Journal of Natural Sciences Research www.iiste.org
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.5, No.1, 2015

Organic Matter Management for Sustainable Tropical Crop Production.

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Abstract

Organic matter exerts a profound influence on crop nutrition, soil structure and cultivation. Healthy soil is the foundation of the food system. It produces healthy crops that in turn nourish people. Maintaining a healthy soil demands care and effort from farmers of which organic matter management is viewed as central to the finest scale approaches used to assess the sustainability of soil systems. Nutrient exchanges between organic matter, water and soil are essential to soil fertility and need to be maintained for sustainable production purposes Agricultural development and production is sustainable when it is ecologically sound, economically viable, socially just, culturally appropriate, humane and based on a holistic scientific approach. This means that sustainable agriculture and rural development including forestry and fisheries must meet the nutritional requirements and other human needs of present and future generations, provide durable and decent employment and where possible enhance the productivity and regenerative capacity of the natural resource base, reduce vulnerability and strengthen self reliance. It is obvious and certain that where the soil is exploited for crop production without restoring the organic matter and nutrient content of the soil and maintaining a good structure, the nutrient cycles are broken, soil fertility declines and the balance in the agro-ecosystem is destroyed.

Introduction

Organic matter exerts a profound influence on crop nutrition, soil structure and cultivation (Adams and early, 2005). Healthy soil is the foundation of the food system. It produces healthy crops that in turn nourish people. Maintaining a healthy soil demands care and effort from farmers (FAO, 2005). By definition, farming disturbs the natural soil processes including that of the nutrient recycling – the release and uptake of nutrients (FAO, 2005). Organic matter management is viewed as central to the finest scale approaches used to assess the sustainability of soil systems (Mullongy and Merckx, 1991). Nutrient exchanges between organic matter, water and soil are essential to soil fertility and need to be maintained for sustainable production purposes (FAO, 2005). Where the soil is exploited for crop production without restoring the soil organic matter and nutrient contents, and maintaining a good structure, the nutrient cycles are broken, soil fertility declines and the balance in the agroecosystem is destroyed (Acquaah, 2002).

Farming systems have tended to mine the soil for nutrients and to reduce soil organic matter levels through repetitive harvesting of crops and inadequate efforts to replenish nutrients and restore soil quality. This decline continues until management practices are improved or until a fallow period allows a gradual recovery through natural ecological processes. Only carefully selected diversified cropping systems or well managed mixed-crop livestock systems are able to maintain a balance in nutrient and organic matter supply and removal, (FAO, 2005; Mullongy and Merckx, 1991; Acquaah, 2002).

The maintenance of soil organic matter levels and the optimization of nutrient cycling are fundamental or basic to the sustained productivity of agricultural systems (Mullongy and Merckx, 1991). However, both are closely related to the bioturbating activities of macrofauna and the microbially driven mobilization and immobilization processes which the activities of large invertebrates also encourage. Maintaining soil organic matter content requires a balance between addition and decompention rates (Mullongy and Merckx, 1991, Adams and Early, 2005; Wikipedia, 2011).

The particular significance of soil organic matter for soil fertility is that it influences so many different soil properties. It is simultaneously a source and a sink for nutrient elements which can form organic moieties; it has physical and chemical properties which facilitate aggregation with mineral particles, particularly clays, and in turn modify soil physical structure and influences soil water requires; and it is a source of energy for the soil biota and thus influences many of the biologically mediated processes of soil (Wikipedia, 2011; Mullongy and Merckx, 1991; FAO, 2005). Thus, soil organic matter itself represents a set of attributes rather than an entity (Mullongy and Merckx, 1991).

According to Greenland and Nye (1959) and FAO (2005), the level of soil organic matter in the soil is determined by the equilibrium between the factors which determine its formation and those which promote its break down. The former include the quantity and quality of the organic input to soil and the later the complex factors which determine the rate of oxidation of the organic molecules. The underlying point about this well known phenomenon is that soil organic matter is a renewable resource. Under a given set of conditions, the organic store of carbon, nitrogen and other nutrients can be replenished to definable levels. Under appropriate management practices, soil organic matter becomes a sustainable resource. (Mullongy and Merckx, 1991; FAO, 2005).

Concept of sustainability

Modern agriculture based on monoculture of cash crop varieties that require high inputs depends on heavy applications of inorganic fertilizers and on chemical pesticides for pest control (Sun and Hsieh, 1992). The sustainability of modern agriculture has become a subject of great concern to policy makers, researchers, and farmers world wide (Acquaah, 2002). There are nearly as many definitions of sustainability as there are people writing about it (FAO, 2005).

Agricultural development and production is sustainable when it is ecologically sound, economically viable, socially just, culturally appropriate, humane and based on a holistic scientific approach. This means that sustainable agriculture and rural development including forestry and fisheries must meet the nutritional requirements and other human needs of present and future generations, provide durable and decent employment maintain and where possible enhance the productivity and regenerative capacity of the natural resource base, reduce vulnerability and strengthen self reliance (USDA,, 2007). Furthermore, it encompasses a number of strategies for addressing a number of problems including loss of soil productivity from erosion and related nutrient losses, the pollution of surface water and fertilizers and low farm incomes as a result of reduced commodity prices and high production costs (Hsieh and Hsieh 1989). According to WECD (1987), sustainable development is that which meets the needs and aspirations of the present without compromising the ability of the future generation to meet their own needs. FAO (1989) defines sustainable agriculture as involving the successful management of resources for agriculture, to satisfy human needs, while maintaining or enhancing the quality of the environment and conserving natural resources. Further more agricultural systems are sustainable when they are environmentally sound, profitable and productive (Kaeney, 1989); maintain an acceptable and increasing level of productivity, that satisfy prevailing needs and is continuously adapted to meet future needs for increasing the carrying capacity of the resource base and other worthwhile human needs (Okigbo, 1991). Young (1985) reported that sustainable land use is that which achieves production combined with conservation of the resource base on which that production depends, thereby permitting the maintenance of productivity. A sustainable cropping system is also one in which the output trend is non-declining and resistant, in terms of yield stability, to normal fluctuations of stress and disturbance. Sustainability can also be defined as the ability of a system to maintain productivity in spite of larger disturbances such as repeated stress or major perturbation (for example the building up of soil salinity or a sudden outbreak of new pest or disease) (Conway, 1985).

