

A Review on Achieving Food Security at the Expense of the Environment: an Advocacy for Organic Agriculture Practices in Nigeria

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Abstract

The ever increasing world population and the need to feed the entire populace resulted in pressure on land resources due to increasing land area under cultivation and intensification of production per unit land area. Massive use of external inputs that increases the cost of production became the order of the day in last few decades due to neglect in management of land resources required to sustain productivity. However, no respite has come to us in the food production sector with the practice of high input and high energy based production technology. This is evident in the increasing level of food imported into our Nation. The immediate effects of the impact of conventional agricultural practices reflect as low yield from farmers plot below the genetic potential of the crops, soil depletion and land degradation, deforestation due to expanding land area in order to cope with food demand, climate change and environmental pollution from the use of pesticides and other agrochemicals. The use of agro-chemicals and inorganic inputs also compromises human health through the toxic residues that enter the food chain through agricultural practices. The fact that the bulk of our nationally produced agricultural commodities come from peasant or small scale farmers is a pointer that the solution to our food security is not in massive land area cultivation but in intensive production with little external inputs. This is achievable with organic agricultural practices. Organic agriculture ensures sustainable production without jeopardizing the environment with the use of eco-friendly agricultural practices, recycling of farm resources in order to prevent use of synthetic external inputs and thereby reducing the negative environmental impact associated with conventional agriculture. In addition to these, farmers' livelihoods will be enhanced through better income obtainable from their produce that can be offered at premium price. One of the cardinal principles of organic agriculture centres on health of man, crops and animal and environment. The exclusion of the use of hazardous pesticides and other external inputs guarantees the safety of human and our environment.

Key words: Eco-friendly agricultural practices, Sustainable production, Organic agriculture, organic amendments.

Introduction

The world is facing food security challenges as a result of increasing world population without a commensurate growth in food production. This situation is more critical in developing nations where the population growth outpaces the growth in food production and supply. This is also complicated by the lack of food sovereignty which is the ability to either purchase and/or produce one's own food including access to resources. FAO (1996)

define food security as “when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life”. To nourish a population adequately, there must be sufficient quantity and a variety of good quality and safe food in the country. For adequate food to be available there must be adequate production or sufficient funds at the National, local or family level to purchase enough food (Latham, 1997). FAO (1996) describe food security on four dimensions namely: food availability, food accessibility, food stability and utilization.

The ever increasing world population and the need to feed the entire populace resulted in pressure on land resources due to increasing land area under cultivation and intensification of production per unit land area. Conventional agriculture intensifies production by increasing external inputs such as chemical fertilizers, pesticides, water, hybrid and genetically modified seeds and in the case of animal production feed concentrates and pharmaceutical drugs. Massive use of external inputs that increases the cost of production became the order of the day in last few decades due to neglect in management of land resources required to sustain productivity. No respite has come to us in the food production sector with the practice of high input and high energy based technology production.

Agricultural production activities have substantially affected the functioning of the ecosystem both positively and negatively in the tropical environment especially among the developing nations. It has places a serious burden on the environment in the process of providing humanity with food and fibres (FAO, 2003). Several conventional agricultural practices has direct or indirect impact on the environment with soil depletion and land degradation, deforestation due to expanding land area in order to cope with food demand, climate change and environmental pollution from the use of pesticides and other agrochemicals being the critical impacts. The use of agro-chemicals and inorganic inputs also compromises human health through the toxic residues that enter the food chain through agricultural practices. The quantum gains in agricultural production and productivity achieved in the past were accompanied by adverse effects on the resource base of agriculture that put in jeopardy its productive potential for the future. Hence, there is a pressing need for the promotion, advocacy and adoption of eco-friendly agricultural practices and resilient agricultural farming system as found in organic agriculture.

Organic agriculture defined by International Federation of Organic Agriculture Movements (IFOAM) indicates it as a holistic production management system which enhances agro-ecosystem health, utilizing both traditional and scientific knowledge. Organic agricultural system relies on ecosystem management rather than external agricultural inputs. Organic agriculture ensures sustainable production without jeopardizing the environment with the use of eco-friendly agricultural practices, recycling of farm resources in order to prevent use of external inputs and thereby reducing the negative environmental impact associated with conventional agriculture. Eco-functionally intensified production systems enable more food to be produced without compromising the quality of the environment and our food. In Organic Agriculture eco-functional intensification is achieved by higher inputs of knowledge, observation skills and agro-ecological methods to intensify the beneficial effects of eco-system functions including, biodiversity and soil fertility, minimizing loses from material cycles and utilizing the self-regulating mechanisms of biological systems to achieve stable farming systems (IFOAM, 2009).

