

Cottage Crop Production: A Review of Modern Innovations for Sustainable Crop Production as a Panacea for Food Security in Nigeria

¹Olugbemi Peter Wusu, & ²Ola Elijah Olusoga

¹Department of Agricultural Science Education,

²Departments of Agricultural Education,

College of Vocational and Entrepreneurship Education,

Lagos State University of Education (LASUED) Lagos, Nigeria

Article DOI: 10.48028/iiprds/ijareaps.v3.i1.01

Abstract

Agriculture is crucial for food security, but several challenges, including policy implementation, leadership, and climate change, hinder its sustainability. This work reviewed the concepts of micro-organic and conventional crop farming practices with food security regarding its principles, transition and its challenges to food security in Nigeria. Sustainable crop production focuses on preserving the environment and natural resources while producing food. Its principles include conserving natural resources, efficient use of resources, environmental protection, economic viability, and social and economic equity. Nigeria's population growth rate, which increased from 45.14 million in 1960 to 218.5 million in 2022, puts pressure on agricultural land, leading to reduced food production. The use of chemical fertilizers also poses health risks due to toxic metal contents from nutrient uptake in crop produce and products. To combat these challenges, micro-farming and organic agriculture can provide sustainable solutions. Micro-farming involves small-scale agricultural operations that use less land and focus on sustainability, seasonal crops, and niche markets. Despite their sizes, micro-farms can produce a significant amount of food per unit area under proper management. To ensure healthy food production, there should be a shift towards using natural resources and avoiding chemical fertilizers. By adopting sustainable agricultural practices through which Nigeria can improve food security and sustainability.

Keywords: *Sustainable Agriculture, Panacea, Food security*

Corresponding Author: Olugbemi Peter Wusu

Background to the Study

Agriculture is a serious sector in many countries as it is directly linked with the provision of food to ensure food security for many people, a major way of solving the age-long problem of food shortage. The significance of agriculture is hinged on crops and animal production that provide the largest share of food supplies and ensure food security worldwide. However, several policies, innovations and approaches have been put in place that are the outcomes for food security and sustainability in various regions over time. These policies and innovations on how to move productivity up in the agricultural sector are laudable and promising and were born out of research findings but all end up on shelves or never see the light of the day for implementation. Therefore, to think of the sustainability of food production in any part of the world, especially in Nigeria, there is a need to adopt several farming or cropping systems from micro to macro farming with a keen interest in organic agriculture as a panacea for encouraging a sustainable eco-friendly environment.

Besides the inability to implement workable agricultural policies, leadership problems, poor or inadequate awareness and the adoption of new farming innovations are of high trend. More so, the available agricultural land especially in the urban centres is under serious threat from land degradation, land scarcity, modern structures and infrastructures for various non-agricultural purposes and climate change, among others. These are passing negative signals to food security. To this end, the available arable lands are the major focus that must be judiciously used for food production to solve the challenge of food insecurity. Hence, various Agricultural systems such as; micro crop production both organic and conventional farming and large convectional farming operations are important to food security. However, the most ever-increasing challenging factors to the successful and sustainable implementation of food crop production in most Agricultural zones are; land degradation, land scarcity, and climate change. This paper explored the concepts of micro-organic and conventional crop farming practices with food security. Hence, the following areas concerning food sustainability from the points of agricultural production are discussed:

- a. Sustainable crop production and its principles
- b. Transitioning and evidence to sustainable crop production
- c. Micro-farming or crop production
- d. urban farming technology and its bottlenecks
- e. Nigeria population and food production
- f. the challenge with food items in circulation with human health
- g. the roles of organic micro-farming activities in healthy food production
- h. the current challenges facing Agricultural systems in Nigerian

Sustainable Crop Production and its Principles

According to the Union of Concerned Scientists (2022), sustainable agriculture is a system of farming that focuses on producing food while preserving the environment and natural resources. Industrial agriculture, which has been the dominant system for decades, is characterized by large farms growing the same crops year after year, using enormous amounts of chemical pesticides and fertilizers that damage our soil, water, air, and climate. However, a growing number of innovative farmers and scientists are moving toward a farming system that

is more sustainable environmentally, economically, and socially. This system has room for farms of all sizes, producing a diverse range of foods, fibers, and fuels adapted to local conditions and regional markets. It uses state-of-the-art, science-based practices that maximize productivity and profit while minimizing environmental damage (Union of Concerned Scientists, 2022).

