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Effect of Climate Change on Rural Agriculture in Southeastern Nigeria: A Review Ibeawuchi, Izuchukwu Innocent and Onweremadu Emmanuel Uzoma

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Abstract

The vulnerability of agriculture to unfavourable variations in climate and weather conditions is enormous and is pressuring on the limited resources available for human growth and development. In spite of the advantages made in the areas of science and technology with the gene marker, breeding, genetics and more recently biotechnology, improved crop varieties, irrigation and livestock improvement, still the climate remains a very serious factor in agricultural productivity. The effects of climate change on agricultural production are of global dimension and solving the problems require integrated approach. In most rural communities of southeastern Nigeria, agriculture remains the mainstay of the economy employing 70-80% of the rural population. The environment has been degraded through the impact of oil industry (petroleum industry) which destroyed the soil, air, water and infact, the entire ecosystem. By the oil prospecting actions, climate change through the excess release of C02 gave rise to high rainfall and humidity and high wind wave in the area. The gas flaring had destroyed most of the ecology in the oil prospecting areas of southeastern Nigeria. Solutions are realizable when backed by government policies adapted with concern and implemented with sincerity of purpose.

Keywords: *Climate Change, Petroleum Industry, Agriculture, Southeastern Nigeria.*

INTRODUCTION

Through time human activities had been going-on on earth without any visible or significant sign of its disturbing effects. Until recently human population counts in millions, and coupled with the discovery of sophisticated technologies which hitherto have brought to bear on the earth's stability and hence the environment is constantly disturbed resulting to climate change. Therefore, climate change can be explained as variations in the environment that persist for an extended period and involves the magnitude and frequency of weather events as well as the slow continuous rise in global temperature (Houghton et al 1990). The impact of climate change in Africa is exacerbated by the Sahara desert to the north and the Kalahari Desert to the southwest. Already, the Congo forest in-between is threatened with unsustainable logging and expansion of agricultural land (Wangari, 2008)

For better understanding of the scenario, among factors and conditions that cause these changes on climate are gas flaring, deforestation, desertification, flooding, release of toxins into the atmosphere, etc. Thus, the balance of scientific evidence now suggests that over the last century,

humans have a discernible influence on the earth's climate causing it to warm up. This must have started gradually since the beginning of the industrial age of which the concentration of certain gases as C02 in the atmosphere has increased from its normal level to an abnormal high level. Hence, the earth is constantly warmed up through its effects on the Ozone layer, resulting to green house effects. The increase in C02 concentration in the atmosphere has been worrisome in recent years in some rural communities in the Niger Delta of Southeastern Nigeria. The major reason for the increase may be attributed to the extensive use of fossil fuel, (petrol, coal and gas) including the use of refrigerators that are built with chlorofluorocarbon (CFC) which also cause depletion of the Ozone layers. The destruction of carbon sink by excessive bush burning, improper land use and deforestation might have aggravated the effect and caused for atmospheric C02 increase over the past years. Today, rural communities witness excessive sunshine, skin burn, high day and night temperatures, excessive rainfall and drought, cold, and flooding of some rivers and drying up of others. In Emekuku, Owerri, Imo State Nigeria, Oketankwo; a seasonal stream now arrive late in June/July instead of April/May as a result of change in climate. These are all visible signs of climate changes in our rural communities. The increasing urban population and the use of certain household appliances such as air conditioners have added to the Ozone layer depletion causing climate change which adversely affects agriculture and food production.

Presently, climate change is synonymous with global warming(www.direct.govt.uk 2008), carbon emissions, desert encroachment, glacial fall etc. Globally, climate change means that extreme weather events such as floods, droughts and tropical storms will become more frequent and more dangerous. Thus, climate change depends on how these factors mix in the earths atmosphere (www.direct.govt.uk 2008). Climate change can be explained as a lasting impulsive change or consistent trend in the central tendency of climate and has a great effect on agriculture, food production and economy of the people. Thus, any significant change in climate on a global scale shall impact on agriculture and the world food supply as can be witnessed in recent times on the global food crises.

