International Journal of Agricultural Extension and Rural Development Studies
Vol.3, No.5 pp.10- 19, November 2016
Published by European Centre for Research Training and Development UK (www.eajournals.org)

CONTRIBUTIONS OF ORGANIC FARMING TO ENVIRONMENTAL SUSTENANCE AND FOOD SECURITY IN WEST AFRICA: POLICY RECOMMENDATIONS

R. N. Mgbenka* and E.N. Mbah**
Department of Agricultural Extension, Faculty of Agriculture, University of Nigeria, Nsukka, Nigeria

Department of Agricultural Extension and Communication, University of Agriculture Makurdi, Nigeria

ABSTRACT: *The article examines contributions of organic farming (OF) to environmental sustenance and food security and identifies policies to enhance the implementation. Scientific literature on environmental damage and stress on food security caused by conventional agriculture and climate change, and benefits of OF in adaptation and mitigation of climate change were synthesized and used for the study. Results show that OF helps in keeping the environment clean by making use of refuse and wastes in the environment to produce healthy foods. Composting in organic farming brings nutrients back from the cities to the farmland. Compared to production of inorganic fertilizer it takes less energy, and when managed in an aerobic condition eliminates methane production reducing the generation of greenhouse gases and climate change. It therefore reduces environmental pollution and promotes the renewed uptake of nutrients from the soil which is what happens under the traditional farming and fallow systems. It supports biodiversity of indigenous fauna and is an advanced form of sustainable agriculture. Organic manure improves the physical properties of soil, biological status of soil, soil fertility and consequently crop yields. Organic manures are general soil amendments and do not burn or harm plants and have long term positive effects on the soil without damaging ground water. Organic manures are also perfect choices for a garden that has many different plants among other advantages. Some of the policies recommended include training extension workers in OF practices, encouraging farmer-to-farmer exchanges, compiling and disseminating emerging indigenous OF knowledge skills, technologies and crop varieties, etc.*

KEYWORDS: Organic manure, farming, contributions, environmental sustenance, food security

INTRODUCTION

Researchers argue that chemical fertilizers destroy the environment by altering the natural balance of the ecosystem. Organic farming offers a sustainable solution to many environmental and food security problems in West Africa [1]. Organic farming is a holistic production management system that avoids use of synthetic fertilizers, pesticides and genetically modified organisms, minimizes pollution of air, soil and water, and optimizes the health and productivity of interdependent communities of plants, animals and people. If practiced according to international principles and local standards it is cost-effective, environmentally sustainable [2], reduces the impact of agriculture on the environment, contributes to poverty alleviation and improves livelihoods of the

ISSN 2058-9093, ISSN 2058-9107

people in the region. It is likely to conserve non-renewable resources and also be sustainable in the long term. Global warming potential of organic farming system is considerably smaller than that of conventional or integrated systems when calculated per land area. This is part of the reason why this type of farming is becoming more popular because people have become more aware of food safety issues, environmental preservation and wildlife protection [3].

Climate change is the most serious environmental challenge facing the world in the present century [4] but there is much scope for mitigating climate change and reversing the damages through sustainable organic farming. [5]. Organic farming sees itself as not being limited to producing positive effects on the environment alone, although it is clear that environmental friendliness or benefits for the environment are key concepts of organic farming. For many outside the organic farming movement, such environmental benefits are the most interesting [6]. However, [7] note that currently, the level of organic farming production in West Africa is very low when compared with production in the agricultural sector as a whole. This is probably because people are not aware of the benefits of OF in relation to environmental sustenance and food security, hence, the need for policy formulation. What are then the benefits of OF? How does OF contribute to environmental sustenance? How does it contribute to food security? What are the policy implications?

The paper reviews the roles of organic farming (OF) in environmental sustenance and food security. It does this by synthesizing literature on damages to food security and the environment from conventional agriculture and the benefits in adoption of OF in mitigation of climate change and adaptation to the change.