The objectives of this paper are to highlight (i) the drives towards achieving food security (ii) impacts of conventional agriculture on environment (iii) roles of organic agriculture in achieving food security without compromising the environmental resources.

The drive to reduce food insecurity

Agriculture is one of the key aspects to the functionality of our society especially in the developing nations where agriculture and agro-allied industries provide the major source of employment. Food accessibility in the developing world is tied closely to local food production in smallholder farms which can often be increased significantly through improving the use of locally available resources and agro-ecological methods for soil fertility building and pest prevention (IFOAM, 2009).

In the last 15 years, the drive to reduce hunger has been slow and varied around the world and the percentage of hungry people is increasing in the sub-Saharan Africa (UNCTAD-UNEP, 2008). Therefore, the fundamental food security challenges still stare at our faces. There is a combination of reasons for rising global hunger including; market rather than people focused agricultural policies, poverty, lack of food sovereignty, climate change, degraded and unproductive farming systems and the destruction of ecosystems and their services (IFOAM, 2009). Over 70% of the food insecure population in Africa lives in the rural areas. This comprises of small scale farmers that produce bulk of food supply in these nations. Thus food insecurity cannot be significantly reduced without transforming the living conditions of those rural farmers. The keys lie in increasing profitability of small scale farmers. Organic Agriculture can help put the needs of the most vulnerable first and break the cycle of poverty. It is best practice for achieving food security through the support of the world's smallholder farms.

Efforts at solving food supply problem has been directed towards doubling supply by redoubling efforts towards modernized agriculture and through intensification of production and increasing acreage of production. Despite the technological advancement in the last half century, it has not led to major reduction in hunger and poverty in developing countries. Fundamentally the lack of knowledge of affordable, sustainable, resilient and productive farming systems that put the needs of local people and ecosystems first is missing (IFOAM, 2009). The lack of adoption of the systems is a major barrier to food security and accessibility in the developing world where majority of the farmers are small scale farmers. These farmers produce on small (less than 2 ha) and marginal (less than 1 ha) farms and form the backbone of local food security throughout the developing world (IFOAM, 2009)

Impacts of modern agriculture on environment

Ecosystem has several benefits such as provision of fresh water, food, feed, fibre, biodiversity, energy and nutrient recycling (Killebrew and Wolff, 2010). Agricultural production activities have substantially affected the functioning of the ecosystem both positively and negatively. It has placed a serious burden on the environment in the process of providing humanity with food and fibres (FAO, 2003). In an agro-ecosystem, the deliberate cultivation and rearing of animals modify and changes ecosystem dynamics through agricultural practices that takes away the natural habitats. This worsened with the increase food demand and intensification of production which places higher demand on the environment in order to meet the food, feed and fibre requirements of man. In the last half century, the growth in the global food production placed higher demand on the food,

feed and fibre components of the ecosystem resulting in overall decline in the other ecosystem benefits (biodiversity, energy, nutrient recycling etc.). Agriculture also generated adverse effects on the wider environment, e.g. deforestation, loss or disturbance of habitat and biodiversity, emissions of greenhouse gases (GHGs) and ammonia, leaching of nitrates into water bodies (pollution, eutrophication), off-site deposition of soil erosion sediment and enhanced risks of flooding following conversions of wetlands to cropping (FAO, 2003).

Over the last few centuries several means have been deployed to improve the efficiency of our agricultural practices which has increased the carrying capacity of the earth and allowed for more people to survive on our planet (Önder *et al.*, 2011). With advances in the agro-techniques of crop and animal production in order to tap the main provision of the environment (fresh water, food, feed and fibre), a great impact on our environment was observed as evidenced on the quality these services derived from the ecosystem and other ecosystem services (biodiversity, energy, nutrient recycling etc.) with the greatest tradeoffs. To prevent further irreversible damage to these ecosystem services, deliberate action needs to be taken. It will be difficult to find a balance that reduces the negative impacts that are plaguing our environment while still allowing for the practices that provide nourishment to so many in the world (Önder *et al.*, 2011).