The instability caused by climate change leaves a question on what happens to the agricultural economy in developing countries in sub-Saharan Africa. This however, will depend on the interplay of a set of dynamic factors specific to each locality within the sub region like the Niger Delta environment where quest for petroleum resources have destroyed the ecosystem – land resources, water resources, fish and the local community air spaces. The objective of this paper therefore was to review the effect of climate change on agriculture in rural communities of southeastern Nigeria.

Observations of Climate Change on Rural Agricultural Communities

Agriculture is an art, science and business of crop and animal production including forestry, fishery/aquatic resources and the management and extension of all plants and animal products for the beneficial use of mankind. These activities are affected by climatic conditions which hitherto forms the basis of agricultural production. The occurrence of disasters reminds us of the importance of climate for successful life on earth. Such climatic factors and elements as, rainfall, temperature, evaporation, light, humidity, wind and composition of the atmosphere affect the environment (atmosphere, lithosphere and biosphere) and all that inhabit it.

Observations (Obasanjo, 2008) made over the past years, have shown that indirectly, higher temperature has caused the breakdown of organic matter in the soil, stress on man, animals; crops and trees including shrubs of the rural communities, hence causing lower levels of soil organic matter leading to less soil moisture retention and additional crop moisture stress. According to Obasanjo, (2008) the plateau snowfalls in Jos is disappearing, there is frequent and increasing ocean surge in Lagos, and Lake Chad today is only 20% of what it was 50 years ago. All these, most times threaten yield and lead to death of plants. Ordinarily, climate influences plants, animals, man and soil directly (Ayoade, 1993) but if there is an extreme either way, the environment and inhabitants suffer. Understanding the climate is vital to people living in tropical environment which can be harnessed for effective development programmes aimed at raising the standard of living and quality of life of the inhabiting agrarian population. The excessive heat due to environmental warming in the rural areas of Southeastern Nigeria causing change in weather and climate had been observed to reduce the feed in take, feed conversion efficiency and weight gain of our livestock (www.direct.govt.uk 2008). The consequences of these are changes in meat, and even milk production for feeding the young animals and reduced animal reproduction.

This already have negative feedback in food production and the economy of the rural people as supplies of protein, hides and skin are reduced. We have witnessed increased rainfall variability which had resulted in frequent floods giving rise to differences in crop yields in different rural communities within the southeast agro-ecological zone. Higher rainfall in the Southeastern Nigeria coupled with sea level rise had lead to crop losses due to water logging and increased pest infestation. However, if this situation is reversed, reduced rainfall in the region will affect our agro-ecology, the forest and derived savannah may shift southward giving way for the expansion of the savanna and desert encroachment. Stable weather and climate is a pre-requisite for both crops and animals to survive.

Soil

Soil is a complex bio-chemical material which formed at the interface between the earth-crust and the atmosphere and differs markedly in physical, chemical and biological properties from the underlying rock (Youdeowei et al 1999). Indicators of land degradation due to climate change are already apparent in Nigeria particularly in the rural communities. According to Ofoh,(2009) Nigeria is sandwiched between desert in the North and sea in the South. He emphasized that .the impact of global warming is already obvious in that there is increased desertification in the north, coastal erosion in the south, gully erosion in the centre and shifts in rainfall pattern. Soil supports plant growth by supplying it with nutrients, anchorage and moisture and its productivity is affected by properties such as structure, texture, bulk density, potassium, nitrogen, phosphorus, soil reaction(pH) etc and may however be altered due to several anthropogenic processes (Tivy, 1973). Soil as a living body shows and responds to effects of environmental factors such as climate, vegetation, micro and macro organisms, the relief of the land and time (Youdeowei et al 1999).