Agriculture and climate change

At the global level, agriculture contributes about 10-12% to climate change [8].The main sources of GHG emissions are methane from enteric fermentation in ruminants and rice paddies, improper manure management (agriculture is the most significant emitter of methane). Due to the increase in livestock numbers, ruminants have become the world's most significant emitters of methane, accounting for about a third of global greenhouse gas emissions from agriculture [9]. Other sources of GHG emissions include nitrous oxide from nitrogen fertilizer use and burning of crop residues, carbon dioxide from the production of fertilizers and pesticides, clearing of forests for tillage farming and livestock grazing as well as for the production of feedstuffs for livestock.

The mechanization of farming such as the use of agricultural machinery also consumes a lot of energy and therefore results in changes in climate. Additionally, intensive soil cultivation reduces the soil humus content and thus reduces the quantity of carbon agricultural soils can store.

ISSN 2058-9093, ISSN 2058-9107

Benefits of organic farming to environmental sustenance and food security

Reduced emission of nitrous oxide and methane

Organic farming is self-sufficient in nitrogen by recycling manures from livestock and crop residues through composting. It uses leguminous crops as a catch crop, for under-sowing or as green manure, thus fixing nitrogen from the air. In OF, the ban of mineral nitrogen and the reduced livestock numbers per hectare considerably reduce the concentration of easily available mineral nitrogen in soils and thus N_2O emissions. Diversified crop rotations with green manure improve soil structure and diminish emissions of nitrous oxide as identified by [10]. Also, soils managed organically are more aerated and have significantly lower mobile nitrogen concentrations. In conventional livestock operations, nutrients are available in excess because of large quantities of organic manure from large numbers of livestock, and over-fertilization occurs. Emissions of CO_2, N_2O and methane are likely to be very high and water pollution may occur when manure is treated as waste and not recycled as a valuable fertilizer in the crops. Integration of livestock and arable crop production, the rule on organic farms, can thus reduce the global warming potential of food production.

Methane accounts for about 14% of the greenhouse gas emissions [11]. Two thirds of these are of anthropogenic origin and mainly from agriculture (mainly from enteric fermentation and organic manure). Organic farming's impact on reduction of methane stems from reduced number of livestock (as principles of OF demands) in organic farming [12, 13]. Methane emissions from liquid manure can be reduced nearly to zero by fermenting the slurry in biogas plants, which could have the positive side effect of generating renewable energy and is in line with organic principles. Organic cattle husbandry contributes positively to reducing methane emissions by aiming towards animal longevity [14]. Dairy cow is favourable in organic system because, calculated on the basis of total lifespan of organic dairy cows, less methane is emitted. Also, case study calculations showed that the methane emissions from milk and beef production can be reduced more than 20% by keeping double-use breeds (i.e., for milk and meat production) [15]. Better organic rice production practices such as avoiding continuous flooding or choosing low methane-emitting varieties [16] could enhance reduction of methane emissions. One promising approach could be the combination of organic practices with resource-saving systems as the system of rice intensification (SRI), where soils are kept un-flooded most of the growing period and hence methane emissions are significantly reduced [17].

Organic farming sequesters carbon dioxide in the soil

Globally, OF is 20% more effective in carbon sequestration than non-organic farming [18]. Organic farming strives to build humus in the soil in order to improve soil fertility. Humus formation increases soil stability and water retention capacity and thus reduces the soil's susceptibility to erosion. Humus provides more favourable conditions for soil organisms and stimulates soil biota (all animals and plants in the soil). Increased humus content is also an indicator of increased sequestration of atmospheric carbon dioxide in the soil.

ISSN 2058-9093, ISSN 2058-9107

Arable soils naturally have a major potential for sequestering carbon dioxide (CO_2). However, over the course of the millennia, arable land use has led to a loss of soil organic matter. This loss is largely due to intensive agricultural land use and the use of industrial fertilizers and chemical pesticides. Arable cropland and permanent pastures lose soil carbon through mineralization, wind and water erosion and over-grazing. The application of improved agricultural techniques such as organic farming, conservation tillage, agro-forestry stop soil erosion [19] and converts carbon losses into gains. This can happen through the use of green and animal manure, soil fertility-conserving crop rotations with intercropping and cover cropping, composting techniques. This way, considerable amounts of CO_2 may be removed from the atmosphere. In the USA, a field trial showed a fivefold higher carbon sequestration in the organic system (i.e., 1218 kg of carbon per hectare per year) in comparison with conventional management [20]. The sequestration potential of organic croplands was calculated to be 0.9–2.4 Gt CO_2 per year (which is equivalent to an average sequestration potential of about 0.2–0.4 t C per hectare per year for all croplands) [21], which represents 15–47% of total annual agricultural GHG emissions [22]. Most of the soil-sequestered carbon is stored as soil organic matter. In different long-term field trials, organic matter content in organically managed soils was higher. Soil organic matter has positive effects on the water-holding capacity of the soil [23]. A higher water-holding capacity strengthens the resilience to droughts and reduces the risk of floods, which are both more likely to increase with climate change.

