Table 4.8: Garden Egg Nutritional Contents Variance

Nutritional Components	Control	Droppings	Waste	N.P.K
Moisture	90.1625 ± 0.4107[a]	91.6150 ± 0.7999[b]	91.3225 ± 1.2891[b]	88.6042 ± 1.1543[c]
Proteins	4.4100 ± 0.2107[a]	3.3450 ± 0.5440[b,c]	3.7908 ± 0.7638[a,c]	4.4875 ±1.1159[a]
Fibre	3.2058 ±0.1613[a,c]	2.5275 ±0.3792[b]	3.1150 ±0.2906[a,c]	3.5283 ±0.2872[a]
Fat	0.3600±0.5737[a]	0.2192±0.0178[a]	0.2142±0.0268[a]	0.2017±0.0212[a]
Ash	0.1650±0.0183[a]	0.1275±0.0365[b]	0.1675±0.0201[a]	0.1825±0.0186[a]
Carbohydrate	1.9050±0.2554[a]	2.1775±0.5319[a,b]	2.1300±0.6796[a]	3.0225±1.3183[b]
Vitamin A	286.1600±104.4793[a]	302.0800±116.2287[a]	266.3133±99.6796[a]	298.5225±128.5362[a]
Vitamin C	1.7700±0.6097[a]	1.8625±0.1941[a]	1.6725±0.1946[a]	2.5600± 0.1792[b]

Means followed by the same letter in a row are not significantly different at p=0.05

4.5 Anti-Nutritional Component Analysis

The anti nutritional component analysis (Table: 4.9) unveils varying level of oxalate concentration in the four samples; Okra depicts no significant difference in oxalate content of the three treatment samples while control contain significantly least oxalate content. Also, there is no significant differences between tomatoes poultry and waste treatment samples oxalate content when control contains significantly least content and NPK had significant higher oxalate content. Finally, garden egg proximate analysis shows no significant differences between control, poultry and waste treatment samples as NPK contains significantly higher oxalate content. Consequently, it is proved that NPK had higher oxalate content than control and organic treats.

Table:4.9 Antinutritional Components Variance

Vegetables	Control	Droppings	Waste	N.P.K
Okra	5.6500±0.3098^{a}	8.2092±0.0602^{b}	8.1475±0.0741^{b}	8.1450±0.1377^{b}
Tomatoes	6.7350±0.2594^{a}	7.2817±0.1849^{b}	7.2525±0.0682^{b}	7.5675±0.0974^{c}
Garden Egg	7.4250±0.2386^{a}	7.3692±0.1914^{a}	7.3875±0.2200^{a}	8.3308±0.2424^{b}

Means followed by the same letter in a row are not significantly different at p=0.05

4.6 Vegetable Uptake of Heavy Metals Analysis

The four treatments in this study which include; control, house waste, poultry droppings and NPK have the essential plant growth and development nutrients as well as other elements in different concentrations. Their nutrient concentrations has been shown (Table 4.1), where the organic carbon/total nitrogen, P, Na^{+}, K^{+} and Ca^{+} compositions of the poultry droppings and decompose waste were higher than that of the soil (control) except for Mg^{+}, and $CaCl_2$ that were higher in the control than decompose waste. Hence, when applied to the soil, they can either act antagonistically or synergistically or rarely have no effect on the levels of heavy metals present in that soil and that will eventually be taken up by the vegetables. This action lies in the ability of these nutrients to chelate and form compounds with heavy metals making them unavailable or more available.