Furthermore, high atmospheric C02 concentrations normally increase growth rates and water use efficiency of crops and natural vegetation. Increased C02 concentrations, in the atmosphere usually counteract adverse effects of temperature rise especially increased nighttime respiration witnessed in some rural communities. The shortened growth cycle of some crop species because of higher C02 and temperature would be compensated for in natural vegetation by adjustments in species composition or dominance (Tivy, 1973). In agro-ecosystems, the choice of longer duration cultivars is changes in cropping pattern. This would eliminate unproductive periods that might arise because of shorter growth cycle of the main crops. The greater microbial activity will tend to increase the quantity of plant nutrients cycle through soil organisms.

MATERIAL & METHODS

The increased production of root material at similar temperatures tend to increase soil organic matter content which also entails the temporary immobilization and cycling of large quantities of plant nutrient in the soil. As a result of these activities in the soil, there is increased microbial activity due to higher $C0_2$ concentration and temperature produces high amounts of polysaccharides and other soil stabilizers (Babalola 1996). On one hand, soil microbial activity is known to have declined in contaminated soils of certain locations in southeastern Nigeria (Onweremadu and Nwufo, 2008) contamination is sourced from use of inorganic fertilizer, automobile series and oil exploitation and exploitation Therefore, increase in litter or crop residues, root mass and organic matter content tend to stimulate the activity of soil macro fauna including earthworms, which consequently improved infiltration rate and by- pass flow. The improved soil stability and infiltration increased the resilience of the soil against water erosion and consequent loss of fertility, and the increased proportion of by- pass flows also decreased the nutrient loss by leaching during periods with excess rainfall (Babalola, 2002).

Soil Fertility and Erosion

High air temperatures bring about warmer soil conditions which accelerate the decomposition of organic matter and increase the rate of other soil processes that reduce soil fertility. Consequently, application of fertilizers may be needed to counteract these processes and to take advantage of the potential for enhanced crop growth that can result from increased atmospheric $C0_2$. This can result to environmental risk, since additional use of chemicals (fertilizers) may impact water and air quality as already being witnessed by petroleum industry effect in the Niger Delta of Nigeria. Also, continual cycling of plant nutrients like carbon, nitrogen, phosphorus, potassium and sulphur in the soil-plant-atmosphere system is also likely to accelerate in warmer conditions and hence enhancing $C0_2$ and N_20 green –house gas emissions (Ayoade 1993, Agres 1991).

Nitrogen is made available to plants in a biologically usable form through the action of bacteria in the soil. This process of nitrogen fixing

association with greater root development is predicted to increase in warmer conditions. The dry soil conditions will suppress both root growth and decomposition of organic matter and increase the vulnerability of the soil to wind erosion especially with wind intensification (Babalola and Zegal 2000). Furthermore, wind affects the level of rainfall, accounts for the different season in the tropics and reduces or increases evapotranspiration as well as spread diseases by distributing air borne spores and other pathogens.

Rainfall supplies drinking water for man and animals and dissolves soil nutrients in forms it can be absorbed by plants. It is also essential for seed germination. However, too much or excessive rainfall causes soil erosion, flooding and leaching of soil nutrients thus reducing soil fertility especially in the southeast agro-ecology making farmers to have low crop yield. Serious land degradation (gully erosion) has been witnessed in most farming communities of southeastern Nigeria like Nanka, Agulu in Anambra State, Ndi Egoro, Item and Ovim - Isukwuato in Abia State; Ogba, Ndoni and Egbema in Rivers State, Odoro Ikpe in Akwa Ibom State; Amucha, Ubowalla, Uboegbelu, Umuocham-Emekuku;Obodo –ukwu, Urualla IdeatoNorth ,Osina Ideato South all in Imo State and other sites. Roads had been destroyed families and Villages relocated and as a result of erosion a lot of sand is carried into the rivers thereby reducing the depth and speed of flow of such rivers. All these climate factors (temperature, wind and rainfall) affect soil fertility and changes in agriculture and food production. In Nigeria, especially within the Southeastern agro-ecological zone, rain fed agriculture is the predominant occupation and it is the source of food production but increased rainfall variability had led to frequent flooding in most parts of the region resulting in variability in crop and animal yield in different communities within the same agro-ecology. This change in climate had led to forced migration and poverty within the region. In fact, the soils of the southeast agro-ecology of Nigeria have been destroyed, neglected, misused and mismanaged. The scenario is worrisome because southeastern Nigeria is located in the tropical rainforest joining the mangrove forest and the swamp coupled with the inherent fragile and infertile nature of their soils which is under pressure from petroleum exploration coupled with serious erosion, leaching and other forms of degradation going on seen and unseen in the region. According to Babalola and Zagal (2000), more than 90% of the soils in Nigeria have suffered from variable degree of degradation. Water erosion is widespread in this region and synonymous with soil degradation which produced spectacular gullies that are the exhibits of erosion within the Southeastern Nigeria. According to; Onweremadu and Duruigbo, (2007) the distribution of soil nutrients among farmers in Ohafia Southeastern Nigeria is shown in Table 1.