Zero tillage or conservation agriculture, protects and restores soils while capturing carbon. Extensive trials carried out in Brazil show that soils cultivated using this method trap CO_2 rather release it into the atmosphere [24]. The absence of tillage which avoids disturbing the layers of soil combined with the rotation of crops and permanent ground cover limits the oxidation of organic matter in the soil, a major source of CO_2 in tropical environments. Zero tillage was pioneered in USA and Brazil where 22 million ha are cultivated in this way. It is now taking hold in parts of Central Asia and Africa. During the past nine years, pilot projects for conservation agriculture have been launched in Southern and East Africa. Farmers who practice it obtain higher yields and benefit from carbon credits.

Agroforestry

This is a management system that integrates perennial and annual crops in a two-canopy or multi-canopy production system and it is a principle of OF. Organic farming could play a role in the development of agroforestry systems and combining these two systems is a potential solution for reducing greenhouse gases, sequestering CO_2 and increasing the agro-ecosystems. The CO_2 sequestration potential of agroforestry in the short and medium term is mainly above ground. Agroforestry guarantees better exploitation of light, water and soil nutrients and protects soil more effectively from erosion and leaching. It leads to a more diversified and sustainable production system than many treeless alternatives and provides increased social, economic and environmental benefits for land users [25]. In the humid tropics, agroforestry is seen as viable alternative to slash-and-burn agriculture. Organic farming contributes to halting deforestation with its negative impact on climate change and environmental degradation. Organic farming aids at reclaiming and making use of degraded land due to its favourable effects on soil fertility and soil organic matter. Additionally, careful land management as in OF enhances environmental security and will help to stop losses of fertile arable land not only by erosion.

ISSN 2058-9093, ISSN 2058-9107

Considering the environmental sustaining capability of forests and agroforestry, there are campaigns in different parts of the world for afforestation, reforestation and avoidance of deforestation. For example, under the Kyoto Protocol's Clean Development Mechanism (CDM), carbon offset schemes are limited to afforestation and reforestation [26]. Agroforestry has the potential to sequester nearly 600 mega tonnes of CO_2 a year by 2040. Growing numbers of Africa, Caribbean and Pacific (ACP) producers are integrating trees into farming systems, planting fodder trees for cattle, fruits and nut trees for food and other trees and shrubs that produce gums, resins and medicines [27].

Soil management

Organic farming systems using organic fertilizers can make a similarly valuable contribution to soil conservation and humus formation than non-organic no-till systems [28]. Moreover, the combination of organic farming and reduced tillage techniques is one of the most effective techniques to enhance carbon sequestration rates. While reduced tillage techniques prove difficult under organic conditions due to weed problems, the long-term reduced tillage trial at Frick has shown that compared to the organic variant with ploughing, 800 kg carbon per year could be sequestered [29]. A long-term organic trial in Maryland, USA showed even higher carbon sequestration rates [30].

Using farmyard manure, slurry, compost and other organic fertilizers to fertilize the soil can contribute to increasing soil organic matter. Careful soil cultivation also leads to organic matter being stored in the upper soil strata. Moreover, maintaining a continuous green cover of actively assimilating plants causes a continuous flow of assimilates through the plant roots into the soil [31].

The better drainage and water-holding capacity of organic soils reduces the risk of drought and soil erosion [32]. There is usually less erosion due to better soil structure and more plant cover in organic farming. In Tigray Province, one of most degraded parts of Ethiopia, agricultural productivity was doubled by soil fertility techniques over one million hectares through agroforestry, application of compost and introduction of leguminous plants into the crop sequence. By restoring soil fertility yields were increased to a much greater extent [33].