Table 4.10: Mercury, Cadmium and Lead Concentration variance in Tomato

Treatments	MERCURY	CADMIUM	LEAD
Control	2.504 ±0.0002^{a}	0.000 ± 0.0001^{a}	0.023 ± 0.0005^{a}
Waste	3.129 ±0.0001^{b}	0.000 ± 0.0001^{a}	0.000 ± 0.0003^{b}
Poultry Droppings	1.829 ± 0.0001^{c}	0.000 ± 0.0001^{a}	0.000 ± 0.0001^{b}
NPK	1.537 ± 0.0002^{d}	0.000 ± 0.0001^{a}	0.000 ± 0.0003^{b}

Mean followed by the same letter in a column are not significantly different at p=0.05

In the tomato plant treatments (Table 4.10), the mercury levels in tomato were significantly higher than the cadmium and lead levels for all the treatments. This could be attributed to existing presence of mercury in the soil probably due to washing down of mercury from rock to the farm area or accumulation of waste overtime that was absorbed by the soft tomato tissues. Across the treatments, the mercury levels in the vegetable from the waste treatment was significantly higher at a mean value of 3.129 ppm when compared to the control (2.504 ppm), poultry droppings (1.829 ppm) and NPK (1.537 ppm) levels. The control treated tomatoes having this level of mercury (2.504ppm) clearly indicate that the soil has been contaminated before the experiment. Also higher level of mercury in the waste treated tomato is indicative of the presence of mercurial waste which added to the soil has synergistically increased the level of mercury taken up by the plant. No cadmium was found between the treatments inferring that the soil and the other forms of treatment have level of cadmium below detection. Mean lead level of 0.023ppm was obtained in the control tomato alone. Its absence in the other treatments indicates an antagonistic reaction probably due to metal chelating that has made the lead unavailable. It can also be attributed to the plant absorbing its element majorly from the nutrients in the organic (waste and poultry droppings) and inorganic (NPK) manures, thereby reducing the chances of contamination from the soil. Meanwhile sampling done in Borno state by Amin *et al.* (2013) reported 0.1332ppm of both lead and cadmium in tomato samples.

Table 4.11: Mercury, Cadmium and Lead Concentration Variance in Garden Egg

Treatments	MERCURY	CADMIUM	LEAD
Control	3.894 ± 0.0005^{a}	0.000 ± 0.0006^{a}	0.000 ± 0.0002^{a}
Waste	6.791 ± 0.0020^{b}	0.001 ± 0.0002^{b}	0.054 ± 0.0002^{b}
Poultry Droppings	1.764 ± 0.0002^{c}	0.000 ± 0.0003^{a}	0.000 ± 0.0002^{a}
NPK	1.606 ± 0.0002^{c}	0.000 ± 0.0006^{a}	0.046 ± 0.0004^{c}

Mean followed by the same letter in a column are not significantly different at p=0.05

The garden egg vegetable followed a similar trend of higher level of mercury (1.606-6.791ppm) than cadmium (0.000-0.001ppm) and lead (0.046-0.056ppm) for all treatments. The deviation from the trend in tomato treatments is in the presence of 0.001ppm of cadmium in the plant treated with waste and the presence of 0.046ppm and 0.056ppm of lead for waste and NPK treated garden egg respectively. Amin *et al.* (2013) reported 0.1401ppm of Cadmium in unwashed garden egg and 0.1261ppm when it was washed they added that Cadmium accumulates in many agricultural crops mainly as a result of the use of sewage sludge or phosphate fertilizers. Cadmium has also been reported to destroy biological membranes and cause uncontrolled uptake of metal from soil to plants (Sarwar, *et al.,* 2010). The low level of cadmium reported in this study indicates that the biomembranes may not have been damaged in these crops.

In addition, Orisakwe *et al.*, (2012) reported levels of 0.80ppm, 0.35ppm, 0.03ppm for Pb, Cd and Hg respectively for garden egg planted in southern Nigeria sites these levels are higher than their corresponding maximum permissible levels. Muhammed and Sharif (2011) in Kano state also reported lead levels upto 0.048 mg/g in the leaves of *Vernonia amygdalina* to 0.119mg/g in the leaves of *Cassia tora* both being edible vegetables, they also quoted Asaolu and Asaolu's (2010) report of low cadmium concentration of 0.014mg/g in the leaves of *Corchorus olitorius* and Sobokola *et al.* (2010) mean *Vernonia amygdlina* Cd concentration of 0.0006mg/g. This low cadmium trend is similar to that in our finding. Occurrence data for the three EU member countries; France, Germany and UK reported in SCOOP (2004) indicated mercury levels ranging from 0.0006-1.17 µg/g. In comparison, our findings present higher values normalizing the units. SCOOP also reported lead levels in vegetable from eleven EU member states between 0.004 and 0.6 µg/g, this is similar to our findings thereby confirming that lead and cadmium concentration in the entire treatment is safe for consumption and healthy livelihood.