Sustainable crop production is a system of farming that focuses on producing food while preserving the environment and natural resources. It involves the use of modern technologies, such as precision agriculture, to optimize crop yields while minimizing the use of resources such as water, fertilizers, and pesticides. Sustainable crop production entails the use of crop rotation, cover crops, and conservation tillage to improve soil health and reduce erosion (Velten & Hoffmann, 2017). Some principles govern the sustainability of either crop production or any form of agriculture. These are discussed as follows:

Principles of Sustainable Crop Production

- a. Conservation of natural resources:** Sustainable crop production aims to conserve natural resources such as water, soil, and biodiversity. This is achieved by using modern technologies such as precision agriculture to optimize crop yields while minimizing the use of resources such as water, fertilizers, and pesticides. Sustainable crop production also involves the use of crop rotation, cover crops, and conservation tillage to improve soil health and reduce erosion.
- b. Efficient use of resources:** Sustainable crop production aims to use resources such as water, fertilizers, and pesticides efficiently to minimize waste. This is achieved by using modern technologies such as precision agriculture to optimize crop yields while minimizing the use of resources such as water, fertilizers, and pesticides. Sustainable crop production also involves the use of crop rotation, cover crops, and conservation tillage to improve soil health and reduce erosion.
- c. Environmental protection:** Sustainable crop production aims to protect the environment by reducing pollution, greenhouse gas emissions, and soil erosion. This is achieved by using modern technologies such as precision agriculture to optimize crop yields while minimizing the use of resources such as water, fertilizers, and pesticides. Sustainable crop production also involves the use of crop rotation, cover crops, and conservation tillage to improve soil health and reduce erosion.
- d. Economic viability:** Sustainable crop production aims to be economically viable by producing high-quality crops at a reasonable cost. This is achieved by using modern technologies such as precision agriculture to optimize crop yields while minimizing the use of resources such as water, fertilizers, and pesticides. Sustainable crop production also involves the use of crop rotation, cover crops, and conservation tillage to improve soil health and reduce erosion.
- e. Social and economic equity:** Sustainable crop production aims to promote social and economic equity by providing fair wages and working conditions for farm workers and supporting local communities. This is achieved by promoting local food systems and supporting small-scale farmers.

Transitioning and Evidence to Sustainable Crop Production

Lal (2018) pointed out that the transition to sustainable agriculture requires growing and sustaining an ecologically skilled workforce. Farmers and researchers have developed a thoroughly studied and tested pathway for sustainability transition in agriculture. The pathway involves the use of modern technologies, such as precision agriculture, to optimize crop yields while minimizing the use of resources such as water, fertilizers, and pesticides. Sustainable crop production also involves the use of crop rotation, cover crops, and conservation tillage to improve soil health and reduce erosion.

Several studies have shown that sustainable crop production can improve crop yields while preserving the environment and natural resources. For example, a study established that sustainable crop production practices such as crop rotation and cover crops can improve soil health and reduce erosion. Another study found that sustainable crop production practices can improve crop yields while reducing the use of fertilizers and pesticides (Deytieux, Makowski & Munier-Jolain, 2017). Sustainable crop production also involves the use of crop rotation, cover crops, and conservation tillage to improve soil health and reduce erosion (Lal, 2018). Several studies also established that out of the threatened natural resources; especially land, these natural resources can be subjected to sustainable production mode for food security to the supplying of the growing population through: micro-farming, organic and urban farming technologies.

Nigeria Population and Food Production

From 1960 to 2021 the population of Nigeria increased from 45.14 million to 211.40 million; this was a growth by 368.3 per cent in 61 years. The highest increase in Nigeria was recorded in 1978 with 3.08%. The smallest increase in 1961 with 2.05% and the average age in Nigeria rose from years 2012 to 2020. In 2017, the Minister of State for Budget and National Planning of Nigeria gave an estimated total of 190 million people, and the number keeps increasing at a fast rate up to this year. Consider the extract below as summarized from Nigeria Population growth rates from 2019 to 2022.