***Soil Reaction* (*pH*):** Most soils would not be subject to rapid pH change resulting from climate change. Exceptions might be found in potential acid sulphate soils extensive in some coastal plains and estuaries, when subjected to increasingly long dry season (Amatekpor; 1989). Although, most of such soils are clays with moderate or high cation exchange capacity, the amounts of acid liberated in such soils upon oxidation generally exceed the rapid buffering capacity. Hence, pH values may temporarily reach 2.5-3.5 and a small part of the clay fraction may be decomposed. (Amatekpor; 1989). It should be noted that the simple moddleling of accelerated $CaC0_3$ leaching under a double atmospheric $C0_2$ concentration generally does not hold true (Amatekpor, 1989). Rather, in most soils the ongoing decomposition of organic matter maintains $C0_2$ condition in the soil air far above atmospheric concentration and $CaC0_3$ solubility is determined by partial pressure of $C0_2$ in soil air and its activity in soil water rather than in the atmosphere (Amatekpor 1989). In conditions where leaching is accelerated by climate change like in the upper region of the Niger Delta (ultisols of the Southeastern Nigeria), it would be that rapid soil acidification prevailed after a long period of time with the apparent change. The ensuing high temperature and rainfall including high relative humidity stimulates rapid organic matter decay and leaching leaving the soil with a pH range of 3.5 – 5.5 in most places.

The above soil information are hardly used by rural arable farmers due to language of delivery, lack of usable information and scantiness of soil data (Onweremadu et al, 2007)

RESULTS & DISCUSSION

Soil Water Management and Climate Change.

The soil located at the atmosphere-lithosphere interface plays a great role in determining the amount of precipitation that enters the soil resource for future use. This water that enters the soil is held by cohesive forces through hydrogen bonding. Soil water is important for forecasting temperature and precipitation. Rise in temperature leads to increase in evaporation rate of soil moisture. Such evaporation loss affects soil water budget for agriculture and non-agricultural uses.

Soil water is relevant in nutrient dissolution, nutrient update by mass flow, germination and

spouting in plants, reactivation of enzymes and influences soil organic matter decomposition. Soil water conditions influences emission of $C0_2$, methane (CH_4) and nitrous gases, which are greenhouse gases (GHGs)

There is a strong relationship between soil moisture and precipitation. Soil moisture evaporation and low pressure systems tend to condense water vapour leading to precipitation. But, precipitation is less likely if there is low soil moisture evaporative capacity.

Adaptation and Mitigation of soil moisture

Coping with the climate change impacts as well as reducing the severity of greenhouse gas emissions will in no small measure help for environmental health.

Conservation consciousness and awareness will go a long way in fitting into the new atmospheric trend as well as help in palliating the change. Conservation should include environmental –friendly attitudes in all activities in the rural area.

Rural communities are agro-based and this calls for conservation agriculture.