Another toxicological perspective is to view these values from their allowable intake levels. In the year 2004, the European Commission SCOOP report decided a Provisional Tolerable Weekly Intake (PTWI) of 0.005 mg/kg bodyweight for total mercury. This equals to 0.35 mg/week for a person weighing 70 kg. The average intake of total mercury by an adult in the EU Member States is, calculated to be 0.00553 mg/day, which is equal to 0.0387 mg/week this has placed the EU member states within a safe limit for Hg consumption from vegetable source. In the case of our study, if we are to adopt the FAO/WHO dietary goal recommendation on the consumption of 400g/day (2800 mg/week) vegetable, per week, we will then be consuming;

(Mass of Metal that will be consumed weekly can be obtained by = (Xmg/1Kg) *(2.8kg)

Where "X" is the concentration of Metal present in every one Kg of Vegetable)

8.9572 mg/week, 13.888 mg/week, 5.0316 mg/week and 4.4016 mg/week of mercury from control, waste, poultry droppings, and NPK treated vegetables respectively. These figures are alarming and require urgent intervention with respect to mercury levels in soil and manure in order to mitigate its toxic effect.

A PTWI of 0.025 mg/kg (25 μg/kg) bodyweight has been decided for lead. This is equal to 1.75 mg/week (1750 μg/week) for a person weighing 70kg. The average intake of lead by adults in the EU Member States is, according to current information is 42 μg/day which is equal to 296 μg/week. Also, PTWI for cadmium was set at 0.007 mg/kg bodyweight. This is equal to 0.49 mg/week (490 μg/week) for a person weighing 70 kg. The average intake of cadmium by an adult in the EU Member States is 14.4 μg/day, which is equal to 101 μg/week (range 2.73- 176μg /week). This corresponds to 0.52 – 38.2% of the PTWI, assuming an average weight of 70 kg for a Member State adult (EU SCOOP report, 2004). Are our values still within safe limit?

4.7 Discussion

The experiment reveals that soil treatment is crucial in recent time as increase human pressure on available soil resource have led to soil degardation, coupled to the fact that shifting cultivation is imposible and bush fallow system is unsustainable due to increase population and need for expansion of farm land due to availablity of herbicides and pesticides. Consequently, continuous cultivation is on increase as a piece of land is cultivated year after year leading to low yield that distinctive of agricultural pratices in recent times. As a result, there is need for environment-friendly initiatives towards proper soil management and consrevation for continuous cultivation and higher yield such that will balance the delicate equilibrum in soil composition. Additions of organic manures result in increased soil organic matter content (Alabandan *et al.,* (2009), Haynes & Naidu (1998) and Mbah et.al. (2011)).

These growing environmental challenges have led to increase interest in identification of environment- friendly measures that will enhance environmental sustainability such that will convert waste to resource particularly in tropical countries where the high temperature and rainfall will favour organic decomposition. The productivity of vegetables in Nigeria is much lower than the potential productivity because of the indiscriminate use of inorganic fertilizer with resultant deterioration of soil health (Achieng *et al.*, 2010). The higher vegetable performance and yield recorded with poultry dropping and waste treatment in the present research ascertain the fact that waste and poultry dropping treatment does not only competes favourably with chemical fertilizer but increase vegetable performance and yield than NPK. This finding is in agreement with Ghosh et.al (2004) who observed that organic manures played an important and significant role in increasing yield. As well as, indicating that available soil need additional treatment for any meaningful yield since control record lowest height, least leave concentration and yield. Vegetables can be grown on a wide range of soil types, their yield is known to be mostly limited by soil fertility and cultural management (Mbah *et al.*, 2009). Specifically, poultry and waste treatments vegetable height and leave concentration demonstrated that these treatments could be an economical alternative to chemical fertilizer that is commonly used across the state.

