ROLE OF EXTENSION SERVICES ON YIELD IMPROVEMENT OF CROPS IN NUTRIENT DEPLETING SOILS- A REVIEW

[1]P.R. Waziri-Ugwu, [2]O.Joe Guluba,[3]L.D.Wakawa and [4]A.F. Ogori

[1]Department of Agricultural Economics and Extension, Federal University Gashua, Yobe State

[2]Department of Agricultural Education, School of Vocational Education, Federal College of Education, Niger State

[3]Department of Forestry and Wildlife Management, Federal University Gashua, Yobe State

[4]Faculty of Agriculture, Department of Home Science, Federal University Gashua, Yobe State

ABSTRACT

Soil nutrient depletion is affecting cereal yield and farm practices, with overturn on economic viability especially on Sahara region of Nigeria. These causes were highlighted and the attentions of an arm of the agricultural sector known as "Agricultural Extension service unit" whose sole responsibility is to transmit and disseminate vital information on modern methods and approaches towards the improvement of farming practice and cereal yield improvement on nutrient depleting soils were opined. Dissemination of improved farming practice and technology, use of organic materials as well as combining arable crops with trees are some of the possible means to maintain and improved soil fertility.

Keywords: Nutrient depletion, Extension services, Crop yield, Agroforestry

INTRODUCTION

Soil fertility on farms is a major problem in Sub-Sahara Africa resulting from nutrient mining which has been reported to be attributed to negative nutrient balance (Naube*etal*, 2009). However, soil fertility varies spatially and temporally from field to regional scale, influenced by land use and soil management practices by rural and urban farmers. Fertilizer applications, cropping system and farming practice, moisture stress and native soil nutrient status are factors influencing soil fertility at field scale (Liu *etal*, 2006; Samra, 2006). Understanding variability of soil fertility in relation to its application, its distribution and the causes of the observed variability are important to improving sustainable land use strategies and yield improvement hence extension communications. Agriculture is the foundation upon which the economic stability of any nation can be built. However, unless the agricultural techniques and practices are adequate enough for self sufficiency in food production, the nations' stability will be threatened.

Nutrient depletions are due to high output of nutrient in harvested product and soil erosion. Major Africa countries like Nigeria rely on Agricultural addition from few inputs to replenish soil fertility and soil conservation which are inadequate leading to soil degradation and depletion. The Global Assessment of Soil Degradation (GLASOD) assert that degraded soil amount to about 494million hectare in Africa derived from granites through millennia weathering containing relatively low level of nutrient (Adewole and Ayahare, 2010). The long phase range stability of soil nutrient is disappearing gradually. Yet restoring soil nitrogen and phosphorus are major priorities not only for sustained productivity but also in the rehabilitation of eroded and degraded soils. There is little option to use of fertilizer to balance the loss of phosphorus, potassium and nitrogen, on the other hand, application of organic input either as animal manure or crop residue is insufficient to meet the crop nutrient requirement which may result in depletion of soil so required extension role or expertise to alleviate this obvious phenomenon through extension technology dissemination.

The improvement of soils fertility in relation to crop yield in small holder farming systems in semi-arid and humid Africa soil has over the years been rendered difficult and complicated due to increased scarcity of locally derived nutrient sources and changing socio-economic environment (Braman, 1998). The traditionally sourced nutrient used by farmers include manure, leaf litters, green manure, crop residue and termitarium soil and are largely derived from common poor resources, (Campbell *et al*, 1993). The rising human population pressure has caused rapid disappearance of these nutrient resources including lose of grazing areas and cultivatable land centre's, expanding at the mercy of nutrient depletion, (Campbell *et al*, 1994). Although inorganic fertilizers are the most commonly used source of nutrients supplement it has poor capacity to sustain yield over seasons and available to limited household farmers (Prini and Van Reular, 1993).

Cereals and legumes are generally supported by the soil however yield declines set in after two years of continuous cultivation or inorganic fertilizer application due to soil porosity and acidity, thus giving cereals and legumes support before depletion characteristic sets in. Nutrient depletion and low yield of cereal crops in Nigeria especially northern Nigeria is critical to the process of poverty alleviation and economic viability of the region. Many approval to abate soil depletion and low yield abound, but adoption of this technology still remain low and reasons may be inadequate awareness, rainfalls and soil erosion technologies are absent to keeping the nutrient capital investment in place preventing nutrient pollution of stream and rivers, lakes and ground

ISSN: 2455-6939

Volume:01, Issue:02

water, thus making nutrient completely absent for cereal crop growth. These happenings could bring about decline in food production; decrease in per capital income for farmers.

Self sufficiency in food production can only be achieved by keeping the farmers abreast with the modern techniques required for large scale production through efficient extension service delivery. The shortages of food and high cost of available food materials in our markets are areas of great concern to the common man. The fact that Nigeria's agriculture is appreciably below its potentials is not a dispute. Most Nigerian farmers are of age and this leads to low total output or return from the farm (Idachaba, 1991; Onoja, 2011). The impact of soil depletion is having falls on rural farmers especially women whose economic livelihood are so closely linked to production of sales of agricultural produce and services. These linked issues are causing no diversification between livestock, crops and vegetables. The pest and pesticide or herbicides, ionizable molecules are contributing fast to moleculization or trapping of soil nutrient against yields of cereal crops.