Food security

Food security exists when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life [34]. A nation is considered food secure when a sufficient, stable and safe supply of food is available to satisfy basic needs and market demand. This does not prevent hunger in marginal areas or negative trade balance as a result of food import dependency. A household is considered food secure when it can produce or obtain enough food to meet all of its members' nutrition needs [35].

Developing sustainable food security for all has been the key mandate of FAO since its founding. This mandate was reinforced by the World Food Summit in 1996 and its follow up

ISSN 2058-9093, ISSN 2058-9107

meetings and instruments, such as the Right to Adequate Food [36]. Recognizing that there has been great progress towards this goal in the last 60 years, the 32nd Session of the Committee on World Food Security assessed the food situation in September 2006 and acknowledged that the World Food Summit target of halving the number of hungry people by 2015 will not be met; the number of undernourished has remained virtually unchanged since 1990-92, although there has been a reduction in the percentage of undernourished [37]. Household and national food security is complex and complicated goals influenced by many factors such as technologies, human capacities, policies, prices, trade and infrastructural context.

Demand for food is certain to increase with increasing population pressure and income, even though this demand and ability to supply the demand are not equal in all communities. Hunger, poverty and environmental degradation persist even as concerns about global human security issues continue to increase. Moreover, the last decades provide uncompromising evidence of diminishing returns on grains despite the rapid increases of chemical pesticide and fertilizer applications [38],resulting in lower confidence that these high input technologies will provide for equitable household and national food security in the next decades. However, OF has made considerable contributions to food security in the regions that practice it.

Contributions of organic farming to food security

The following contributions of OF to food security was proposed by [39]:

- By diversifying and optimizing farm productivity, reducing the need for purchased inputs and eventually developing households' market-orientation for earning additional income, organic systems contribute to hunger and poverty alleviation.
- For transitional food emergency situations, organic fields show lower fluctuations in yields and diversification is the best assurance in cases of a single crop failure, environmental adversity or socio-economic shocks.
- The cropping diversity found on organic fields coupled with rotation crops of minor economic value but high micronutrient and protein content enriches household diets and health.
- By being labour intensive, organic farming creates not only employment but improves returns on labour, including also fair wages and non-exploitive working conditions. In developed countries, organic farms provide more than 30 percent more jobs per ha than non-organic farms thus, create employment opportunities.
- Damage avoidance of organic agriculture on the global environment is chiefly achieved by omissions on the use of polluting substances such as nitrogen fertilizers and synthetic pesticides, as well as reduced anthropogenic impacts on desertification, biodiversity erosion and climate change.
- Organic farming offers a great potential in local sourcing of diversified foods, through low carbon systems and shorter supply chains to the extent possible.
- The fact that poor farmers often live in areas where there are few employment alternatives and agricultural inputs are not supplied makes organic agriculture a unique alternative for local food provisioning, provided that agro-ecological knowledge is available. Organic

ISSN 2058-9093, ISSN 2058-9107

farming offers advantages in terms of enhancing food production where it is most needed by decreasing dependence on external inputs and increasing agro-ecosystem performance. A modeling for large-scale organic conversion in sub-Saharan Africa [40] suggests that agricultural yields would grow by 50 percent, thus increasing local access to food and reducing food imports.

- Organic agriculture is also an opportunity to commercialize small holder agriculture. A Market-oriented food system, if available, offers additional income generating opportunities that allow small producers to compete with quality while encouraging local food supply.
- The only solution to problems related to industrialized agriculture is a return to sound organic farming practices.

Policy recommendations for promoting organic farming for environmental sustenance and food security

Organic farming policy standardizes the organic sector protecting both producers, consumers as well as promoting fair ecological and social practices [41]. The International Federation of Organic Agriculture Movement (IFOAM) –the umbrella organization of OF organizations has formulated principles for OF. Here are some of them:

- Principle of fairness: Organic farming should be built on relationships that ensure fairness with regards to the common environment in life opportunities.
- Principle of care: Organic farming should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generation and the environment, etc [42].