The nutritional component analysis depicts variability in the nutrition composition with varying treatment however, treatments does not devoid vegetable samples availability of any nutrition component. By implication the four samples still contain all the necessary nutritional components but in most cases poultry and waste treatments samples compete very well with control and at times have higher nutritional content specifically, control, poultry and waste often have higher fibre content than NPK treatment. Generally, the entire samples have high moisture content of above 90% to 87%, highest protein content of about 5% is recorded for okra, fat and ash content is generally less than 1%, carbohydrate content ranges from about 1-3% an indication of low carbohydrate content in vegetables. The samples are commonly rich in vitamin content particularly vitamin. Fundamentally, this indicates that vegetables cultivated using poultry and waste treatment to enhance soil fertility contains the entire nutritional requirement for human livelihood.

Oxalates is the main anti nutritional compound determined and it is naturally occurring compound found in almost all plants, in animals and humans, Noonan and Savage (1999), Oxalate can be found in relatively small amounts in many plants. The small amount of Oxalate compound found in the four samples is typical of all vegetables however the lower oxalate content in control and organic treatment sample signify that no treatment and organic treatment are still better for human livelihood than chemical treatment. Consequently, the present research proves that organic treatment is exclusively the best amendment for soil; its records the best vegetable performance (height and leave concentration), highest yield record, has all the required nutritional content and had less oxalate value the compare to other treatment like NPK.

A number of serious health challenges including depletion of essential body nutrients which contributes to diseases can develop as a result of excessive uptake of heavy metals (Arora *et al.*,2008). Heavy metals are easily accumulated in edible parts of leafy vegetables (Bahemuka and Mubofu, 1991), up to levels high enough to induce/health problems (Alam *et al.*, 2003). Soil chemical composition plays important role in the composition of plant materials, according to Muhammad *et al.* (2010), overall toxic metal availability in soil rhizosphere contributes to metal contents in fruits/ vegetables. Availability of heavy metal ions are influenced by various factors including soil pH, physical and chemical soil properties, clay content and Mn oxide concentration (Xian and Shokohiford, 1989).

The findings in our study have shown that Cd and Pb levels in the vegetables were within safe limits based on the FAO/WHO (1999; 2011) cadmium maximum levels of 0.05 ppm for fruiting vegetable applicable to tomato and garden egg. While the Mercury which has Central Nervous System (CNS) and kidney damaging potential (FSAI, 2009), was found at alarming levels all through the samples when compared to the FAO/WHO (1999; 2011) maximum levels of 0.03ppm for food and food products (Muhammad *et al.*, 2010). Taking the mean for mercury levels of both garden egg and tomato, we arrive at mean values of 3.199 ppm, 4.960 ppm, 1.797 ppm and 1.572 ppm for control, waste, poultry droppings and NPK treated vegetables respectively. By this result, waste treated has the highest concentration of Hg, followed by control while NPK has the least Hg content but not withstanding all the values are above permissible level. Moreover, this indicates that high mercury content is not limited to any type of treatment adopted as even control still record high mercury concentration.

Consequently, there identify was for minimizing mercury concentration from the soil and all type of manure treatment to enhance the fertility of the soil.

Mercury being a biologically non-essential trace element can get to the farm through wastes from cosmetics, pharmaceutical, and wastes from antimicrobial preservative in paints (US-CPSC, 1977). Chronic effects produce CNS toxicity, mercury is nephrotoxic and its toxicity is time and dose dependent (Beliles, 1994). Lead can contaminate the environment from waste containing batteries, paints, gasoline products, pigments, solders, glass among others (ASTDR, 1993). In the list of hazardous substances, it ranks second (ASTDR, 1999), Inhalation and ingestion are the main routes of exposure to inorganic lead. Some plants are capable of taking up lead from soil through their root systems; although this uptake does not appear to be appreciable (ATSDR, 2007). According to Kabata-Pendias and Mukherjeee (2007), only about 0.005 to 0.13% of lead in the soil solution is available to plants. The absorption of lead by roots is passive, and low hence, low lead concentration which are within permissible level were recorded from the varying treatments. Levels of lead in leaves often correlate with atmospheric Pb concentrations (Kabata-Pendias and Mukherjeee, 2007). Moreover, washing of vegetables has been seen to reduce the concentration of lead in garden egg from 0.1401 to 0.1261ppm and in tomato from 0.1332 to 0.1061ppm (Amin *et al.*, 2013).