- i. The population of Nigeria in 2022 was 218,541,212, a **2.41%** increase from 2021.
- ii. The population of Nigeria in 2021 was 213,401,323, a 2.44% increase from 2020.
- iii. The population of Nigeria in 2020 was 208,327,405, a 2.47% increase from 2019.
- iv. The population of Nigeria in 2019 was 203,304,492, a 2.48% increase from 2018.

Source: Chart and table of Nigeria Population from 1950-2022

(<https://www.macrotrends.net/countries/NGA/nigeria/population-growth-rate, 2022>)

The implication of this increased in population to Agriculture is not far fetch as the working class of the population are sparingly involved in farming activities. This situation coupled with the aged long problems facing agriculture reduces food production.

The Challenge with Food Items in Circulation with Human Health

As what goes into the soil determines what is obtained in our farm produce, so there is a link between soil fertility and human health. Hence, chemical fertilizers, which are a mixture of concentrated chemicals (toxins), are absorbed by plants when applied to increase crop yield.

These toxins enter into the food chain via vegetables, fruits, nuts, cereals and other farm produce eaten by man and animals, creating a health hazard. According to reports, high concentrations of inorganic or chemical fertilizers are injurious to humans (Joseph and Sidney, 2008; Olugbemi, 2022). Likewise, the amount of these toxins consumed causes disturbances to the kidneys, lungs and liver and even causes cancer (Dissanayake and Rohana, 2009). This is due to the toxic metal contents of fertilizers applied during crop production. Besides, these toxic metals replace or remove the main nutrient of the soil, change the soil pH and accelerate the degradation process of soil and the environment of our ecosystem. Major health risks due to the presence of these toxins during the cropping period, for instance, include groundwater contamination (e.g. nitrates and nitrites); leading to haemoglobin disorders when farm produce from such sites is consumed (Nayana, and Ritu, 2017). Besides, heavy metals (e.g. mercury, lead, cadmium and uranium) accumulated by human systems increase over six times the risk of different cancer types including brain cancer, lymphoma, prostate cancer and intestine cancer (Ameeta and Ronak, 2017). This must be strictly avoided to produce healthy food for the populace. There are various means technologically to combat healthy food production that will be environmentally friendly. Common agro-tech in practice especially where there are agricultural land constraints are: organic macro or micro farming or agriculture, cottage vegetable crop production, and urban and backyard farming among others. However, each of these modern farming techniques is associated with notable challenges relating to the health of the consumers. Hence, there should be a shift to the use of inputs that are of natural resources.

Micro Farming or Agriculture and its roles in Food Sustainability

Micro farms are small-scale agricultural operations that use far less land than the average commercial or family farm around the compound; common examples are the garden, potting or mobile farming activities often found in urban or suburban areas. The population pressure on the land for housing and other non-agricultural uses gave birth to this type of farming activities. Size limits and zoning restrictions force micro farmers to be creative about the crops they grow and the ways in which they seek to make a profit, and they tend to focus on sustainability, seasonal crops and niche markets for their products. Despite their size, micro farms have the potential to produce an enormous amount of food per given unit area under properly management. To combat the space issue, many micro farmers focus on maximizing their time. By implication, profitable growers choose ephemeral crops that can be re-sown several times throughout the season in the same plot of land or space. Such intensive use of the available space or land requires careful crop rotation, inter-cropping and composting to maintain soil fertility. The main rule of the operation is that short-season crops allow micro farmers to have more farm produce available for the households and to the market throughout the season. Micro farmers also keep track of their local market's appetite for specialty crops to take advantage of seasonal favorites that can command premium prices.

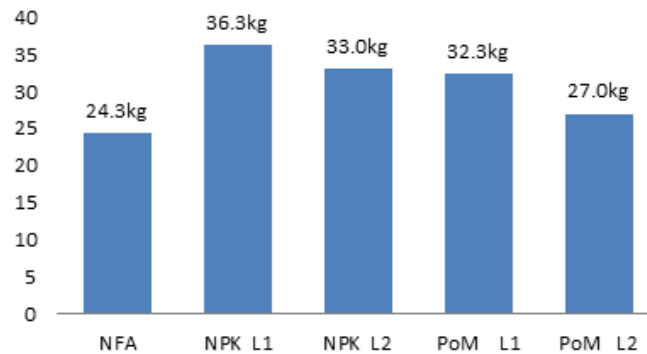


Fig. 1: Yam yield obtained from micro yam farm of under different fertilizers application using 50 kg capacity containers/ bags as growing medium (Olugbemi *et al.*, 2023).