In order to promote and accelerate sustainable OF in West Africa, all stakeholders and government must [43]:

- Set sustainable agriculture through organic practices as a priority,
- Review current policies and programmes, and remove disincentives to organic agriculture
- Establish Department/Faculties of OF in higher institutions of learning especially the
- Train extension workers in OF practices,
- Encourage farmer-to-farmer exchanges,
- Compile and disseminate emerging indigenous OF knowledge, skills, technologies and crop varieties,
- Adequately and promptly fund OF research,
- Build on indigenous knowledge in response and in partnership with farmers; and promote development of local and regional markets for organic products

Additionally, [44] proposed the following policy recommendations which emanated from a study they conducted in Nigeria:

ISSN 2058-9093, ISSN 2058-9107

- active involvement of youths and women in organic crop production,
- improvement of information sources on organic farming, and enlightenments on various organic methods of weed, pest and disease control through the regular sources of information on OF.
- farmers should be motivated through credit facilities and discouragement of inorganic farming in order to ensure sustainable production of food, since the farmers have a favourable perception towards OF.

CONCLUSION AND RECOMMENDATIONS

Organic farming promotes environmental stability. It protects both human and the environment from the risks of conventional agriculture by using sustainable methods such as crop rotation, agroforestry, natural soil enrichment and pest predators. These methods protect native biodiversity and promote soil stability and fertility without the leaching of essential nutrients that occurs in conventional systems. The level of practice of organic farming in West Africa is still low hence the formulation of policies for promoting and enhancing the practice of organic farming.

REFERENCES

AdeOluwa, O. O. (2010). Organic agriculture and fair trade in West Africa. Food andAgriculture Organization of the United Nations, Office of Knowledge Exchange, Research and Extension, FAO VialedelleTerme di CaracLL, 005153 Rome, Italy.

Berner, A., Hildermann, I., Fließbach, A., Pfiffner, L., Niggli, U., Mäder, P. (2008). Crop yieldand soil fertility response to reduced tillage under organic management, *Soil & Tillage Research*, 101, pp. 89-96.

Bellamy, P. H., Loveland, Bradley, R. I., Lark, R. M. and Kirk, G. I. D. (2005). Carbon losses From all soils across England and Wales 1978 – 2003. *Nature*, 437, pp. 245 – 248.

Dabbert, S. (2006). Measuring and communicating the environmental benefits of organic foodproduction. Online. *Crop Management* doi:10.1094/CM-2006-0921-13-RV.

Edwards, S. (2007). The impacts of compost use on crop yields in Tigray, Ethiopia. Institute forSustainable Development(ISD). *In Proceedings of the International Conference on Organic Agriculture and Food Security*. FAO, Rome, Italy. Available at web site ftp;//ftp.fao.org/paia/organicag/ofs/02-Edwards.pdf (verified 15 October, 2009)

Food and Agricultural Organisation (FAO) (2006). *Mid-Term Review of Achieving the World Food Summit Target*. CFS: 2006/3. Rome.

Intergovernmental Panel on Climate Change (IPCC) (2007). Synthesis report. In: O.R.D. Metz, P.R. Bosch, R. Dave and L.A. Meyer (eds.), *Fourth Assessment Report: Climate Change, 2007*. Cambridge University Press, Cambridge, UK.

Institute of Science in Society (ISIS) (2008). Mitigating climate change through organic agriculture and localized food systems. *ISIS Report* 31/1/08.

International Trade Centre (ITC), (2007). *Organic farming and climate change*. *InternationalTrade Centre UNCT/WTO*. Research Institute of Organic Agriculture (FiBL), Geneva:

ISSN 2058-9093, ISSN 2058-9107

ITC, 2007.27P. Doc. No. MDS-08-152.E

Niggli, U., Rounsevell, M.D.A., Smith, P., and Verhagen, J. (2009). *Low Greenhouse Gas Agriculture: Mitigation and Adaptation Potential of Sustainable Farming Systems*. FAO, Rome, Italy. Available at Web site ftp://ftp.fao.org/docrep/fao/010/ai781e/ai781e00.pdf (verified 15 October 2009).