Soil organic matter.

Organic matter (or organic material) is matter that came from a once living organism, is capable of decay or the produce of decay; or is composed of organic compounds. The definition of organic matter varies upon the subject for which it is being used (Wikipedia, 2011). Soil organic matter has been described by FAO (2005) as any material produced organically by living organisms (plant or animal) that is returned to the soil and goes through decomposition: it consists of natural carbon-containing materials living or dead, but excluding charcoal (Franzmier *et al*., 1985). At any time, it consists of a range of materials from the intact original tissues of plants and animals to the substantially decomposed mixtures of materials known as humus (FAO, 2005). It is also described in three main categories, the living organisms, dead but identifiable organic matter and humus

(Adams and Early, 2005). In a forest floor for instance, leaf litter and woody material falls to the forest floor, this is referred to as organic material. When it decays to the point in which it is no longer recognizable, it is called soil organic matter. When the organic matter has broken down into a stable humic substance, that resist further decomposition, it is called humus (Wikipedia, 2011).

Most soil organic matter originates from plant tissue. Plant residues contain 60-90 percent moisture. (Wikipedia, 2011; Adams and Early, 2005). The remaining dry matter consists of carbon (C), oxygen (O), hydrogen (H), and small amounts of sulfur (S), nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg). Although present is small amounts, their nutrients are very important from the view point of soil fertility management (FAO, 2005).

Constituents of soil organic matter.
Soil organic matter consists of a variety of components. These include in varying proportions and many intermediate stages, an active organic fraction including microorganisms (10-40percent) and resistant or stable organic matter (40-60 percent), also referred to 95 humus (FAO, 2005).

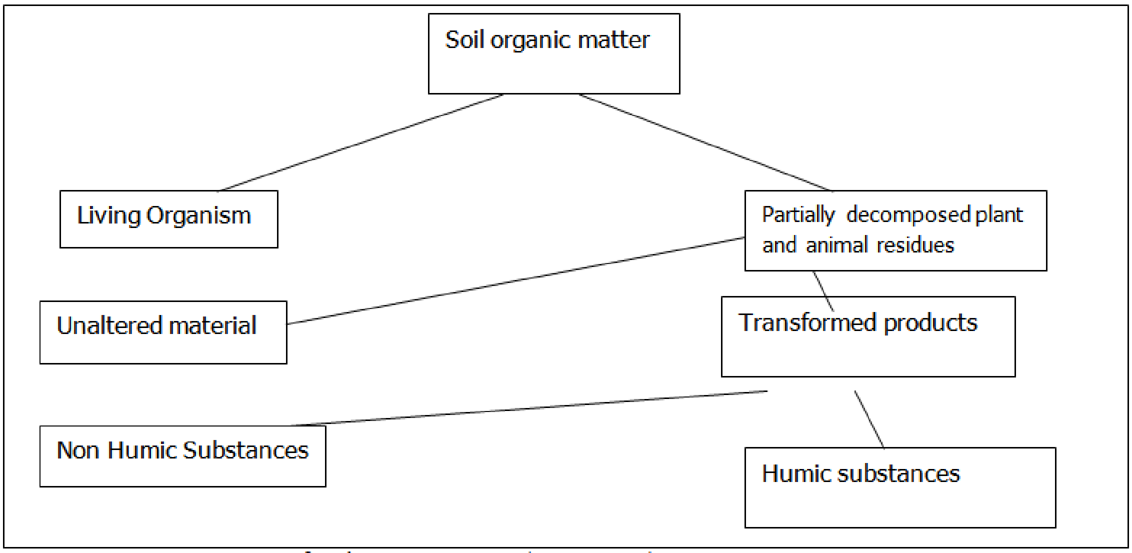

Figure 1: Components of soil organic matter (FAO, 2005).

Living organism.
The living organisms and their interactions enhance many soil ecosystem functions and make up the soil food web. The energy needed for all food webs is generated by primary producers: the plants, litchens, mosses, photosynthetic bacteria and algae that use sunlight to transform Co_2 from the atmosphere into carbohydrate (Adams and Early, 2005; FAO, 2005). The primary consumers are those organisms which feed on the plant materials while secondary consumers feed only on animal material (Adams and Early, 2005). In practice there are some organisms that feed on both plants and animals and also parasites living on other organism in all categories (Magdoff *et al.,* 1996).

Decomposers are an important group which break down dead or decaying organic matter into simpler substances with the release of inorganic salts, making them available once more to the primary produces (Adams and Early, 2005). Secondary decomposers live on waste products of other decomposers and include bacteria and many species of fungi, sometimes referred to as microbial biomass.