The labour of land rational are high, voiding labour intensive soil conversation technologies which are termed financially intensive, however used to conserve soil nutrient (Cheareral Schrieber, 1994). An extension officer pointer to the effect of contour hedge or erosion control technologies labour hiring are likely to do more harm than give to cereal yield or improvement. Farmers in Nigeria, especially the northern part of the country have spatial soil knowledge and temporal with less regard to land which has implication to cereal yield and improvement.

Programme focused on fertilizer to date has been impressive but regrettably has not led to revolutionary change in cereal yield and improvement on nutrient depleted soils. Because imbalanced application of nutrient do not produce a sustainable production system, these are highest where fertilizer use is particularly low and nutrient loss due to soil erosion, overgrazing, urbanization, low retained nutrient, low mineral stock in the soil, and harsh climate weather, interior plains and plateaus, deforestation, desert encroachment, and flooding and poor information service flow from extension agents. However, little emphasis had been on cereal yield and nutrient depleted soil in Nigeria as well as knowledge gap on extension role and expertise related to improving cereal yield on nutrient depleting soil which has not been addressed. It is on the premise that this review work is being done with aview to bridging the extension role with farmer's amides scanty empirical studies on cereal yields in relations to nutrient depleted soil. Therefore, the purpose of this review is to guide, educate and inform farmers on cereal yield, improvement technology and strategies on improving nutrient depleting soils.

The role of agricultural extontionist

Agricultural extension has continued to advance in terms of activities rendered to farmers. The traditional transfer of proven technologies can no longer satisfy the yearnings and aspirations of the farmer particularly the small-scale rural farmers on depleting soil nutrient and poor yields. They need advisory services on home soil science, Agronomy, decision making, leadership, nutritional practices, general education, credit and credit mobilization as well as health care and hygiene practices. FAO (2013) admonished that as farmers become more yield oriented, so extension workers need to be in a position to advise them not only on how to grow crops but also on how to conserve the soil for future yields. Knowledge of cropping techniques , cultivating strategies ,produce handling, storage and packaging was essential to the performance of the farmer in his farming business provide advice to farmers on problems or opportunities in agricultural production, marketing, conservation and family livelihood;

Facilitate development of local skills and organizations, and to serve as links with other programmes and institutions;

Transfer new technologies to farmers and rural people

Address public interest issues in rural areas, resource conservation, and health and food security

Monitoring agricultural production,, monitoring food safety, nutrition and family education as well as youth development.

Swanson and Rajalahti (2010) stated that the traditional technology transfer model of extension was prevalent only during colonial times. Ovwigho and Ifie (2009) stated that agricultural extension encompass transfer of technology, youth extension programme, social development and home making, rural youth extension programme, and health care and hygiene. This definition is broader in perspective than the traditional definition of agricultural extension germane to transfer of technology.

The role of information in farming cannot be overemphasized. Agricultural information reaches the targeted population via different pathways each of which has different adoption enhancement capabilities. The most preferred source of information was government extension service. The implications for this finding is that since farmers seemed to still trust the information from the government, efforts should be made to avail this information preferably through print media such as farmers magazines and newspapers which could probably be distributed periodically to farmers as reference materials.

Relationships between Soil Nutrient Depletion and Extension Services

Nigerian people depend on agriculture for their livelihoods. The fateof agricultural production therefore, directly affects economic growth, social improvement and local trade as the local government population continues to grow rapidly, outpacing the growth rate. As the agricultural lands are becoming increasingly degraded, farmers are intensifying land use to meet food needs without proper management practices and external inputs via extension services. The resulting depletion of nutrients from soils had caused crop production to stagnate or decline in many ADP areas. The rate of nutrient depletion is drastic therefore employing drastic measures such as doubling fertilizer application or manuring or halting erosion losses would not be enough to offset nutrient deficits.

Cereal yield improvement in relation to nutrient depletion on the farm scale land is absent though local people have significant knowledge of soils and environment acquired by experience that have been tested by many generation (Wuwerpins, 2003) however, farmers in the north are facing soil depletion via nutrient loss due to relatively sandy and acid soil. Sloppy terrains and spatial rainfall which leads to nutrient depletion thus, threatening crop cereal yield and improvement hence farming systems.

Soil Fertility and the Role of Women on Replenishment

Soil fertility is the number-one natural resource in Africa; yet its depletion on smallholder farms has led to stagnant or decreasing per capita food production all over Africa during the last two decades. Unexamined are the gender impacts of the soil fertility crisis in Africa. If one generalization can be made about the diverse farming systems and multitude of cultural traditions in sub-Saharan Africa that women farmer usually produce the subsistence food crops, while men produce export and cash crops could go a long way to define agricultural output. African women on small rain fed farms produce up to 70-80% of the domestic food supply in most sub-Saharan African societies and also provide 46% of the agricultural labour (Christiana, 2002). However, women’s food-crop yields are generally too low by Green Revolution standards, and much lower than men’s yield (Christiana, 2002). African policy ought to adopt methodological work policy, and reach women farmers with different household compositions.