Impact of fertilizer use on environment

In conventional agriculture, import of nutrients rather than recycling of nutrients within the agricultural system are emphasized. High input of fertilizer particularly Nitrogen, Phosphorus and Potassium which are the most deficient major element is deployed for sustainable production. These inputs of nutrients to agricultural system are either stored or transferred (Jenkins, 2004). However, tropical soils are characterised with low activity clay and low nutrient holding or storage capacity for these nutrients. The storage capacity is exceeded when the input exceed the rate of use or uptake. The resultant effect is losses through overflow. These nutrients are lost in forms of run-off, erosion, and volatilization and leaching. The nutrients end up becoming environmental pollution in adjacent fields, ground waters and water bodies.

In Nigeria and other developing nations, the addition of fertilizer and soil amendments to the soil are either used excessively or applied at sub-optimal level. Modern agricultural techniques are typically wasteful in their use of fertilizers. Often, many farmers add large amounts of fertilizer or manure at the time of sowing. This technique is inefficient, since the young plants are unable to absorb most of the nitrogen. Therefore, much of the nitrogen is lost to the environment in a number of ways (Rodriguez *et al.* 2004). The instances of excessive application usually result from adoption of blanket application method without prior knowledge of the soil nutrient status on the field. The excessive application of nutrients beyond the requirements of crops and what the soil can store will ultimately results in environmental pollution. The long-term ecological impacts of increased rates of agricultural nitrogen and phosphorus input will depend on the levels to which these nutrients accumulate in various non-agricultural ecosystems (Tilman, 1999). Among these major elements, Nitrogen has been implicated in several pollution cases, this include eutrophication, contamination of ground water by nitrate leaching and contribution to the green house effect by release of nitrous oxide during denitrification. Optimising the application of fertilizers, Organic Agriculture also avoids eutrophication of water bodies caused by oversupply of highly soluble fertilizers, manure and slurry (IFOAM, 2009).

Impact of pesticide use on environment

The practice of intensive agricultural production is associated with modification of ecosystem due to activities that deviates from the normal ecological systems. The resultant effect of the modification is the changes in dynamics of pest population in the environment. In normal ecosystem, these pest organisms may not assume a status of pest but agro-ecosystem provides and multiplies suitable habitats for these pests to attain pest status through adoption of practices such as mono-cropping and continuous cropping that lacks diversity. Also associated with this is the rapidly changing weed population in the environment. In the bid to combat these agricultural menaces and to reduce drudgery associated with manual weed control; several variants of pesticides were produced as means of achieving quick and efficient control on a large scale. Pesticides that are used to eliminate harmful insects, microorganisms and other pests when mixed with soil, water, air and food, causes pollution on the agricultural foods and affect both human health and natural balance and become environment problem (Önder *et al.*, 2011). However, the preliminary objective of using these chemicals is usually marred with the long term effects on the environment and human health. Some of these effects include air pollution, water pollution, food poisoning, killing of beneficial organism and other organisms in the environment. It has been estimated that less than 0.1% of the pesticide applied to crops actually reaches the target pest; the rest enters the environment gratuitously, contaminating soil, water and air, where it can poison or otherwise adversely affect non-target organisms (Pimentel and Levitan, 1986).

Agriculture's role in climate change

Agricultural activities contribute to climate change through the emission of green house gases (GHGs) viz. Carbon-dioxide (CO₂), Methane (CH₄) and Nitrous oxide (N₂O). Globally, agriculture generates some 30 percent of total anthropogenic emissions of GHGs. About 50 percent of anthropogenic CO₂ emissions, 50 percent of CH₄ and about two-thirds of emitted N₂O comes from agriculture (FAO, 2003; khana, 2009). N₂O are gases with warming potentials many times higher than that of CO₂. Agricultural activities have been implicated as one of the major contributors to the effects of climate change. The adoption of intensive systems of production has resulted into loss of much protective vegetation through deforestation. The main source of CO₂ emissions is tropical forest clearance, related biomass burning and land use change. The chief sources of methane are rice production and enteric fermentation of ruminants and animal excreta. For nitrous oxide it is mineral fertilizer and animal wastes deposition by grazing animals (FAO, 2003).

Agricultural practices also contribute to climate change mitigation through carbon sequestration in cropland in the form of vegetation and soil organic matter (SOM) derived from crop residues and manure and the provision of bio-fuels that can substitute for fossil fuels. However, this potential is negatively influenced by high rate of organic matter decomposition thereby reducing the rate of fixing carbon into the soil. Frequent tillage practices also influences rate of decomposition of organic matter thereby contributing to the GHGs.