Living organism which form part of soil organic matter also include plant roots which shift and move soil particles as they penetrate the soil and grow in size. Others are earth worms, slugs, snails, arthropods such as millipedes, springtails, mites. Others are termites, worms and several other horticultural pests which play an important part in organic matter decomposition (Adams and Early, 2005). About 1000million or more occur in each gram of fertile soil, consequently, despite their microscopic size, the top 150mm of fertile topsoil carries about one tone of bacteria per hectare (Adams and Early, 2005). They attack minerals, leading to weathering of rocks, debris and release of plant nutrients, detoxify pesticides and herbicedes on cultivated soils (FAO, 2005).

Fungi live saprophytically on soil organic matter, some species are capable of utilizing simple organic matter while others decompose lignin (Adams and Early, 2005). Living organism form about 5percent of the total soil organic matter (FAO, 2005).

The activity of soil organism follows a seasonal as well as daily pattern. Not all organisms are active at the same time. Availability of food is an important factor that influences the activity of soil organisms and thus is related to land use and management (FAO, 2005). Practices that increase the numbers and activity of soil organisms include: no tillage or minimal tillage; and the maintenance of plant and animal residues that reduce disturbance of soil organisms and their habitat and provide a food supply (FAO, 2005).

Dead but identifiable organic matter: These comprise above and below ground plant and animal residues which are referred to as litter (Paul, 1997). It also includes partially decomposed plant and animal residues (FAO, 2005).

Humus: Humus or humified organic matter is the remaining part of organic matter that has been used and transformed by many different soil organisms (Tan, 1994); a relatively stable component formed by humic substances (Adams and Early, 2005). It is generally a material that has been more extensively physically and/or biochemically transformed as a result of soil forming processes than macro organic matter (Vaughan and Makolm, 1985)l which coats soil particles and gives top soil its characteristic dark colour (Adams and Early, 2005).
There are two major categories of humus: non humic substances (e.g. amino acids, lipids, carbohydrates) and humic substances (Aseries of high-moleclar weight amorphous compounds). Humic substances include humic acids, fulvic acids and humin. Humic acids are considered to be dark coloured amorphous materials, polymerization products of fulvic acids and other decay products (Vaughan and Malcolm, 1985). They contain primary acid functional groups such as phenolic or carboxylic groups and are composed of molecules with molecular weights in the range of 20,000 to 1,360,000 (Vaughan and Malcolm, 1985). Fulvic acids are organic materials considered to be decay, products of fibrous vegetation high in lignin such as straw (Adams and Early, 2005). They also contain acidic functional groups as well as basic functional groups and are composed of molecules with molecular weights in the range of 275 to 2100 (Vaughan and Malcolm, 1985). Fulvic acid are usually soluble in water under all pH condition with light yellow and light brown colour. Humic acids are soluble in water except for conditions more acid than pH2, and usually dark brown to black colour. Humin, the fraction of humus that is not soluble in water at any pH and that cannot be extracted with strong base such as sodium hydroxide is commonly black in colour (FAO, 2005).

Non humic substances are released directly from cells of fresh residues . this part of soil organic matter is the active or early decomoposed fractions (FAO, 2005). This active fraction is influenced by weather conditions, moisture status of the soil, growth stage of the vegetation, addition of organic residues and cultural practices such as tillage. It is the main food supply for various organisms in the soil (FAO, 2005).

About 35-55 percent of the nonliving part of organic matter is humus (FAO, 2005). Compared to simple organic molecules, humic substances are very complex and large, with high molecular weights. The characteristics of well decomposed organic matter, the humus are very different from those of simple organic molecules (FAO, 2005).

Although soil organic matter can be partitioned conveniently into different fractions these do not represent static end products. Instead the amounts present reflect adamic equilibrium (FAO, 2005).

Organic matter as an index of sustainable soil fertility.
The organic matter content of the soil is often used as an index of soil fertility (Hsieh and Hsieh, 1989). Generally, organic matter enhances the soil in three ways by altering the physical, the chemical and the biological properties (Sun and Hsieh, 1992). The application rate of organic matter is determined by soil fertility, the nutrient content of the organic material concerned and the nutrient requirements of the crop. Sun and Hsieh (1992) reported that less than 2% organic matter in the soil is generally counted to be “insufficient”, 2.5% is “fair” and more than 5% is “plenty”.

Most top soils contain between 1 and 6% of organic matter where as subsoil usually contains less than 2% (Adams and Early, 2005). Soil organic matter is concentrated on the top soil because most of the roots occur in this same zone and the plant residues tend to be added to the surface forming the leaf litter layer (Adams and Early, 2005).

Nutrient exchanges between organic matter, water and soil are essential to soil fertility and need to be maintained for sustainable production purposes (FAO, 2005). Where the soil is exploited for crop production without restoring the organic mater and nutrient content of the soil and maintaining a good structure, the nutrient cycles are broken, soil fertility declines and the balance in the agro-ecosystem is destroyed.

Functions of organic matter in the soil: The basis for sustainable agriculture.

Soil organic matter the product of on-site biological decomposition, affects the chemical and physical properties of the soil and it is overall health. Its composition and breakdown rate affect the soil structure and porosity, the water infiltration rate and moisture holding capacity of soil, the diversity and biological activity of soil organisms and plant nutrient availability (FAO, 2005).

Organic matter within the soil serves several functions.

As a revolving nutrient fund:

Organic matter serves two main functions as a revolving nutrient fund:

As soil organic matter is derived mainly from plant residues, it contains all of the essential nutrients. Therefore accumulated organic matter is a store house of plant nutrients (FAO, 2005).

The stable organic fraction (humus) adsorbs and holds nutrients in a plant available form (Adams and Early, 2005; FAO, 2005).