Niggli, U.; Schmid, H. and Fliessbach, A. (2008).*Organic Farming and Climate Change.* International Trade Centre (ITC), Geneva. www.fibl.org

Ojo, T. (2011). Organic farming: Nigeria yet to share in global market. Diver, S., Kuepper, G., Born, H. (1999). Organic tomato production. *ATTRA - National Sustainable Agriculture Information Service NCAT Agriculture Specialist CT073***,** National Center for Appropriate Technology,*Butte, MT 59702,* Publisher.http://attra.ncat.org/attra-pub/PDF/tomato.pdf

Olesen, J.E., Schelde, K., Weiske, A., Weisbjerg, M.R., Asman, W.A.H., Djurhuus, J. (2006).Modelling greenhouse gas emissions from European conventional and organic dairy farms, *Agriculture, Ecosystems & Environment,* 112, pp. 207-220.

Pimentel, D., Hepperly, P., Hanson, J., Douds, D., and Seidel, R. (2005). Environmental,energetic and economic comparison of organic and conventional farming systems, *Bioscience,* 55, pp.573–582.

Rosenberger, E., Go¨ tz, K.-U., Dodenhoff, J., Krogmeier, D., Emmerling, R., Luntz, B., and

Anzenberger, H. (2004). *U¨ berpru¨fung der ZuchtstrategiebeimFleckvieh*. BayerischeLandes anstaltfu¨ r Landwirtschaft, Poing, Germany. Available at Web site http://www.lfl.bayern.de/itz/rind/09285/index. php (verified 20 October 2009).

Sanders, R. (2006). A Market Road to Sustainable Agriculture? Ecological Agriculture, Green Food andOrganic Agriculture in China. In: *Development and Change* 37(1), pp. 201-226. Institute of Social Studies 2006.Blackwell Publishing, USA.

Sani, L. O., Aiyelaagbe, O. O., Idowu, M. A., Olayiwola, I. O., Dipeolu, A., Adebowale, A. A., Fomba, S., Dixon, A., Sawi, N. K., Kamara, N. R. and Egounley, Ir. M. (2010). Sustainable organic agriculture development in West Africa. MRCI/08/F07/p33/POLICY BRIEF No. 2 *Mobilising Regional Capacity Initiative (MRCI) Program*, Association of African Universities (AAU), Aviation Road Extension, Airport Residential Area, Accra-North, Ghana. E-mail: chuksmba@yahoo.com/secgen@aau.org

Scialabba, N. E. (2007). Organic agriculture and food security. F*ood and Agriculture Organization (FAO) of the United Nations. International Conference on Organic Agriculture and Food Security, 3-5 May, 2007.* FAO, Italy. www.fao.org/organicag

Scialabba, N. E., and Muller-Lindenlauf, M. (2010). Organic agriculture and climate change.

Natural Management and Environment Department, Food and Agriculture Organization of the United Nations (FAO), VialedelleTerme di Caracalla, 00153 Rome, Italy. *Renewable Agriculture and Food Systems*, 25(2), pp.158–169.

Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., McCarl, B., Ogle, S., O'Mara,

F., Rice, C., Scholes, B., and Sirotenko, O.(2007). Agriculture. In: B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, and L.A. Meyer (eds.). *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK.

Smith, K. A. and Conen, F. (2004). Impacts of land management on fluxes of trace greenhousegases. *Soil Use and Management*, 20, pp. 225-263.

ISSN 2058-9093, ISSN 2058-9107

Spore (2008). Crops weathering the changes. *Technical Centre for Agriculture and Rural Cooperation (CTA), Spore Special Issue August, 2008*, pp7-8. http:spore.cta.int

Teasdale, J.R., Coffman, C.B., Mangum, R.W.(2007). Potential long-term benefits of no-tillage andorganic cropping systems for grain production and soil improvement. *Agronomy Journal*, 99 :1297-1305, DOI: 10.2134/agronj2006.0362

Weiske, A., Vabitsch, A., Olesen, J.E., Schelde, K., Michel, J., Friedrich, R., Kaltschmitt, M. 2006. Mitigation of greenhouse gas emissions in European conventional and organic dairy farming. *Agriculture, Ecosystems & Environment*, 112(2), pp. 221-232.

ISSN 2058-9093, ISSN 2058-9107