The Scale of Agricultural Extension Services on Depleting Soil

Agricultural Extension in the current scenario of rapidly changing world has been recognized as an essential mechanism for delivering knowledge, information and advices as an input into modern farming (Jones, 1997). Present day agriculture and Indian farming community is facing a multitude of Problems to maximize crop productivity. In spite of successful research on new agricultural practices related to crop cultivation, the majority of farmers are not getting upper bound yield due to several reasons. One of the reasons is that expert/scientific advice regarding

ISSN: 2455-6939

Volume:01, Issue:02

crop cultivation is not reaching farming community on time. Farmers need expert advice well on time to make them more productive and competitive. For this, extension agency plays a major role in bridging this gap to make available the latest technologies at the doorstep of the farmers. Agricultural extension which depends to a large extent on information exchange between and among farmers on the one hand and a broad range of other actors on the other has been identified as one area in which extension agents and their roles can play significantly.

Extent of Nutrient Depletion

The magnitude of nutrient depletion in Africa's agricultural land is enormous. Smaling (1993) indicated that an average of 660kg Nitrogen/ha-1, 75kg Phosphorus/ha-1, and 450kg potassium/ ha-1 has been lost during the last 30 years from about 200 million hacker of cultivated land in 37 African countries, excluding South Africa. This is equivalent to 1.4 tonne urea ha-1,375kg triple super phosphate (TSP) ha"1 or 0.9 tone average composition ha1,and 896kg potassium compound fertilizer 1 ha during the last three decades. These figures represent the balance between nutrient inputs as fertilizer, manure, atmospheric deposition, biological nitrogen fixation, and sedimentation, with nutrient outputs as harvested products, crop-residue removals, leaching, gaseous losses, surface run off, and erosion. These values are the aggregate of a wide variety of land use systems, crops, and agro ecological zones in each country (Stoorvogel and Smaling, 1990). Africa is now losing 4.4 million tone Nitrogen, 0.5million tone Phosphorus, and 3 million tone potassium every year from its cultivated land. These rates are several times higher than Africa's annual fertilizer consumption, excluding South Africa 0.8million tonne Nitrogen, 0.26 million tonne of Phosphorus and 0.2 million tonne of potassium (FAO, 1995). Commercial farms in the temperate region have averaged net positive nutrient balances in the order of 2000kg Nitrogen ha-1,700kgPhosphorus ha-1, and1000kg potassium/ ha-1 during the last 30 years in about 300 million hacker of cultivated land, sometimes resulting in ground water and stream pollution (Sanchez, 1994). Nutrient depletion in Africa, therefore, contrasts sharply with nutrient accumulation in temperate regions.

The process of depletion of soil nutrients are everywhere in the world, people settle first in high potential areas with fertile soils, adequate rainfall, and mild temperatures (Sanchez and Buol,1975), such as the part of the high lands of eastern and Central Africa, the plateau of southern Africa, and some river basins in West Africa. The Lake Victoria Basin in East Africa is one example, and now supports one of the more dense rural populations in the world, (Corbett, 1995). Such settlements were first supported by the originally high soil fertility. As populations grew, this fertility was gradually depleted by crop harvest removals, leaching, and soil erosion, when farmers were unable to sufficiently compensate these losses by returning nutrients to tie soil via crop residues, manures, and mineral fertilizers (Shepherd and Soule, 1998). Smallholder

ISSN: 2455-6939

Volume:01, Issue:02

farmers also cultivate low potential areas primarily in sub humid and semi arid areas, where many of the sandy soils are naturally infertile. Still, soil nutrient stock is also being depleted in these areas (Pieri, 1989)

SOIL NUTRIENT DEGRATION IN NIGERIA

Soil degradation due to nutrient mining, erosion and desertification is the major threat to food production in Northern Nigeria (Chude, 1998). The reasons for the widespread of these ecological problems have been fairly well documented, but adequate solutions have not yet reached the application phase. The problem of soil fertility in the Northern States of Nigeria like most sub-Saharan African countries is driven by a wide range of biophysical, chemical and socio-economic factors. The first one is the geologic origin of the parent material on which the soils have developed. The parent materials consist of old and weathered materials, which probably have never contained many nutrient-bearing minerals. The second cause of low fertility is nutrient depletion. Nutrient balances are negative for many cropping systems indicating that farmers are mining their soils. Current estimates in the country indicate that in 1983, for a total of 32.8 million hectares of land cultivated, soil nutrient mining amounted to a total loss of 111,000 tonnes of nitrogen (N), 317,000 tonnes of P2O5 and 946,000 tonnes of K2O (Stoorvogel and Smaling, 1990) equivalent to over US$800 million of N, phosphorus (P) and potassium (K) fertilizers. The third factor which indirectly influences restoration of soil fertility in Northern Nigeria is the farmers` socio-economic conditions. Macro-economic policies also play a pivotal role in influencing the accessibility, availability and the type of inputs a farmer can use. Unfavorable exchange rates, poor producer prices, high inflation, poor infrastructure and lack of markets contribute to low fertilizer use by farmers.

The major cereal crops grown in Nigeria are maize, millet, sorghum and rice. These crops are predominantly grown in Northern Nigeria due to suitable soil and climatic conditions. Generally, there was decline in yield of these crops in the last one decade (Table 1). Of particular interest is the lower yield of rice despite government efforts at revamping rice production in the country. This was attributed to farmers` inability to obtain good quality and high yielding seeds (NAERLS, 1999) and shortage in supply of fertilizer during the period. Of the 163,700 metric tons of fertilizer approved by the government for 2002 wet season, only 104,024 metric tons (63.5%) were delivered.