Organic matter release nutrients in a plant – available form upon decomposition slowly. In order to maintain this nutrient cycling system, the rate of organic matter addition from crop residues manure and any other sources must equal the rate of decomposition and take into account the rate of uptake by plants and losses by leaching and erosion (FAO, 2005; Adams and Early, 2005). According to Khera et al (1976), organic manures have been observed to effectively conserve nutrient, moisture etc, within the soil effective rooting zone. Swift and Anderson (1993) corroborated this report, that organic manures supply nutrients which NPK could not supply. The beneficial effects of organic manure on the nitrogen content of the soil has been largely demonstrated under prolonged use as shown by Tirol-Padre et al (2007) while Moyin-Jesu (2009) reported that organic fertilizers were found to increase the soil N,P,K, Ca and Mg significantly ($P<0.05$). Humic and fulvic acids serves as sources of N,P and S (Tan, 1994; Schnitzer, 2005).

Improvement of Soil Physical Properties: The active and some of the resistant soil organic components together with microbes (especially fungi) are involved in binding soil particles together with mineral particles into larger aggregates (FAO, 2005). Polysaccharides have been reported to promote soil structure through their ability to bind soil particles into stable aggregates. Research indicates that the heavier polysaccharide molecules may be more important in promoting aggregate stability and water infiltration than the higher molecules (Elliot and Lynch, 1984).

Stable, well-structured fine sand and silts are only possible under intensive cultivation if high humus levels are maintained by the addition of large quantities of bulky organic matter (Adams and Early, 2005). Soil aggregation has been linked to either total carbon (C) (Matson *et al.,* 1997) or organic carbon (C) levels (Dalal and Mayer, 1986). More recently, techniques have been developed to fractionate carbon on the basis of liability (ease of oxidation), recognizing that these sub-pools of C may have greater effect on soil physical stability and be more sensitive indicators of C than total C values of carbon dynamics in agricultural systems (Lefroy, *et al.,* 1993; Blair *et al.,* 1995; Blair and Crocker, 2000). The liable carbon fraction has been shown to be an indicator of key soil chemical and physical properties, and has been shown to be the primary factor controlling the breakdown of aggregates in ferrosols (non-cracking red clays) (Bell *et al.,* 1999).

Aggregation is important for good soil structure, aeration, water infiltration and resistance to erosion (FAO, 2005). Surface soil structure is greatly influenced by the soil organic matter and surface soil depth is often defined by charge in organic matter content (Mullongy and Merckx, 1991). The surface charges on humus are capable of combining with clay particles, thereby making heavy soils less sticky and more friable (Adams and Early, 2005); often protecting the coated particles from weathering (Paul, 1997). Long term studies have shown that organic manures largely improved soil physical condition such as moisture retention capacity and aggregate soil stability, crop water use efficiency (Hati *et al.,* 2006). Humic and fulvic acids are considered to be hydrophilic, as such, they have high affinity for water and are solvated in aqueous solution (Paul, 1997). Organic compounds (organic colloids <2 micrometer) have the characteristic to increase field capacity because they tend to hydrolyze. Generally, organic matter can hold up to 20 times its weight in water. This is particularly important for sandy soils to improve moisture conditions during dry seasons, when precipitation is limited and evapo-transpiration rates are high (Scialabba, 2001).

The deterioration of soil physical properties have been shown to accompany organic matter decline as observed by Aina (1976), who reported a considerable reduction in soil aggregate stability, porosity, hydraulic conductivity and increased bulk density on an liwo soil in southwestern Nigeria over 10years or continuous cultivation which resulted in declining soil fertility and increased soil loss through erosion

Detoxification of the Soil Poisonous Substances

One of the most striking characteristics of humic substances is their ability to interact with metal ions, oxides, hydroxides mineral and organic compounds including toxic pollutants, to form water-soluble and water insoluble complexes. Through the formation of these complexes, humic substances can dissolve, mobilize and transport metals and organics in soils and water, or accumulate in certain soil horizons. This influences nutrient availability, especially those nutrients present in macro concentrations (Schnitzer, 1986). Accumulation of such complexes can contribute to a reduction of toxicity e.g aluminium (Al) in acid soil (Tan and Binger, 1986) or capture of pollutants – herbicides such as atrazine or pesticides such as Tefluthrin – in the cavities of the humic substances (Vermer, 1996).

Improved cation exchange capacity of soils:

The resistant stable fraction of the soil organic matter contributes mainly to the nutrient holding capacity of the soil or its cation exchange capacity (FAO, 2005; Adams and Early, 2005), and hence to the retention of exchangeable cations (Magdeff, *et al.,* 1996). This is because humification produces organic colloids of high specific surface area. It should be stressed that the cation exchange capacity (CEC) of soil organic matter is completely pH dependent and buffered over a wide range of H^+ ion concentration (Vaughan and Malcolm, 1985). The functional groups such as the COOH (Carboxylic) and the oH (phenolic groups) dissociate H^+ ions and can accept cations such as K^+, Na^+, Mg^{2+}. These cations are generally considered to be part of a reservoir of exchangeable cations in the soil. The approximate CEC of organic matter varies between 1500-5000 cmol/kg. From 2-20% of CEC of many soils is caused by organic matter (Franzmeier et al., 1985, Paul, 1997).