Research report on yam production under micro- crop production showed that the various fertilizers applications on open fields on the performance of crop are similar under pot or micro production. From (Figure 1), yam tuber yield under NPK and Poultry fertilizers are similar and not significantly different as reported (Olugbemi, Viatonu and Odulate, 2022).

Table 1: Total Fresh Biomass and tiger nut yield at Harvest as Influenced by two types of Fertilizers

Fertilizer types	Biomass weight (g/unit)	Nut weight (g/unit)
NFA -0	85.6	98.4
NPK 3g/5 kg soil	108.3	237.3
NPK 5g/5 kg soil	139.4	203.6
PM, 15g/ 5kg soil	87.7	153.2
PM, 30g/ 5kg soil	125.2	159.8

Legend: PM = Poultry Manure (15g and 30g/5kg of soil), NFA-0 = No fertilizer application

Source: Olugbemi & Emmanuel, 2022

In a similar vein, tiger nut production at a mini or micro level among other arable and ephemeral crops is possible for food production (Figure 2) for immediate household consumption as reported by Olugbemi and Emmanuel (2022). Crop production under this system assured a constant supply of food materials throughout the year, weather, climate and other biotic factors are under regular control of the farmers practising micro-crop production.

Urban Farming Technology and Its Bottlenecks

Micro-farming is cost-effective because it requires only a small plot of land or space. Purchasing an unused urban plot is generally cheaper than acquiring vast farmland in rural areas. These smaller plots can often be farmed manually with basic tools, eliminating the need

for expensive machinery. Although it demands significant labour, the lower operational costs help micro-farmers achieve higher profit margins.

Beyond selecting profitable crops for a limited space, urban micro-farmers must also maintain good relationships with their neighbours. Adhering to city zoning laws is essential to avoid legal issues. Many urban farmers cannot keep large livestock, so they rely on vegetable compost rather than manure for soil fertility management. However, small animals like rabbits, snails, and a few poultry birds may be permitted. However, larger livestock such as ruminants and other big monogastric animals are typically restricted due to waste management and environmental concerns. Organic urban farmers will also need to test their soil for contaminants, as city soils are prone to pollution. Raised beds with imported, clean loam soil may be required to avoid soils contaminated with heavy metals. It's also advisable to research municipal wastes and salts to make sure that the soils are free from contaminants. Micro-farming may look like a hobby to the casual observer, but the farmers who make a success of working with a small plot of land understand that such farming activity is a business. To make micro-farming profitable, it's crucial to understand and know the modern agribusiness strategies for better production.

The roles of Organic micro-farming activities in Healthy Food Production

Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasises the use of management practices in preference to the use of off-farm inputs, considering that regional conditions require locally adapted systems. This is accomplished by using agronomic, biological, and mechanical methods, as opposed to the using of synthetic materials as inputs for production." (FAO/WHO Codex Alimentarius Commission, 1999).

If micro-farming is based on organic practices, it is expected to produce healthy food and foster a sustainable environment, ensuring a steady supply of nutritious produce for households, communities, and the nation. In other words, this contributes to long-term sustainability. The long-term effects of the natural resources used for farming activities within the environment include:

- a. Maintain and improve fertility, soil structure and biodiversity, and reduce erosion
- b. Reduce the risks of human, animal, and environmental exposure to toxic materials
- c. Fine-tune farming practices to meet local production conditions and satisfy local markets.

The Current Challenges Facing Nigerian Agriculture

Agriculture is rewarding but the numerous challenges facing it in the country has made it less enticing to a larger chunk of the population. This accounts for the low investment in the agricultural sector by the teeming youths of the country. The farmers, who constitute the largest percentage of the farming population, are seriously threatened by the problems of rural poverty and neglect, poor access to markets, lack of storage facilities, mindset, insecurity, corruption and the Desire for Primitive ways of farming.