ISSN: 2455-6939

Volume:01, Issue:02

Table 1: Yield trend and growth rate of cereals in Nigeria 1996-2005

	Maize		Millet		Sorghum		Rice
Years	Actual (kg ha^{-1})	Growth (%)	Actual (kg ha^{-1})	Growth (%)	Actual (kg ha^{-1})	Growth (%)	Actual (k
1996	1326		1061		1144		1750
1997	1251	-5.67	1076	1.41	1107	-3.22	1596
1998	1320	5.52	1000	-7.03	1133	2.29	1602
1999	1381	4.63	1064	6.37	1126	-0.59	1496
2000	1027	-25.64	1050	-1.28	1120	-0.54	1500
2001	1143	11.32	944	-10.05	1021	-8.81	1247
2002	1044	-8.68	990	4.81	1090	6.72	1010
2003	1070	2.49	1030	4.04	1135	4.13	956
2004	1070	0.00	1030	0.00	1140	0.88	960
Mean	1195	-2.29	1027	-0.25	1109	0.00	1395

Source: Federal Ministry of Agriculture and Rural Development (FMARD), Abuja, Nigeria

On the basis of amount of annual rainfall, Northern Nigeria can be divided into four major agro-ecological zones (AEZ) namely, Sahel, Sudan, Northern and southern Guinea savanna zones (Lombin, 1987). Considering the importance of soil moisture for crop growth and for the uptake of plant nutrients, it is obvious that soil fertility improvement measures will differ considerably between the four zones, especially since soils and farming systems are closely related to the rainfall regimes (FAO, 1986). The decline in rainfall experienced in most of the areas in Northern Nigeria has resulted in decrease in vegetation cover (Hess et al., 1995; Nicholson et al., 2000). With this, much of the soil is left bare and therefore directly exposed to the vagaries of wind and water erosion. Land degradation due to water erosion is more severe in the Guinean zone than in the Sudano-sahelian zone. Infiltration rate is higher in the weakly crusted surface of the sandy Sahelian soils than the Alfisols of the Guinean zone, which is poorly structured and highly prone to crust and compaction Wuddivira et al., 2000). In Samaru (Northern Guinea savanna) with a slope of 0.3% only 25.2% runoff was recorded with soil loss of 3.0 t year-1 on sorghum field, whereas in Ougadougou (Sahel) with a slope of 0.5% on sorghum field a total runoff of 40.6% was recorded resulting in soil loss of 10.2 t year-1 on sorghum field (Bationo et al., 1996).

It is apparent that no single measure could be recommended to tackle the problem of soil fertility in Northern Nigeria. The technical actions, which are envisaged to enhance and restore soil

ISSN: 2455-6939

Volume:01, Issue:02

fertility, have to be selected and designed in accordance with the specific constraints and potentials of these very diverse environments (Dudal, 2002). It is therefore logical that several technological and institutional innovations that can solve soil fertility decline were developed based on specific constraints and potentials.

Table 2: Major soils in Northern Nigeria and their classification

Descriptive grouping	Soil taxonomy	Classification (USDA)	Distribution
Less leached, mature upland soils	Alfisols	Haplustalfs, Paleustalfs, Plinthustalfs.	Dominant
Well-drained, shallow, immature soils	Entisols and Inceptisols	Orthents, Psamments, Tropepts.	Dominant
Tropical Black Earths	Vertisols	Torrerts	Moderately
		Usterts	Dominant
Hhydromorphic soils #		Tropaquepts (Entisols) Tropaquepts (Inceptisols) Tropaqualfs (Alfisols)	Less Dominant

Adapted from Lombin (1987): Soils with seasonally fluctuating groundwater table and shallow depth

Table 3: Physical and chemical properties of some selected soils in Northern Nigeria

Locations	Ecological zone	Texture	Soil pH (water)	Org. matter (g kg^{-1})	Total N (g kg^{-1})	Avail. P (mg kg^{-1})	CEC (cmol kg^{-1})
Bakura	Sudan S.	SL	4.6	6.9	0.14	4.90	0.45
Bauchi	NGS	"	5.6	8.6	0.70	14.00	3.50
Bokkos	"	"	4.5	18.2	0.84	7.00	1.84
Dambatta	Sudan S.	Sand	5.9	3.1	0.28	4.20	1.87
Daura	"	"	6.2	3.4	0.42	18.20	0.69
Dutsin-Ma	"	SL	5.9	3.4	0.28	1.40	0.88
Gombe 1	NGS	LS	5.7	2.8	0.42	12.60	0.46
Gombe 2	"	Sand	5.4	20.6	0.56	4.90	0.29
Gummi North	Sudan S.	SL	5.8	5.5	0.28	1.40	1.98
Gummi South	"	Loam	5.5	3.1	0.28	3.50	0.38
Gusau	"	SL	5.0	5.2	0.28	34.80	1.65
Hadejia	"	LS	6.3	4.1	0.42	4.20	1.80
Hoss 1	SGS	Clay	4.6	18.6	0.98	0.70	2.20
Hoss 2	"	"	5.2	21.3	0.98	0.70	2.76
Ikara	NGS	SL	5.4	5.8	0.70	7.00	1.20
Kafin Maiyaki	Sudan S.	"	6.2	8.0	0.28	2.45	2.55
Kankiya	"	LS	5.9	5.8	0.70	4.20	2.27
Katsina	Sahel S.	SL	4.5	3.8	0.28	4.20	0.62
Lafia	SGS	"	4.8	9.9	1.12	3.50	1.50
Maigana	NGS	Loam	5.3	7.9	0.84	2.45	2.10
Malumfashi 1	"	SL	6.3	4.2	0.56	24.50	1.63
Malumfashi 2	"	"	6.7	13.2	0.56	1.40	2.81
Ringin	Sudan S.	Sand	6.4	4.1	0.42	3.50	1.17
Samaru 1	NGS	Loam	5.2	6.2	0.70	13.3	1.52
Samaru 2	"	"	5.3	7.9	0.56	6.30	1.20
Soba	"	"	5.9	8.3	0.56	22.40	2.92
Sokoto	Sahel S.	SCL	5.2	9.3	0.28	16.96	6.12
Talatan Mafara	Sudan S.	SL	5.1	4.5	0.28	4.90	1.53
Wudil	Sudan S.	LS	6.9	4.5	0.70	2.45	1.77
Wurno	Sahel S.	"	5.5	6.9	0.28	4.90	1.54