Reports by Young (1976) indicated that organic manure addition to acidic weathered soils increased the cation exchange capacity. This was confirmed by Akamigbo (1990) who observed that organic matter contributes about 71% of CEC in oxisols; 70% in ultisols and 58% in alfisols. Regular application of farm yard manure (10 to 20tha^{-1}) for over 27years was found to increase the cation exchange capacity from 15meq/100g soil to 21 meq/100g soil (Egawa, 1975). Agboola et al (1975) also reported that there is reduced acidification, increased contents of exchangeable calcium, thus enhancing root growth and uptake of phosphorus when regular applications of organic matter is maintained. Junadasa et al (1997) reported that application of organic manures increased soil pH, organic matter content, available phosphorus, and increased soil salinity and extractable iron.

Improved soil biological life:

Organic matter stimulates a rapid multiplication and activities of soil improving biofertility indicators (bioindicators) and ecosystem engineers essentially snail, earth worms, millipedes, termites, worms etc (Swift *et al.,* 2008). The living part of soil organic matter includes a wide variety of micro-organisms such as bacteria, viruses, fungi, protozoa and algae, insects, and larger animals such as moles, rabbits, mice that spend a part of their lives in the soil. The living portion represents about 5% of total soil organic matter (FAO, 2005). Microorganisms, earth worms and insects help break crop residues and manure s by ingesting them and mixing them with minerals in the soil and in the process, recycling energy and plant nutrients. Sticky substances on the skin of earthworms and those produced by fungi and bacteria help build soil particles together (Adams and early 2005), earthworm casts are more strongly aggregated (bound together) than surrounding soil as a result of the mixing of organic matter and soil minerals as well as intestinal mucus of earth worms. Organism soccur wherever organic matter occurs (Ingham, 2000). Therefore soil organism are concentrated around roots, litter, on humus, on the surface of soil aggregates and in spaces between aggregates (FAO, 2005).

According to Schialabba (2001), organically manages systems have upto 100 percent more carabids, 70-120percent more spiders, 30-40 percent more earthworms, more mycorrhizal colourization of roots, 20-85percent more microbial biomass and hence higher rates of decomposition of organic matter with little light fraction material remaining undecomposed than in conventional farming-systems. Furthermore, the ratio of microbial carbon to total soil organic carbon is higher in organic system, the difference being significant at 60cm depth, markedly higher enzyme activities higher energy efficiency and greater erosion control than in conventional systems (Schialabba, 2001). According to Adams and Early (2005), organic matter stimulates increased population and activities of rhizobia and azobactor species which fix gaseous nitrogen as well as other bacteria which play important roles in detoxification of the harmful organic materials such as pesticides and her bicides.

Effect on soil colour and temperature:
Because of the dark colour of organic compounds, the adsorption of solar radiation is high and reflection low, therefore soils high in soil organic matter tend to warm-up faster than soils low in soil organic matter (Paul, 1997).
Organic matter existing on the soil surface as raw plant residues help to protect the soil from effect of rainfall, wind and sun, thus controlling or reducing temperature fluctuation and maintaining lower soil temperatures (FAO, 2005). Chadbury and Prihar (1974) reported that organic manure mulches decrease soil temperatures and improve root growth.

Buffering:
Organic matter exhibits buffering in slightly acid neutral and alkaline range. This buffering helps to maintain a uniform reaction in the soil (Paul, 1997). Sweenen (1990) reported that organic matter buffers soil fluctuating physico-chemical properties and temperature of the tropical uitisols.

Improved plant growth, protection, and yields:
By breaking down carbon (C) structures and rebuilding new ones or storing the C into their own biomass, soil biota plays the most important role in nutrient cycling processes and, thus, in the ability of a soil to provide the crop with sufficient nutrient to harvest a healthy product (FAO, 2005).

Humic and fulvic substances enhance plant growth directly through physiological and nutritional effects. Some of these substances function as natural plant hormones (auxins and gibberellins) and are capable of improving seed germination, root initiation, up take of plant nutrients and can serve as source of N, P and S (Tan, 1994).
Indirectly, they may affect plant growth through modification of physical, chemical and biological properties of soil (Stevenson 1994). Organic matter addition to the soil has been reported to improve soil fertility, crop performance and yields (Kaur *et al.,* 2005; Sakar *et al.,* 2005). Musa (1975) reported that yields of sorghum in Sudan were increased from $1.3tha^{-1}$ to $2.4tha^{-1}$ by using farm yard manure. Tsai Huang and Hay (1989) reported that yield of sorghum increased by 20% when 20metric tones of Berseem clover were ploughed slightly under the soil as green manure and by 40% when 30 metric tones of clover was applied. Growth parameters of date palm, cola, African cherry nut and bitter cola seedlings in the nursery have been enhanced by use of organic manures of different sources in their sole and supplemented forms (Aisueni *et al.,* 2009; Moyin-Jesu, 2009; Moyin-Jesu and Adekayode, 2010; Moyin-Jesu, 2008). Ogazi (1996) reported that the high productivity of plantation under small holder compound production system is attributed to such house hold wastes including livestock waste, waste water, and wood ash thrown around the plantain mats. Poultry manure at the rate of 10 to 50 tha^{-1} gave optimum response of marketable yield of *Cochous oliltorius* (Adejoro, 1999), cabbage (Holchmut *et al.,* (1993), peppers, egg plant, tomatoes and okra (Maynard, 1991; Hussein, 1997; Alasiri and Ogunkeyede, 1998).