Poverty: One of the major problems facing agriculture in Nigeria is extreme poverty prevalent in the country. The country has a huge population of poor people who cannot afford to go into mechanised and commercial farming. Farming activities are done on a small scale and usually for the consumption of the farmer and his family members. Lack of access to funds prevents the production of food on a large scale. Again, since most of the farmers reside in rural areas, their inability to access funds and soft loans from banks, as well as government grants, hinders production on a large scale. As a result of this, they rely on crude implements and organic manures to cultivate crops.

Access to Markets: Most of the farming activities in Nigeria are done by the locals who reside in villages. There are no access roads to markets in the towns where these farm products are sold. Sometimes, the produce which cannot be stored is wasted due to their inability to transport them to the markets where they can be sold. Access to the market presupposes access to a good transportation network. Transportation thus, becomes a major problem for agriculture in Nigeria.

Lack of Storage Facility: Agricultural produce is seasonal. Very few crops are produced all year round. The availability of seasonal crops outside their natural growing period depends on the country's storage and processing facilities. However, due to inadequate infrastructure, surplus harvests often go to waste instead of being preserved for future use.

Mindset: The mindset of the greater population of Nigerian youths, especially the educated ones, is that agriculture is for the poor and illiterate, therefore, it is taboo to indulge in it. Modern agriculture requires highly educated and skilled individuals to adopt advanced farming techniques that ensure the production of healthy food through improved methods.

Resistance to Modern Farming Practices: One of the major challenges facing agriculture in the country is the reluctance of many farmers to embrace innovative and efficient farming techniques. For instance, livestock farming worldwide is primarily conducted through ranching or controlled enclosures, while nomadic herding has largely been phased out. However, in Nigeria, some farmers still believe that moving livestock from place to place is the most beneficial approach for both themselves and their animals.

Insecurity: Agriculture in Nigeria faces significant challenges due to widespread insecurity. In the past, farmers and their farms were rarely targeted by criminals, but now, attacks have become rampant. Farmers are being killed on their way to their fields, crops are destroyed, and livestock is frequently stolen by bandits. In some areas, farmers are forced to pay levies to armed groups just to access their land. The worsening security situation, particularly in the northern regions, has discouraged many farmers from working their farms, leading to reduced agricultural productivity.

Corruption: Corruption remains a major obstacle to agricultural development in Nigeria, particularly in the allocation of grants and financial support intended for farmers. These funds, meant to benefit rural and local farmers, often fail to reach their intended recipients,

either being mismanaged or diverted, leaving those who need them most without the necessary resources to improve their farming practices.

Population pressure on land for non-agricultural purposes. The available lands are continuously subjected to construction, estates and housing investment, depriving Agriculture and forestry activities.

Conclusion and Recommendations

From the ongoing discussion, the sustainability of food production to curb food security is feasible and possible only if there is synergy between the non-agricultural land use and the consciousness of the sustainable use of natural resources for Agricultural production. This will require a repositioning of the food production systems for healthy Agricultural practices. Hence, sustainable agriculture is a system of farming that focuses on producing food while preserving the environment and natural resources. Sustainable crop production involves the use of modern technologies, such as precision agriculture, to optimize crop yields while minimizing the use of resources such as water, fertilizers, and pesticides. Sustainable crop production also involves the use of crop rotation, cover crops, and conservation tillage to improve soil health and reduce erosion. The principles of sustainable crop production include the conservation of natural resources, efficient use of resources, environmental protection, economic viability, and social and economic equity. By following these principles, sustainable crop production can improve crop yields while preserving the environment and natural resources. Therefore, transitioning to sustainable agriculture requires growing and sustaining an ecologically skilled workforce.