Adapted from Abdu (2007). NGS and SGS = Northern and Southern Guinea savanna, respectively

Soils: The major soils of Northern Nigeria may be grouped into four descriptive categories and classified according to the USDA (Anonymous, 1975) as shown in Table 2.Surface soil (0-20 cm) samples were collected from 30 different locations across the various agro-ecological zones of Northern Nigeria and analyzed for some important physical and chemical properties (Table 3). The results show that the soils range from sandy loam to loam in texture, moderately acidic in reaction, low in Organic Carbon (OC), available phosphorus, total nitrogen and Cation Exchange Capacity (CEC) according to the classification made by FMNAR (1990) .The data in Table 4 indicate that continuous cultivation of the weakly buffered soils of Northern Nigeria will result in a rapid decline of exchangeable cations and soil acidification. Soil calcium and pH will decrease by 21 and 4%, respectively in Sudan savanna, these soil properties will also decrease by 46 and 10% in the southern Guinea.

Table 4: Percentage change of soil fertility over 50 years in farmers` fields under continuous cultivation in the savanna zones of Nigeria

	Exchangeable cations			
Zone	Ca	Mg	K	Soil pH
Sudan	21.0	32.0	25.0	4.0
Northern Guinea	18.6	26.8	33.0	3.8
Southern Guinea	46.0	50.6	50.0	10.0

Adapted from Balasubramanian et al. (1984)

Out Come of Nutrient Depletion On-Farm Yield

A marked decline in crop productivity and food security are the main consequences of the policies that result in soil-fertility depletion in Africa. Nutrient depletion per se also produces negative on-farm side effects and exacerbates several off-farm effects or externalities. On-farm effects include less fodder for cattle, less fuel wood for cooking, and less crop residues and cattle manure to recycle nutrients. These affect, often increase run off and erosion losses because there is less plant cover to protect the soils. In sandy soils, the top soil structure may collapse resulting in soil compaction or surface sealing.

Soil nutrient depletion lowers the returns to agricultural investment, which reduces nonfarm in community level through multiplier effects (Delgado *et al*.,1994). Other consequences of depletion are decreased food security through low production and resulting in higher food prices, increased government expenditures on health, more famine, and reduced government revenue due to fewer taxes collected on agricultural goods. Perhaps the most important negative social externality of soil-fertility depletion is its link to lower employment and increased poverty, Hence vast majority of the poor live in rural areas in the tropics (World Bank, 1990). As long as returns to agriculture are limited by nutrient depletion, farm employment and spill over nonfarm employment opportunities will remain low, sustaining severe poverty. But these externalities are not confined to rural communities, as poverty often pushes individuals and households into urban areas. The influx of rural migrants puts a greater strain on the limited urban infrastructure; and unemployment, crime, and political unrest sometimes result, (Homer-Dixon *et a*l., 1993). Environmentally, Soil fertility depletion also exacerbates several environmental problems at the national and global scales.

Approaches against Nutrient Depletion

Fertility management range from recurring fertilizer applications to low external input based on organic sources of nutrients. Although both extremes work well in specific circumstances, they pose major limitations for most smallholder farmers in Africa. Fertilizer use is the obvious way to overcome soil-fertility depletion, and indeed it has been responsible for a large part of the sustained increases in per capital food production that have occurred in Asia, Latin America, and the temperate region, as well as in the commercial farm sector in Africa (Borlaug and Dowswell, 1994). There is nothing wrong, biophysically or environmentally, with fertilizers when properly used. Fertilizers provide the same nutrients as organic sources to plants. Plants cannot distinguish nitration-phosphate ions they absorb from organic inputs from those they absorb from mineral fertilizers (hereafter referred to as inorganic fertilizers). Most smallholder farmers in Africa appreciate the value of fertilizers, but they are seldom able to apply them at the recommended rates and at the appropriate time because of high cost, lack of credit, delivery delays, and low and variable returns (Heisey and Mwangi, 1996). Such constraints are largely due to the lack of an enabling policy environment in rural areas caused by the deficient road and market infrastructure typical in most African countries. The price of fertilizers in rural areas of Africa is usually at least twice the international price (Bumb and Baanante, 1996). Transport costs are about seven times higher in Africa than in the united state of America (USA) Structural Adjustment Programmes in the last decade has tripled or quadrupled fertilizer prices in relation to crop prices in many African countries (Bumb and Baanante, 1996). Furthermore, since fertilizer recommendations are normally formulated to cover broad areas with diverse soils, farmers also lack information about the best fertilizer to use for their particular fields and cropping practices, making the crop response to fertilizers more erratic and less profitable.