Agronomic practices that influence nutrient cycling, especially mineralization and immobilization result in an immediate productivity loss or gain, which is reflected in the economics of the agricultural system (FAO, 2005). Crop yields in systems with high organic matter content are less variable than those in soils that are low in organic matter. This is because of the stabilizing effects of favourable conditions of soil properties and microclimate. (FAO, 2005). Improvement in crop growth and vigor stem from direct and indirect effect. Direct effects stem from improvements in nutrient and water content while indirect effects stem from a favourable rooting environment and possible weed suppression and a reduction in pests and diseases (FAO, 2005; Adams and early, 2005). Ihejinka et al (2009) reported that soil amendment with poultry manure at 5, 10 and $20tha^{-1}$ significantly influenced field diseases in kola. The resistance to field disease in kola maybe attributed to the fact that poultry manure has the capability of ecological production management system that promotes and enhances biodiversity, biological cycles, soil biological activity that encourages nutrient availability for healthy growth of kola seedlings, reduces soil salinity and extractable ions immobilization. All these provide an un-conducive environment for disease incidence, symptom, manifestation and spread. Apart from the fact that proper manures enhance crop yield on most soils (Maynard 1991), it also sustains plants capability to resist disease attack. Generally, pests and pathogens responsible for field diseases are attracted to inferior or weak plants, the result of crop nutrition (Anon, 1998). This means that they are naturally repelled by vigorous, well-nourished plants (Ihejinka *et al;* 2009).

Reduced soil erosion and improved water quality.

The less the soil is covered with vegetation, mulches, crop residue, etc, the more the soil is exposed to the impact of raindrops. When a rain drop hits above soil, the energy of the velocity detaches individual soil particles from the soil clods. These particles can clog surface pores and form many thin, rather impermeable layers of sediments on the surface, referred to as surface crusts. These surface crusts hinder passage of rain water into the profile, with the consequence that runoff increases (FAO, 2005). This breaking down of soil aggregates by rain drops into smaller parities depends on the stability of the aggregate, which largely depends on the organic matter content (Adams and Early, 2005). Increased soil cover can result in reduced soil erosion rates close to the regeneration rate of the soil or even lower, as reported by Detanba and Amado (1997) for an oats /maize cropping system.

When the soil is protected with mulch, more water infiltrates into the soil rather than running off the surface. This causes streams to be fed more by subsurface flow rather than by surface run off. The consequence is that water is clearer and resembles groundwater more closely, compared with areas where erosion and run off predominate. Increased infiltration reduces flooding by increased water storage in the soil and slow release into streams as well as improves groundwater recharge, thus increasing well supplies (FAO, 2005).

Improved food quality:

Wikipedia (2006) reported that organically grown potatoes, oranges and leafy vegetables have more vitamin c, than conventionally grown foods. Phenollic compounds are found in significantly higher concentrations in organic foods and they may provide anti-oxidant protection against heart disease and cancer. A study in the Journal of American College of Nutrition (2004) compared vegetables analyzed in 1950-1999 and found noticeable decreases in six of thirteen nutrients examined. The six were protein, calcium, phosphorus, iron, riboflavin and ascorbic acid. Percentage reductions range from 6% for protein to 35% of riboflavin.

Factors that determine organic matter quantities in the soil.

There are natural and man made factors that determine the amount of organic matter in the soil. The organic matter level in the soil depends on how much fresh maternal is added compared to the rate of decomposition (Adams and Early, 2005).

The natural factors include:

-Climate
-Soil type
-Vegetation
-Topography
-Soil organisms
-Parent material
-Time
-Soil texture
-Salinity or acidity

Human activities affect soil organic matter contents by increasing or decreasing organic matter and biological activity.

Human activities that decrease organic matter levels in the soil include.

Decreased biomass production through replacement of perennial vegetation with agricultural crops. A consequent of clearing forest for agriculture is the disappearance of the litter layer, with a consequent reduction in the numbers and variety of soil organisms (FAO, 2005).

Decrease in organic matter supply through burning of natural vegetation and crop residues which leads to elimination of organism that inhabit soil surface and litter layer (Scialabba, 2001).

Overgrazing which increases erosion hazards and reduces the nutritive value and carrying capacity of the land (FAO, 2005).

Tillage practices such as ploughing, harrowing, leading to more breakdown of soil organic matter, increase the potential for erosion by wind and earth worms, disturbing their burrows and living space (Glanz, 1995).Thus affecting,-Drainage,-Crop removal, -Fertilizer and pesticide use

Human practices that increase soil organic matter include:-

-Addition of composts
-Cover crop/green manure crops

-Crop rotation
-Perennial forage crops
-Zero or reduced Tillage
-Agroforestry and alley cropping
-Increased biomass production
-Water harvesting and irrigation
-Balanced fertilization
-Mulching
-Protection from fire
-Integrated pest management

Sources of Organic Matter
-Composting
-Straw
-Farm yard manure
-Horticultural peats
-Leaves
-Mulching with trash, sawdust, woodchips, etc
-Air-dried digested sludge
-Leys
-Animal droppings e.g. poultry, manure, goat manure, cow dung pig manure etc.

Conclusion
The maintenance of organic matter levels and the optimization of nutrient cycling are essential to the sustained productivity of agricultural system (FAO, 2005). Both are related closely to the bioturbating activities of macro-fauna and the microbially driven mobilization and immobilization processes which the activities of large invertebrates, also encourage. Maintaining soil organic matter content requires a balance between addition and decomposition rates.

Crop production worldwide has generally resulted in decline in soil organic matter levels and, consequently in a decline of soil fertility. Converting grass lands and forest lands to arable agriculture results in the loss of about 30 percent of the organic C originally present in the soil profile (FAO, 2005). In low- input agricultural system, yields generally decline rapidly as nutrient and soil organic matter levels decline.