The extent of future emissions from agriculture will be determined by the practices such as land use, fertilizers application and numbers of animals. The potential exists for it to sequester much more carbon than it actually does under most current cropping practices in the form of vegetation and soil organic matter (SOM) derived from crop residues and

manure and crop residues, hence an increase in gross carbon sequestration. This is achievable with adoption of organic agriculture where better residue management and cropping pattern is achieved through recycling of farm resources. Organic agriculture not only enables ecosystems to better adjust to the effects of climate change but also offers potential to reduce the emissions of agricultural greenhouse gases. In organic agriculture, soil fertility is maintained mainly through farm internal inputs (organic manures, legume production, wide crop rotations etc.); energy-demanding synthetic fertilizers and plant protection agents are rejected; and there is less or no use of fossil fuel (Khanal, 2009).

The concept of organic agriculture

Organic agriculture is a sustainable and environmentally friendly production system that offers African and other developing countries a wide range of economic, environmental and cultural benefits (UNCTAD-UNEP, 2008). The Minister of Agriculture and Livestock of Zambia, Honourable Emmanuel T. Chenda, MP, at the Second African Organic Conference, entitled “Mainstreaming Organic Agriculture in the African Development Agenda held at Lusaka, Zambia stated this about organic agriculture as quoted by FAO (2013) as “one of the best practices in ensuring environmental sustainability. It sustains the fertility of soils, ecosystems and sustains the health of people. It relies on locally adapted improved ecological processes and cycles, and natural biodiversity rather than the use of synthetic inputs and genetically modified materials. It is therefore, important that our farmers are encouraged to practice organic farming. I have no doubt that organic agriculture has potential to contribute to food security, increased incomes and generation of employment for our people”.

Lusaka declaration on mainstreaming organic agriculture into the African development agenda at the Second African Organic Conference (AOC2) held in Lusaka, Zambia, 2-4 May 2012 agree that organic agriculture also known as ecological organic agriculture in Africa plays a key role in sustainable development, food security, poverty reduction, environmental security, climate change adaptation, human health, preservation of indigenous knowledge, plant varieties and animal breeds as well as socio-cultural development. International research results confirm that the adoption of organic agriculture practices significantly increases yields and improves livelihoods and food security in Africa. With the use of locally available renewable resources instead of purchased chemical inputs (over 90 percent of which are imported in sub-Saharan Africa), organic producers are less vulnerable to international input price volatility. Moreover, organic agriculture is climate-smart agriculture, as it produces lower emissions and also provides much greater resilience in times of climate extremes such as drought and heavy rains.

Principles of organic agriculture

The practice of organic agriculture is hinged on some principles that guide the every aspect of the production. These principles are the principle of health, ecology, fairness and care. These principles are to be used as a whole and not in isolation. International Federation of Organic Agriculture Movements (IFOAM) explained the principles as follow:

1. **Principle of Health:** organic agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible. The principle points out that the health of individuals and communities cannot be separated from the health of ecosystem. The role of organic agriculture, whether in farming, processing, distribution, or consumption, is to sustain and enhance the health of ecosystems and organisms from the smallest in the soil to human beings.
2. **Principles of ecology:** organic agriculture should be based on living ecological systems and cycles, work with them, emulate and sustain them. The principle guides the attainment of ecological balance through the design of farming systems, establishment of habitats and maintenance of genetic and agricultural diversity.
3. **Principle of fairness:** organic agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities. Fairness is characterized by equity, respect, justice and stewardship of the shared world, both among people and in their relation to other living beings. The principle emphasizes the management of natural and environmental resources used for production and consumption in a way that is socially and ecologically just.
4. **Principle of care:** organic agriculture should be managed in a precautionary and responsible manner to protect the health and well being of current and future generation and environment. This principle guides the choice of management, development and technology usage in organic agriculture because it's a system that is living and dynamic, responding to internal and external demands and condition.

These principles guiding the practice of organic agriculture takes a holistic approach in the management of production system and agro-ecosystem to achieve a stable environment as much as possible. Adherence to these principles will minimize the impact of conventional agricultural practices as manifested in environmental pollution, soil degradation and polluted food chain. To achieve this, a number of eco-friendly practices in organic agriculture are employed in production practice they include:

- a. Reduced external inputs.
- b. Soil fertility management through legume based crop rotation, rock phosphate etc.
- c. Intercropping.
- d. Biological pest control (neem, garlic ashes, pyrethrum etc.)
- e. Water management and conservation (bunds, trenches, mulching, agro-forestry etc.).
- f. Erosion control: strip cropping.
- g. Nutrient recycling.