Conservation agriculture aims to minimize soil disturbance while at the same time ensuring high organic input into the soil resource. The organic matter component promotes structural stability through micro- aggregate formation; organically stable soils increase infiltration rates, buffer soils, sequester soil organic carbon by trapping carbon dioxide and encourage the proliferation of soil organisms. Rural agriculture should among other things involve an ample supply of organic components in its farming and cropping systems. Good a thing, there is an abundance of organic materials in rural areas when compared to urban and peri-urban centers of Nigeria.

A set of organically –related practices include composting , green manuring, mulching, farm yard manure, the use of animal droppings, crop rotation and even night soil technologies composting materials are easily sourced in one to three years fallow farmlands since at that stage plants are very succulent hence easy to decompose and yield good quality manures for enhanced productivity of soils.

Green manuring is unpopular in the Nigerian rural landscape but can be practiced by cutting green leaves and putting them in holes meant for yam production. It involves digging holes, parking in green leaves which are later covered to enhance decomposition process in advance before seed yams are planted.

Mulching is not primarily meant for manuring but organic mulch materials release nutrients on decomposition. Stubble mulches keep soils structure stable after harvest as they do not allow direct impact of rain drops on soils. Legume-based mulch materials are helpful as they readily decomposed to release plant nutrients. Cover crop mulches that are of leguminous origin fix nitrogen, which is a critical element in plant nutrition. In other words live leguminous mulches help in N-sequestration, thereby mitigation the changing atmosphere. Farm yard manures improve soil fertility and enhance soil aggregation necessary for carbon sequestration. Most house sweepings are dropped on homestead farms where they add quality to continuously cultivated home farmlands. Animal droppings vary in quality but include poultry, goat, sheep, cow and pig dung and their urine. They are mainly sourced from mini-livestock enterprises while cow dung is dropped on farmlands by grazing cattle.

A combination of these agronomic techniques with other biological and engineering measures will go a long way in mitigation negative effects of climate change such as flooding and erosion. Some of the engineering structures will promote water harvesting and trapping in the rural farms especially on sloping terrain. Use of terraces, contour strips, bunds etc will certainly act as good practices in soil conservation thus improving soil fertility and yield of farm crops.

Pests and Diseases

Warmer climates favour the proliferation of insect pests. Due to longer growing seasons, insects such as grasshoppers will be able to complete a greater number of reproductive cycles during the rain and harmattan seasons of the year. However, wind patterns may change the spread of both wind borne pests and that of bacteria and fungi that are agents of crop disease. This situation will bring about greater use of chemical pesticide to control them and the side effect can pollute the environment and also kill non-target organisms that may be beneficial to man and the environment. (Clayton 1996). However, integrated pests management techniques are advocated.

Pests and diseases can cause considerable growth and yield changes to crops and livestock thus affecting agriculture and food production. They can reduce the quality and quantity of crops and reduce market values and the income for the farmers. Pests and diseases increase the cost of production through reduced yields of crops and harvest out puts. Through all these adverse effects of pests and diseases, agriculture and food production are affected as farmers struggle to eliminate the pests, and thus avert reduced income and food crisis in Nigeria.

Changing climatic conditions do have positive impact because climate change can largely determine what can and what can not be grown in an area. A change in climatic conditions sometimes may be positive and favourable to produce plants and animals and such causes of changes in climatic conditions are far rare. For example, a change in climate causing an increased level of carbon dioxide ($C0_2$) will likely lead to the greater yields of livestock feed grain, forage crops and pastures. Common agronomic principles noted that the most important climatic factors that limits plant growth and hence the quantity of feed available to livestock and man are length of daylight, intensity of solar radiation and ambient temperature. However, the quantity of feed available depends; mostly on rainfall strength and the intensity of solar radiation and thus a change in climate affect food crop production and availability.

CONCLUSION

In Nigeria, especially in areas where petroleum is exploited, gas flaring had to be stopped without delay to help control the pollution effects caused by flared gases. Also, the fuel produced by refineries must be treated to reduce the carbon monoxide formation. There should be bi-monthly or quarterly environmental impact assessment of the petroleum producing communities to ensure high environmental quality.