However restoration is possible through practices that ensure proper organic matter and nutrient management that guarantee proper soil health, activities soil life and ultimately healthy crop and improved crop yields. Reduced or zero tillage, integrated pest management, crop rotation, agroforestry, are strongly integrative and may signify an early shift followed by other improved land use practices that offer protection of the resource base over the long-term without sacrificing the level of agricultural productivity. These also promote above and below ground diversity which is important to maintain a well functioning and stable ecological system. Where many different types of organisms co-exist, there are fever problems with diseases, insects and rematches, move competition among species, and more possibility for many types of predators to thrive, in such a situation, no single pest organism is able top reach a population of sufficient size to affect crop yield seriously (FAO, 2005; Adams and Early, 2005; Millongy and Merckx, 1991).

Farmers can take many actions to maintain, improve and rebuild their soils, especially soils that have been under activation for a long time. A key to soil restoration is o maximize the retention and recycling of organic matter and plant nutrients and to minimize the losses of these soil components caused by leaching, run off and erosion (FAO, 2005). However, rebuilding soil quality and health through appropriate farming practices may take several years, especially in dry land areas where limited moisture reduces biomass production and soil biological activity. Thus the challenge is to identify soil management practices that promote soil organic matter formation and moisture retention and ensure productivity and profitability for farmers in the short term (Adams and Early, 2005; FAO, 2005).

References

Adams, C.R. and M. P. Early (2005). Principles of Horticulture (Fourth Edition). Elsevler, Butterworth. Heinemann 185-193 pp.

Acquaah, (2002). Horticulture principles and practice. Pearson Education Publishers Ltd Singapore 705-722pp.

Adejoro, S. A. (1999). Residual effect of poultry manure on jute (*corchorus olitorius*) plant. B. Agri tech, project, F.U.T.A, Nigeria, 31p.

Agboola, A. A., G. O. Obigbesan and A. A. Fayemi (1975). Interrelations between organic and mineral fertilizers in the tropical rainforest of Western Nigeria. FAO. Soil Bulletin No. 27: 337-351.

Aisueni, N. O., C. E. Ikuenebe, E. C. Okdo and F. Ekhator (2009). Response of date palm (Pheonix dactylifera) seedlings to organic manure, N and K fertilizers in polybag nursery. *African Journal of Agricultural Research*, 4(3) 162-165.

Alasiri, K. O and D. O. Ogunkeyede (1998). Effects of poultry manure on seed yield of okra. Program of activities and abstract of papers, presented at 24^{th} conference of Nigeria, December 7-11, Abubakar Tafawa Balewa University, Bauchi Nigeria 17p.

Anon, A. (1998). Effects of Weed removal regimes and poultry manure on the growth and yield of Okra. Post Graduate Diploma Project F. U. T. A. Nigeria.

Bell, M. J., P. W. Moody, S. A. YO and R. D. Connolly (1999). Using active fractions of soil organic matter as indicators of the sustainability of ferrosol farming systems. *Aust . Jnl soil Res*. 37:279-287.

Blair, G. J., R. D. Lefroy and L. (1995). Soil Carbon fractions based on their degree of oxidation, and the development of a carbon management index for agricultural systems *Aust. Ju. Soil Res*., 46:1459-1466.

Blair, N. and G. J. Crocker (2000). Crop rotation effects on soil carbon and physical fertility of two Australian soils. *Aust. Jnl. Soil Res.,* 28: 71-84.

Conway, G. R. (1985). Agricultural ecology and farming systems research in Remenyi, I. V. (ed) Agricultural Systems Research for Developing Countries Camberra, Australia ACIAR.

Dalal, R. C. and R. J. Mayer (1986). Long-term trends in fertility of soils under continuous cultivation and cereal cropping in southern Queenland. Changes in soil properties and trends in winter cereal yields *Aust. Jnl. Soil Res.*, 24: 281:292.

Detarba, L. and T. J. C. Amado (1997). Desenvolvmento de sistemas de prodducacde milho no sul do brasil com carateristicas de sustentabilidade. *Rev. bras. Cien. Solo* 21:473-480.

Egawa, T. (1975). Utilisation of organic materials as fertilizers in Japan in FAO soils Bulletin 27: 253-271.

Elliot, L. F. and J. M. Lynch (1984). The effect of available carbon and nitrogen in straw on soil on ash aggregation and acidic acid production. *Plant soil.* 78:335-343.

FAO (1989). Soil tillage in Africa: Needs and challenges, FAO soil Bulletin No. 69. Rome.

FAO (2005). The important of soil organic matter. FAO corporate document Repository . http//www.fao.org/docrep/009/a0100e02.htm.

Franzmeier, D.P., G. D. Lamme and R.J. Miles (1985). Organic carbon in soils of North Central United States. *Soil. Sci. Soc. Am. J.,* 49:702-708.

Greenland, D.J. and P.H. Nye (1959). Increases in the carbon and nitrogen contents of tropical soils under natural fallows, *J. Soil. Sci.* 10:284-99.

Hsieh and Hsieh (1989). Organic farming. Special publication No. 16 of he Taichung District Agricultural Improvement Station Taiwan R. O. C. 307pp.

Hussein, T. O. (1997). Effects of poultry manure and the growth of tomatoes proc. 15^{th} Ann. Conf. HORTSON. April 8-11, NIHORT Ibadan Nigeria. 45pp.

Ihejirika, G.O., I. I. Ibeawuchi, J. C. Obiefuna, O. Obilo and W. J. Nwokocha (2009). Organic soil amendments as a protectant for Kola seedlings transplant against some field diseases in kola based cropping system. *International Journal of Agriculture and Rural Development*. 100-109pp.