These policy and information constraints can certainly be overcome, thereby in the longer term resulting in increased food security and reducing poverty. An excellent example of a promising approach is in Ethiopia, where many policy distortions have been overcome (Quinones*etal*, 1997).).

Strategies for Cereal Production and Soil Fertility Maintenance

Farmers cope with loss of soil fertility by implementing various practices, extensive cassava cropping systems, and crop rotation. Extensive cassava cropping is known in French as' jachèremanioc', literally meaning cassava fallow. Strictly speaking such systems are not considered fallows as crops are still grown, but this rather extensive practice leads to a much slower degradation of the soil. In both regions, the Peulh people have a rotational system that allows a good distribution of animal manure on the fields surrounding the farmhouse. Some of the practices are old, that is, passed on from generation to generation, like natural fallow, the use of household waste, crop rotation and extensive cassava cropping. Other strategies have been introduced by the extension service and are new, like inorganic fertilizer and cotton rotated with maize. Strategies to maintain soil fertility may not only involve biophysical interventions. If the productivity of the land cannot be sufficiently increased, pressure can be put off the land by migration. Emigration is a strategy used by the younger generation. The older generation generally decides to stay, and applies house hold waste, animal manure, or a combination of inorganic fertilizer and animal manure or household waste away of improving soil productivity. Planting melon and incorporating legume residues are strategies used by women to improve soil nutrients. Extensive cropping with cassava or melon, the application of household waste and ridging/mounding are indigenous strategies. Some of the strategies are area specific. For example, the use of animal manure or household waste is specific to the Africa region and extensive cropping of melon and cassava. However, extensive cassava cropping is also a strategy employed in parts of Ghana (Adjei-Nsiahetal, 2004).

Technological Options for Improving Nutrient Use Efficiency

Introduction of high yielding varieties (HYVs) coupled with expansion of irrigation facilities, and increased use of chemical fertilizers and other agro-chemicals have brought about spectacular increases in the yield of crops, particularly rice and wheat. About half of the total increases in food grain are being attributed to the use of fertilizers and more than one-third of this increase is due to 65 percent area under rain fed, and only about 35 percent areas are under irrigation. Low water use efficiency (WUE) has been the concern as the availability of water for agriculture is decreasing day by day. For saving and effective utilization of this vital resource, proper management strategies involving agro-techniques are impaired. In efficient inputs/fertilizer use is a key factor pushing the cost of cultivation and pulling down the profitability in farming. Total factor productivity (TFP) is used as an important measure to evaluate the performance of a production system and its declining trend is a serious issue. A fatigue in the ratio between the inputs and output is indicative of TFP deceleration with concomitant un-sustainability of crop productivity.

Role of forestry (Tree) in improving soil depleted soil

Trees play a vital role in the maintenance and improvement of soil nutrients. It also has the potential of replenishing nutrients in depleted soil through the process of organic matter addition. This is made possible through the supply of litter and root residues. The incorporation of arable crops and trees (Agroforestry) offers a viable means of soil conservation thus, maintenance and increase of soil fertility. In extension, it is recognized that a prohibitive policy does not work, and conservation must be achieved through the willing cooperation of farmers. To do this, farmers must be motivated through being able to see benefits from conservation works. It follows that soil conservation should be introduced as part of an improved farming package, which will result in an immediate rise in crop yields or other benefits (Queblatin, 1985; Shaxson*et al*., 1989)

CONCLUSIONS

This review has shown that a wide range of technologies is available for soil fertility improvement in Africa and Northern Nigeria. However, wide scale adoption of these technologies has been hampered by lack of enough extension information. The lack of economic motivation, the scarcity of deliverable tools and credit facilities has been major constraints to improved soil fertility. There is no comprehensive, integrated rural development programme that looks at the entire farm as a system comprising other subsystems. Most of the approaches are plot-based and do not consider within farm variability. A complete redress of soil fertility decline in Africa and Northern Nigeria cannot be achieved without commitments from State and National governments. Government should articulate the views and concerns of all stakeholders; identify gaps in knowledge and information and outline processes to fill them. A new research extension approach that seeks to overcome the shortcomings of the past conventional approaches, linking the development of resource conserving technologies, support to institutions and farmer groups and provision of enabling policy environment for agricultural investment should be embraced .Such approach should advocates for participatory farmers research; a holistic approach to address many and complex farming systems problems so as to achieve wide validity and adoption of agro-ecosystems that operate with dynamic natural and economic environment.

REFERENCES

Adewole M.B. and Anyahara U. C. (2010). Adoption rate of land clearing techniques and their effects on some soil fertility parameters of an Alfisol in southwestern Nigeria, *Africa. J Agric. Res.,*

Buol, S.W. (1995). Sustainability of soil use.*Annu. Rev. Ecol. Syst*. 26:254.

Bumb, B.L., and C.A. Baanante. (1996). The role of fertilizer in sustaining food security and protecting the environment to 2020. Food, Agric. and the Environ. Dis. Pap. 17. Int. Food Policy Res. Inst., Washington, DC.

Bekunda, M.A., A. Bationo, and H. Ssali. (1997). Soil fertility management in Africa: A review of selected research trials, p. 63-79. *In* R.J. Buresh et al. (ed.) Replenishing soil fertility in Africa. SSSA Spec. Publ. 51, SSSA, Madison, WI (this publication).