The effective mobilization of the people for tree planting and collaboration of the national governments of the world will go a long way in providing integrated approach to solving effects of climate change. Furthermore, organic mulching, green manuring ,organic agriculture practices including stubble mulching will keep the soil structure stable as they will help control erosion, flooding and ;leaching ;thus improve soil fertility crop yield and animal production. Strong and implementable government policies including media campaigns will help create awareness on community involvement to mitigate climate change.

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REFERENCE

Adams, R. M.; Rosen Weig, C.; Peart, R.M.; Ritchie J.T. McCarl, B.A.; Cilyer, J. D.;Curry, R. B.; Jones, J.W.; Boote, K. J.; Allen, L. H. J., (1990). Clibal Climate Change and U.S. Agriculture Nature., 345, 219-224.

Ayres, R.U and Walters J. (1991). The green House Effect. Damages and cost Environment and Resourc Economics., 1, 237pp.

Amatekpor, J. K., (1998). The effect of seasonal flooding on the clay mineralogy of a soil series in the Volta Lake, drawdown area, Ghana Land degradation and Rehabilitation., 1, 89-100.

Ayoade, J. O., (1993). Introduction to climatology for the tropics. Spectrum Books Ltd. Ibadan Nigeria., 204-246.

Akeredolu, F.A., (1995). Precipitation and Aerosolchemistry in Nigeria in. Seminar IGAC/DEBITS. Yamoussoukro, Cote D'Ivories.

Baker, B.; Viglizzo, J. F., (1998). Rangelands and livestock. In: Feenstra J.F., Burton l, Smith J.B, Tol, RSJ (eds) Handbooks of methods for climate change impact assessment and adaptation strategies. IIM/UNEP Version 20.

Brinkman, R.; Pous, L. J., (1968). A pedo geomorphologyical classification and map of the Holocene sediments in the coastal plain of the three Guyanas. Soil survey paper No.14 Soil Survey Institute (Staring Centre) Wageningen. 40p.

Babalola, O. (1996). Soil Conservation plan for small holder farm project of Ondo State, National Agricultural Land Development Authority (N.A.L.D.A). The Presidency, Abuja 78 pages.

Babalola O and E Zagal (2000). Assessment of soil fertility degradation of Nigerian soils. A report submitted to the World Bank Assisted Project on Assessment of soil degradation in Nigeria. Federal Department of Land Resources Abuja, 73pp.

Claypton, K ., (1996). The treat of global waving. In: o'Rindan T (ed) Environmental Science for Environmental Management. England Longman group Ltd. pp 110-130.

Day, J.W.; Templet, P.H., (1989). Consequences of sea level rise. Implications from the Mississippi Delta. Coastal management., 17, 241-257.

Fuquay, J.W., (1981). Heat stress as it affects Animal production. J. Am. Sci. 52,164-174. shttp/www.fifitime.com/story.aspv? id = 63975. The impact of climate change on people and food – fiji times online 2007.

Houghton, J.T.; Jenkins, G.J.; Ephram, J. J., (1990) Climate change. The IPCC Scientific Assessment. Cambridge University Press. Cambridge U.K. 365pp.

Marcel, V.; Christian, B., (2005). shift in phenology Due to Global Climate change: The Need for Yardstick Proceedings of the Royal Society. Bulletin Vol., 272, 2561-2569.

Mckyes, E.; Sethi, A.; Yong, R.N., (1994) Amporphus Coastuigs on particles of sensitive clay soils, clay and clay minerals 22:427-433.

Miller, A.A., (1965). Climatology, Metheur London www.worldwildlife.org/climate/publications/lara.2007.

Obasanjo,O.A., (2008). Welcome Address at the High Level Technical Workshop on Afforestation and Climate Change in Africa.15th-17thDecember,2008,Abeokuta,Nigeria.