Lugham, E. R. (2000). The soil food web in: Soil Biology primer. Rev. Edition. Ankeny, U.S.A., Soil and water conservation society.

Junadasa, K. B., P. N. Milham, C. A. Hawkins, P. S. Comish, R. A. Williams, C. J. Kaldo and J. P. Conroy (1997). Survey of cadmium levels in vegetation and soils of greater Sydney. *Australia Journal of Environmental Quality*, 26: 924-933.

Kaeny, D. R. (1989). Towards a sustainable agriculture: Need for clarification of concepts and terminology. An *J. Alt. Agric*, 4:101-105.

Khera, K. C., P. Khera, S.S. Prihar, B.S. Sandhu and K. S. Sandhu (1976). Mulch nitrogen and irrigation effects on growth, yield and nutrient uptake of maize and cowpea. *Field crops Research* 4: 33-35.

Lefroy, R. O. E., G. J. Blair and W. M. Strong (1993). Changes in soil organic matter with cropping as measured by organic matter fractions and B. C. natural isotope abundance. *Plant soil*, 155:156:399 - 402.

Magdoff, F. R., M. A. Tabatabia and E. A. Hanlon, Jr. (1996). Soil Organic Matter. Analysis and Interpretation. Soil Science of America, Madison, WI.

Matson, P. A., W. J. Parton, A. G. Power and M. J. Swift (1997). Agricultural intensification and ecosystem properties. *Science* 277:509-509.

Maynard, A. A. (1991). Nitrate Leaching from compost amended soils. *Compost Science, Utilization* 1: 65-72.

Moyin –Jesu, E. I. (2009). Evaluaton of sole and amended organic fertilizers on soil fertility and growth of kola seedlings (*Cola acuminata*). *Pertanika Journal of Tropical Agricultural Science*, 32CD: 17-23.

Moyin-Jesu, E. I. and F. O. Adekayode (2010). Comparative evaluation of different organic fertilizers on soil fertility improvement, leaf mineral composition and growth performance of African Cherry Nut (*Chrgsophyllum albidium* L.) seedlings. *Journal of American Science*, 6:8.

Mullongy, K. and R. Merckx (1991). Soil Organic Matter Dynamics and Sustainability of Tropical Agriculture. Proceedings of an International Symposium, Laboratory of Soil Fertility and Soil Biology, Katholieke Universitiel Leuven (K. U. Leuven) and IITA. Leuven, Beligium 4-6 Nov, 1991. John Willey and Sons, Sayce Publishing (UK) and K. U. Leuven – Belgium, IITA Nigeria 3-17pp.

Ogazi, P. O. (1996). Plantain production, Processing and Utilization. Raman and Associates Publishers, Okigwe, Imo State. 1-22pp.

Okigbo, B. N. (1978). Cropping Systems and Related Research in Africa. 10th Anniversary of A.A.A.S.A. Accessional Publication Series. O.T.I. April, 1978.

Paul E. A. (1997). Soil Organic Matter in Temperate Agroecosystems: Long-term Experiments in North America CRC Press.

Sclalabba, N. E. (2001). Organic Agriculture and Soil Biodiversity.

Schnitzer, M. (1986). The Synthesis, Chemical structure, Reactions And Functions of Humic Substances. In R. G.. Burns, and Dell Agnola, S. Miele, S. Mardi, G. Savoinin, M. Schnitzer, P. Sequi, D. Vaughan and S. A. Visser eds. Humic substances effect on soil and plants. Congress on Humic Subtances. March, 1986, Milan, Italy.

Stevenson, F. J. (1994). Humus Chemistry, genesis, composition reactions. 2nd edition New York, USA. Wiley Interscience 512pp.

Swift, M. J. and J. M. Anderson (1993). Biodiversity and ecosystem function in Agricultural Systems. In Schulz, D. and Mooney, H. (eds). Biodiversity and Ecosystem Function. Berlin, Germany: Springer. Verlag.

Sweenen, R. (1990). Plantain cultivation under West African conditions, reference manual. IITA Ibadan Nigeria, 1-18pp.

Tan, K. H. (1994). Environmental soil science. New York, USA. Marcel Dekker Inc. 304pp.

Tan, K. H. and A. Binger (1986). Effect of Humic acid on aluminium toxicity in corn plants. *Soil Sci*. 14:20-25.

Tirol-Pardre, A., J. K. Ladha, A. P. Regmi, A. L. Bhandari, and K. Inubishi (2007). Organic amendments affect soil parameters. *Soil science*, 37:29-38.

Tsai, Y.F., S.C. Hangaud E. L. Lay (1989). Effects of green manure on the growth of spring sorghum. Bulletin of the Taichung District Agricultural improvement station 23:11-20.

USDA (2007). Sustainable Agriculture: Definitions and Terms. Alternative Farming System Information Centre. National Agricultural Library, Agric Research service. USDA Baltimore, Beltsville.

Vaughan, D. and R. Malcolm (1985). Soil organic and Biological Activity. Dordrecht, Boston.

Vermer, A. W. P. (1996). Interaction between humic acid and hematite and their effect on metalion speciation. Wageningen University. The Netherlands (PH. D. Thesis).

WECD (1987). Our common future. Oxford U.K. Oxford University Press.

Wikipedia (2011). Wikipedia the free encyclopedia. Organic matter. Wikipedia.org.

Wikipedia (2006). Motivations for organic agriculture. http://www.en.wikipedia.org/wiki/2006

Young, A. (1989). Agro-forestry for Soil Conservation. Wallingford, UK/Nairobi, Kenya CAB international/ICRAF.