Badiane O . Delgado C.L. (1995). A 2020 vision for food, agriculture and the environment i sub- Saharan Africa. Food, Agric. and the Environ. Dis. Pap. 4. Int. Food Policy Res. Inst., Washington, DC.

Bhale, V. M. and Wanjari, S.S. (2009). Conservation agriculture: A new paradigms to increase resource use efficiency. *Indian Journal of Agronomy* 54(2):167-177. NAAS.

Borlaug, N.E., and C.R. Dowswell. (1994). Feeding a human population that increasingly crowds a fragile Planet. Key note lecture, p. 3-4. *In* Trans, of 15th World Congress of Soil Science, Acapulco, Mexico. 10-16 July 1994. ISSS, Wageningen, the Netherlands.

Campbell, B.M., P.G.H. Frost, H. Kirchmann, and M.J. Swift.(1997). Nitrogen cycling and management of soil fertility in small-scale farming systems in north-eastern Zimbabwe. J. Sustain. Agric. (in press).

Gladwin, C.H. (2002).Gender and soil fertility in Africa**:** *African Studies Quarterly* 6:1 - 2

Duraisamy, P. (1992). Effects of education and extension contacts on Agriculture production. Indian J. of Agri. Econ. 47(2): 205-214

Delgado, C, J. Hopkins, and V. Kelly. (1994). Agricultural growth linkages in sub-Saharan Africa: Asynthesis, p. 22-26. *In* Proc. of a Workshop on Agricultural Growth Linkages in sub-Saharan Africa, Washington, DC. 26 May 1994. Int. Food Policy Res. Inst., Washington, DC.

Hounkonnou, D., (2001). Listen to the cradle: building from local dynamics for African renaissance. Case studies in rural areas in Benin, Burkina Faso and Ghana. PhD thesis, Wageningen University, The Netherlands.263 pp.

Homer-Dixon T.F., J.H. Boutwell, and G.W Rathfens.(1993). Environmental change and violent conflict. Sci. Am. 268 (2): 16-23.

Khan, S. (1999). The impact of extension services on the farm productivity in district Peshawar. Thesis of M.Sc (Hons), Agri. Extt. & Communication Deptt. Agric. Univ. Peshawar.

Liu N., Li X.J., Zhao G.X., Yu K.Q. and Ma X.Y. (2009) Evaluation of soil quality in the Yellow River Delta based on GIS, *Chinese J. Soil Sci.,* 37(6), 1053−1057.

Mulder, I., (2000). Soil Degradation in Benin: Farmers' Perceptions and Responses. Research Series No 240, Tinbergen Institute. Vrije Universiteit Amsterdam, 241 pp

Ncube B., Twomlow S. J., Dimes J.P., van Wijk M.T. and Giller K.E (2009)., Resource flows, crops and soil fertility management in smallholder farming systems in semi-arid Zimbabwe, *Soil Use and Manag*, 25(1), 78−90.

Olson, C. (1991). The constraints of adoption of improved oil-palm production technologies in Imo state, Nigeria. In Njoku, J.E. and Doss, Cr (eds). Issues in African Rural Development Winrock International Institute for Agric. Dev. Arlington, V. A, USA.

Pieri, C, (1989). Fertilité des terres de savanes. Bilan de trenteans de rechercheset de développement agricoles au Sud du Sahara. Ministère de la Cooperation et CIRAD-IRAT, Paris, France. 444 pp.

Queblatin, E. (1985). Upland agriculture development: the Central Visayas Regional Project-I experience. In E.T. Craswell, J.V. Remenyi and L.G. Nallana. eds. Soil erosion management. AC1AR Proceedings Scries 6. Canberra: ACIAR, 71-76**.**

Sanchez, P.A. (1994). Tropical soil fertility research, towards the second paradigm, p. 65-88.*In* Trans.15th World Congress of Soil Science, Acapulco, Mexico. 10-16 July 1994. ISSS, Wagenigen, the Netherlands

Shepherd, K.D., and M.J. Soule.(1998). Assessment of the economic and ecological impacts of agroforestry and other soil management options on western Kenyan farms using a dynamic simulation model. Agric. Ecosy. Environ, (in press).

Stoorvogel, J.J., and E.M.A. Smaling. (1990). Assessment of soil nutrient depletion in sub-Saharan Africa: 1983-2000. Rep. No. 28. Vol. l-4.Winand Staring Ctr., Wageningen, the Netherlands

Smaling, E.M.A, S.M. Nandwa and B.H. Janssen. (1997). Soil fertility is at stake! In: Buresh, R.J., P. A. Sanches and F.Calhoun (eds.). Replenishing soil fertility in Africa. SSSA, Special Publication No. 51, Soil Science Society of America, Madison, USA. pp. 47-61.

Sanchez, P., A.M. Izac, R. Buresh, K. Shepherd, M. Soule, U. Mokwunye, C. Palm, P. Woomer and C. Nderitu. (1997). Soil fertility replenishment in Africa as an investment in natural resource capital. In: Buresh, R. and Sanchez, P. (eds.), Replenishing soil fertility in Africa. SSA special publication 51 Madison WI: Soil Science Society of America (SSSA

Saïdou, A., Kuyper, T.W., Kossou, D., Tossou, R. and Richards, P., (2004). Sustainable soil fertility management in Benin: learning from fanners. *NJAS- Wageningen. Journal of. Life Sciences* 52, 349-369.