Ofoh, M. C., (2009). Food Security and Mitigation of Climate Change through Ecosystem Based Agriculture. 13th Inaugural Lecture of Federal University of

Technology, Owerri (FUTO) Imo State Nigeria Delivered on Wednesday 27th of May 2009. Pp 36-62.
Oluwole, A. F.; Akeredolu, F.A.; Ogunsola, O. J.; Ohioh, I. B.; Asubiojo. O.l.; Baumbach, G.; Vogt, U., (1994). Measurement of Traffic Related, Pollutants at Urban locations in Nigeria. 3rd international Symposium: Transport and Air Pollution. Aignon. 6-10June 1994. INRETS. France. Pp 117-122.
Onweremadu, E.U.; Duruigbo, C. I., (2007). Assessment of Cd concentration of crude oil polluted arable soils.Int. J.Environ. Sci. Tech., 4(3), 409-412.
Onweremadu, E.U ., (2007). Availability of selected soil nutrients in relation to land use and landscape position. Int. J. Soil Sci, 2(2), 218-134.
Onweremadu, E.U.; Nwufo, M. I., (2008). Pedogenetic activities of soil microbes as influence by trivalent cationic chromium. Res. J. Soil Biol.1(1), 8-14.
Onweremadu, E.U.; Duruigbo, F.O. R.; Matthews-Njoku, E. C.; Obasi, P. C.,.2007. Constraints to adoption of soil survey information by ownermanaged arable farmers of the humid tropics. Int. J. Agric. Rcs.,2(8):712-718
Rotter, R, Vande Geijin, Sc. (1999). Climate Change; effects on plant growth crop yield and livestock pp 657-681.
Smit, B. Menahb D, Smihers, J., (1996). Agricultural adaptation to Climatic variation. 7-29.
Topp. C.F.E.; Doyle, C.J., (1996). A simulating impact of Global warming on milk and forage production in Scotland . 213-270.
Tivy, J., (1973).Biogeography: A study of plants in the Ecosphere. Lowe and Brydone Printers Ltd, Theford Norfolk. Great Britain.Pp 35- 81. Web site: www.direct.govt.uk/en.Environmenta and greener living/the wide (2008). www.wikipedia.org(2008).free encyclopedia on Climate Change and Agriculture
Wangari, M., (2008). Statement by Wangari Maathai (Nobel Peace Laureate2004) during the High Level Technical Workshop on Afforestation and Climate Change in Africa. 15th-17th December, 2008.. Abeokuta Nigeria.

Table 1. Distribution of soil nutrients among land use in Ohafia Southeastern Nigeria

Land Use	TP (mg kg^{-1})	AP (mg kg^{-1})	TN (g kg^{-1})	AN (g kg^{-1})	SOM (g kg^{-1})
Oil palm	56.0a	1.6a	5.5bcd	3.7bd	8.4b
Arable farm	54.0a	1.1a	3.3a	1.8a	5.1a
Pineapple orchard	50.0a	0.9a	4.2ade	3.1ad	5.4ade
Woodland	63.0a	2.0a	4.8bce	4.0cd	8.8bcd
Fallow land	60.3a	1.2a	2.9a	2.6ac	4.9a
Shrub land	61.1a	3.3a	3.8ac	2.8ac	6.2ac
Grassland	59.0a	1.0a	5.1bce	3.9cd	8.9bce
F-Value	0.9^{NS}	1.9^{NS}	3.8^{*}	3.0^{*}	4.5^{**}

TP = Total Phosphorous,

AP = Total Nitrogen

AN = Available Nitrogen

SOM = Soil organic matter

Source: Onweremadu, 2007

Table 2. Relationships of cadmium concentration to selected soil properties

(P = 0.05)

Soil Property	Regression equation	R	R^2	N
Exchangeable acidity(y)	Y = 1.05 +0.41CD	0.58^{*}	0.49	30
Exchangeable bases (y)	Y = 0.45 + 2.35Cd	0.83^{*}	0.69	30

Significant at P=0.05

Source : =Onweremadu and Duruigbo,(2007)