Cadmium is used primarily for the production of batteries, metal plating, pigments, plastics and synthetics among other uses (ATSDR, 1993), occupational exposure to these materials and wastes from such materials serve as contact point to cadmium. If high doses are taken, cadmium has been reported to affect nearly all organ-systems. The major route of exposure that triggers toxic response faster and more often is by inhalation (Beton *et al.*, 1966). The result shows that recorded cadmium and lead concentration in the vegetables for the entire treatment are within safe limit thus suitable for human livelihood while high mercury concentration is not limited to any treatment.

Adoption of this organic manure for cultivation does not only enhance environment quality and attainment of food security but will contribute to local economic development, poverty alleviation and social inclusion as well as, healthy livelihood in particular. Generally, this will lead to increase vegetable production that had less antinutritional substance such as oxalate, safe lead and cadmium concentration for healthy livelihood and improvement in human nutritional needs.

Supplementary irrigation used justify the possibility of all year cultivation of vegetables that are rich in all the essential micronutrients, available in sufficient quantities and accessible to people all year round giving an indication of sustainable vegetable supplies across the year in the State. As most agricultural communities in Niger State, rely mainly on cultivation of food (grains and tubers) crop which are generally on seasonal bases by implication there will be a period of food shortage, usually during the dry season. Vegetables can be cultivated during this period to supplement the family food supplies and generate added income when other sources of employment and income may be limited, provided enough water is available it will create employment. Also, large proportion of the population are low income earners and sources their nutrients from food plants, which are cheaper and more accessible than animal foods consequently, green vegetables cultivation such as okra, tomatoes, garden egg should be encourage using municipal waste.

5.0 Conclusion

The present research demonstrated the effects of different nutrient sources (poultry, waste and NPK) on vegetables performance and yield. The varying treat treatments does not deny the vegetables availability of any nutritional components as it is only the concentration that varies though organic treat have significantly higher concentration of some nutrient and less of antinutritional compounds. The results clearly depicts that organic treatment (poultry and waste) enhance soil fertility, vegetable yield, contains all nutritional components, high nutritional content and less anti-nutritional compound such as oxalate. The concentration of lead and cadmium are within safe permissible level and safe for human livelihood while the mercury level exceeded the FAO/WHO maximum permissible limit for the entire treatments an indication for urgent intervention with respect to minimize mercury levels in soil and manure in order to mitigate its toxic effect. Thus, it should be widely accepted and promoted by the stakeholders for higher yield and healthy livelihood. Generally, fundamental to sustainable livelihood in any environment is adequate management of environmental resource and waste generate through human activities. As a result we should all have a RETHINK to prevent waste generation, REDUCE the amount of waste generation and identify sustainable ways of REUSING waste generated so that nothing get to the dumpsite for enhance environmental quality and sustainability of human livelihood.

Recommendation

Trend in solid waste generation, composition, disposal and its impacts have continued to aggravate environmental problems indicating the need to identify cost-effective alternative approaches to solid waste management. Consequently, the following sustainability issues are recommended;

- There must be increase public awareness on cost-effective individual and community waste management approach base on the principles of 3Rs; RETHINK to prevent waste generation, REDUCE the amount of waste generation and identify sustainable ways of REUSING waste generated.

- There should be establishment of functional waste composite plant and maintenance of the existing one; to reduce the volume of waste and synthesis the solid waste for better performance.
- Partnership and collaboration should be encouraged between NISEPA, local government and the private sector for effective municipal solid waste management.
- The present waste to wealth policy should be encouraged to help remove injurious element and polythene bags from the decomposed solid waste.
- Inorganic manure and poultry dropping should be incooperate into decomposed waste and the soil to minimize mercury levels in vegetable.

614

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