Sandor, J.A. and Furbee, L., (1996). Indigenous knowledge and classification of soils in the Andes of Southern Peru. *Soil Sciences Society of America Journal* 60: 1502 – 1512 2005. Policy options for efficient nitrogen use. Policy paper no.33.pp.12. National Academy of Agricultural Sciences. New Delhi Roy R.N.

Sharma, A.R. (2002). Fertilizer News 47 (5):27-28, 31-38 & 41-44

Shaxson. T.F,, Hudson. N.W., Sanders, D.W..Roose. E. and Moldenhauer, W.C. (1989).Land husbandry. A framework for soil water conservation. Ankeny, Iowa. USA: Soil and Water Conservation Society, pp64 .

World Bank (1990).World Development Report*1990.* New York: Oxford University Press

Anonymous,1975.Soil Taxonomy. A basic system for soil classification for making and interpreting soil survey. Soil Survey Staff., USDA Soil Conservation Service, Washington Balasubramanian, V., V.L. Singh, L.A. Nandi and A.U. Mokwunye, 1984.Fertility status of some upland savanna soils of Nigeria after fallow and cultivation. Samaru J. Agric. Res., 2: 13- 23.

Bationo, A., E. Rhodes, E.M.A. Smaling and C. Visker, 1996.Technologies for Restoring Soil Fertility. In: Restoring and Maintaining the Productivity of West African Soils: Key to Sustainable Development, Mokwunye, A.U., A. de Jager and E.M.A. Smaling (Eds.). International Fertilizer Development Center, Africa, Lome, Togo, pp: 61-82.

Chude, V.O., 1998. Understanding Nigerian soils and their fertility management for sustainable Agriculture. An Inaugural Lecture, Ahmadu Bello

Anonymous, 1975.Soil Taxonomy. A basic system for soil classification for making and interpreting soil survey. Soil Survey Staff., USDA Soil Conservation Service, Washington.

Balasubramanian, V., V.L. Singh, L.A. Nandi and A.U. Mokwunye, 1984. Fertility status of some upland savanna soils of Nigeria after fallow and cultivation. Samaru J. Agric. Res., 2: 13- 23.

Bationo, A., E. Rhodes, E.M.A. Smaling and C. Visker, 1996.Technologies for Restoring Soil Fertility. In: Restoring and Maintaining the Productivity of West African Soils: Key to Sustainable Development, Mokwunye, A.U., A. de Jager and E.M.A. Smaling (Eds.). International Fertilizer Development Center, Africa, Lome, Togo, pp: 61-82.

Chude, V.O., 1998. Understanding Nigerian soils and their fertility management for sustainable Agriculture. An Inaugural Lecture, Ahmadu Bello University, Zaria, pp: 33.

Dudal, R. and R.N. Roy, 1995.Integrated plant nutrition systems.Fertilizers and Plant Nutrition Bulletin 12. Food and Agricultural Organization of the United Nations, Rome, pp: 426.

FMANR, 1990. Literature review on soil fertility investigations in Nigeria (in Five Volumes). Federal Ministry of Agriculture and Natural Resources, Lagos, pp: 32-45. Hess, T.M., S. William and U.M. Maryah, 1995.Rainfall trends in the North East and arid zone of Nigeria, 1961-1990. Agric. Forest Meteorol., 74: 87-97

Lombin, G., 1987. Fertilizer requirements of major cereal crops in the Nigerian savanna. Proceedings of the National Fertilizer Seminar, Towards Efficiency in Fertilizer use and Development in Nigeria, October 28-30, 1987, Port-Harcourt, Nigeria, pp: 1-1.

Ogunwole, J.O., E.O. Adewumi and B.A. Raji, 1999.Effect of soil compaction on the physical properties of a Typic Haplustalf. African Soils, 29: 15-23.

Smaling, E.M.A., 1993. Soil Nutrient Depletion in Sub-Saharan Africa. In: The Role of Plant Nutrients for Sustainable Food Crop Production in Sub-Saharan Africa, Reuler, H. and

ISSN: 2455-6939

Volume:01, Issue:02

W.H. Prin (Eds.). Leidschendam Inc., Netherlands, pp:53-67.

Stoorvogel, J.J. and E.M.A. Smaling, 1990.Assessment of soil nutrient depletion in sub-Saharan Africa: 1983-2000. Report 28, DLO Win and Staring Center for Intagrated Land, Soil and Water Research (SC-DLO), Wageningen, Netherlands.

Food and Agriculture Organization, FAO, 2013.Marketing Extension. Retrieved on 7th October 2013 fromhttp://www.fao.org/ag/ags/agricultural-marketinglinkages/marketing-extension/en/

Ovwigho, B. O. and Ifie, P. A. 2009.Principles of Youth Development in Africa. Benin-City: Ethiope Publishers

Swanson, B. E. and Rajalahti, R. (2010). Strengthening Agricultural Extension and Advisory Services: Procedures for Assessing, Transforming and Evaluating Extension Systems. Agriculture and Rural Development Discussion Paper No. 44. Washing

Smaling EMA, Stoorvogel JJ, Windmeijer PN (1993). Calculating soil nutrient balances in Africa at different scales. II: District scale. Fertil. Res. 35:237-250.