Benefits of organic agriculture

Organic agriculture contributes to poverty alleviation and food security with a combination of many features, most notably by:

- i. Increasing yields in low-input areas over time;
- ii. Conserving biodiversity and nature resources on the farm and in the surrounding area;
- iii. Increasing net income and/or reducing costs of externally purchased inputs;
- iv. Producing safe and varied food; and
- v. Being sustainable in the long term. (UNCTAD-UNEP, 2008).
- vi. Improved health and nutrition.

- vii. Little damage to the environment.
- viii. Greater biodiversity.
- ix. Reduced erosion, better water management.
- x. Low use of non renewable resources.
- xi. Safer working conditions.
- xii. Less risk of contamination.
- xiii. Can build on traditional knowledge, recognises farmers' knowledge integrating traditional farming practices.
- xiv. Contributing to climate change mitigation, as it reduces greenhouse gas emissions and affordably sequesters carbon in the soil.
- xv. Increasing yields in the long run through the use of affordable inputs largely based on local biodiversity.
- xvi. Improving livelihoods and food security.
- xvii. Building resilience to climate change.
- xviii. Reducing the financial risk by replacing expensive chemical inputs with locally available renewable resource.
- xix. Allowing farmers access to new market opportunities: both at home and abroad.
- xx. Combating desertification (IFOAM, 2006)

Organic agriculture and food security in developing nations

Farming systems in most developing nations and Africa as whole are characterised by small holdings from where the bulk of locally produced food comes from. Seventy-five percent of the world's 1.2 billion poor live in rural areas of developing countries. They suffer from problems associated with subsistence production in isolated and marginal locations with low levels of technology (Scialabba, 2007). These subsistence and livelihood systems are risk-prone to drought and floods, crop and animal diseases, and market shocks. However they also possess important resilience factors associated with the use of family labour, livelihood diversity (non-farm activities account for 30 to 50 percent of rural income) and indigenous knowledge that allow them to exploit risky environmental niches and to cope with crises (Scialabba, 2007). With the understanding these facts there is the need for the use of improved knowledge in managing our ecosystem resources to produce the required need of man without destabilizing the ecosystem as it was the case of conventional agriculture that was adopted hook, line and sinker without considering the sustainability of the system and the environmental resources. Organic agriculture offers developing countries a wide range of economic, environmental, social and cultural benefits. Organic production has the potential to produce sufficient food of a high quality. In addition organic agriculture is particularly well suited for those rural communities that are currently most exposed to food shortages (IFOAM, 2002).

The central issues to the adoption of organic agriculture are, therefore, the extent to which farmers can improve food production with cheap, low-cost, locally-available technologies and inputs, and whether they can do this without causing further environmental damage

(IFOAM, 2002). Transition to organic management could have enormous implications for food security, where farmers could virtually double their output without having to invest in expensive and environmentally unfriendly synthetic inputs (Scialabba, 2007). This strategy is the most feasible, especially if it targets the smallholder sector. To achieve this vigorous drive and advocacy through extension will be of fundamental importance to build agro-ecological knowledge.

Conclusions and recommendation

The solution to solving food security problem in developing nations like Nigeria is not large scale intensive production that relies on heavy external inputs that jeopardize the environmental resources. The fact that the bulk of our nationally produced agricultural commodities come from peasant or small scale farmers is a pointer that the solution to our food security is not in massive land area cultivation but in intensive production with little external inputs. Organic agriculture can contribute significantly to improving food security among small- holder farmers in developing countries, and a large-scale conversion has the potential to reduce the future dependence of food imports in Sub Saharan Africa.

Organic agriculture ensures sustainable production without jeopardizing the environment with the use of eco-friendly agricultural practices, recycling of farm resources in order to prevent use of external inputs and thereby reducing the negative environmental impact associated with conventional agriculture. In addition to these, farmers' livelihoods will be enhanced through better income obtainable from their produce that can be offered at premium price. One of the cardinal principles of organic agriculture centres on health of man, crops and animal and environment. There is need for massive advocacy program to create awareness on organic agriculture in Nigeria and Africa as a whole. Policy and legislation is required for the growth and protection of interest of players in the sector. There is also the need for institutional development through networking and collaboration among stakeholders.

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