Recommendations: Steps towards repositioning organic food production

Repositioning food production to meet the high demand will entail working consciously to achieve the expected goals for healthy food production, which needs severe actions by the Government, Institutions and individuals or collective moves as follows:

1. Young and old should embark on home gardening or modern mobile farming activities, as well as encourage people to be more zealous and passionate about cropping activities than teaching activities alone as agricultural science graduates.
2. All households should devote or create space within their premises for mobile gardening, and smallholding poultry and vegetable production should be practiced. More resources should be tailored towards organic agriculture, especially mobile organic Agriculture and Agricultural programmes should be of more practical training than theory with a high level of Government involvement.
3. The expectation of the schools or Agricultural training Institutions should include educating students and providing opportunities for them to acquire more knowledge and productive skills to be self-reliant, by providing more funds and social amenities to their reach.
4. Besides, graduates are to be empowered with the competence of transforming the acquired agricultural and other skills into high-level manpower for food production using natural resources.
5. The Government should also be involved in the following: educating and producing

graduates of high-level manpower in the production of food and raw materials for agro-based industries to educate and produce graduates with the appropriate communication skills for effective transmission of Agricultural information skills to others in the communities.

6. And to produce graduates equipped with sound backgrounds in agriculture for further professional advancement and to produce graduates of noble character and sound judgment of the environment. If individuals, households, or communities can invest wisely in these, starting from micro or trace levels of farming activities, this will go a long way to reposition the food production in our society.

References

- Ameeta S., Ronak, C., 2017. A review on the effect of organic and chemical fertilizers on plants, *International Journal for Research in applied Science and Engineering Technology (IJRASET)* 5(2), 677 – 680
- Brevik, E. C., Cerdà, A., Mataix-Solera, J., Pereg, L., Quinton, J. N., Six, J., & Van-Oost, K. (2015). The interdisciplinary nature of soil. *Soil Research*, 53(2), 131-143. <https://www.publish.csiro.au/sr/SR14100>
- Chart and table of Nigeria Population from 1950-2022. (2022). <https://www.macrotrends.net/countries/NGA/nigeria/population-growth-rate> (Retrieved June, 2023)
- Deytieux, C., Makowski, D., & Munier-Jolain, N. (2017). Sustainable crop production: an analysis based on cropping systems, nutrient management and soil quality, *European Journal of Agronomy*, 82, 411-421. <https://www.sciencedirect.com/science/article/pii/S1161030116304995>
- Dissanayake & Rohana, C. 2009. Phosphate mineral fertilizers, trace metals and human health, *Journal of the National Science Foundation of Sri Lanka* 37(3), 153 - 169
- Food and Agriculture Organization of the United Nations/World Health Organization. (1999). *Codex Alimentarius: Food hygiene, basic texts* (Vol. 1). Rome: Author.
- Lal, R. (2018). Pathways for sustainable agriculture, *Proceedings of the National Academy of Sciences*, 115(23), 6002-6006. <https://www.pnas.org/content/115/23/6002>
- Nayana, S. & Ritu, S. (2017). Effects of chemical fertilizers and pesticides on human health and environment, *International Journal of Agriculture, Environment and Biotechnology* 0(6), 675 – 680

- Olugbemi, P. W, Oyebamiji, Y. O. & Salisu, M. A. (2023). Influence of slurry-fertigation of Maize (*Zea Mays*) production on nutrient-depleted Sand-Loam Soil Agrotech– Food Science, *Technology and Environment* 2(2).14-20 Association of Researcher of Skills and Vocational Training, Malaysia ISSN: 2773- 4870 eISSN:2821-3106 DOI:<https://doi.org/10.53797/agrotech.v2i2.3.2023>
- Olugbemi, P. W. & Emmanuel A. A. (2022). Cottage Tiger Nut (*Cyperus esculentus*) Production for Small Household Consumption: A Trial of Mobile-Urban Farming System. *International Journal of Strategic Research in Education, Technology and Humanities (IJSRETH)*. (10)1, 1 – 8
- Olugbemi, P. W., Odulate, O., L. O. (2022). Comparative analysis of the effects of two Fertilizers on the Growth and Yield of Yam (*Dioscorea rotundata*) Using Bags as Growing Medium, *International Journal of Comparative Studies in International Relations and Development* 8(3) 4201.
- Union of Concerned Scientists. (2022). What is *sustainable agriculture*? *union of concerned scientists*. <https://www.ucsusa.org/resources/what-sustainable-agriculture>
- Velten, S., Kautz, T., & Hoffmann, C. (2017). *Sustainable crop production*. In *Precision Agriculture for Sustainability* (pp. 1-14). Springer, Cham. https://link.springer.com/chapter/10.1007/978-3-319-58702-1_1