

## SUSTAINABLE AGRICULTURE: A STRATEGY FOR THE FUTURE WE NEED

**OGUZOR, Innocent Andrew Ph.D & AKUGBO, Messiah**

Department of Agricultural Education,

School of Vocational Education,

Federal College of Education (Technical), Omoku, Rivers state ,Nigeria

Corresponding Email: [a.oguzor@fctomoku.edu.ng](mailto:a.oguzor@fctomoku.edu.ng)

### Abstract

*Sustainable agriculture is a system that over the long term enhances environmental quality and efficient resource utilization for basic human food and fibre needs while enhancing the quality of life for farmers and society in the present generation as well as preserving them for the future generation. This paper examined the concept of sustainable agriculture, its components, principles, aims of sustainable agriculture and methods as well as benefits of sustainable agriculture. It also highlighted the concept of organic farming. It concludes that sustainable agriculture is both philosophy-driven that combines with a set of concrete farming practices. It therefore recommended among others that sustainable agriculture should be organically focused to meet the need for the renewal of natural resources and secured environment; Organic farming as an aspect of sustainable agriculture should be the focus of farmers in other to avoid the use of practices that are not environmentally friendly.*

**Key words:** *Agriculture, environment, organic farming, Sustainable*

### Introduction

Agriculture is traditionally referred to as the science, art of cultivating the land. In the view of Adeogun and Adebayo (2012), agriculture does not only involve an understanding of crop and soil sciences, and husbandry practices; it includes the study of the agro-ecological environment, economics of agri-business, horticulture, forestry and agricultural biology, fisheries, wildlife, animal science, agricultural engineering, agricultural extension and agricultural education. Agriculture entails processing, storage, distribution, marketing and consumption of plants and animal products for the sustainable livelihood. The advent of agriculture, which allowed humans to raise domesticated animals and produce surpluses of food that allowed them to dwell in cities, was a crucial factor in the creation of sedentary human civilization (Gliessman, 2015). According to Whitemore (2010), agriculture has a long history dating back thousands of years. At least eleven different parts of the globe have independently developed plant cultures. Although 2 billion people still relied on subsistence agriculture in the twenty-first century, industrial agriculture based on massive monoculture started to dominate agricultural production. Technology advancements, modern agronomy, plant breeding, and agrochemicals like pesticides and fertilisers have dramatically enhanced yields while inflicting extensive ecological and environmental harm. Selective breeding and contemporary methods of animal husbandry have both contributed to increasing meat production, but they have also sparked questions about the welfare of humans, animals, and the environment. Aquifer depletion, deforestation, antibiotic resistance, and the use of growth hormones in industrial meat production are a few

Cite this article as

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examples of environmental challenges. The foundation of agricultural sustainability is the idea that we must satisfy our needs today without jeopardising the capacity of future generations to satisfy their own needs. Therefore, short-term economic gain is just as important as long-term stewardship of both natural and human resources. In order to properly manage human resources, it is important to take into account social obligations including the living and working circumstances of labourers, the requirements of rural communities, and the current and long-term health and safety of consumers. Land and natural resource stewardship include preserving or improving the quality of these resources and using them in ways that enable future regeneration. In agricultural operations that contain livestock, stewardship considerations must also address issues regarding animal welfare (Miguel, 2014). The aforementioned problems highlight the urgent need for sustainable agriculture.

In many parts of the globe, there is a lot of interest in and discussion about sustainable agriculture. To achieve sustainable development, sustainable agriculture is required. Sustainable agriculture is described as a system that, over time, improves the environment and the resources on which agriculture relies, meets the fundamental requirements of people for food and fibre, is economically sustainable, and improves the standard of living for farmers and society at large (Keeney, 1989). Numerous meanings have been given to this remark, however the idea of agricultural sustainability has not changed. The commitment to meet the present and long-term food and fibre requirements of people while also improving the standard of living for farmers and society at large is another definition of sustainable agriculture. The "triple bottom line (TBL) hypothesis," put out by John Elkington in 1994, states that sustainability depends on a combined emphasis on environmental changes and their influence on society (people), the environment (plants), and economic value (profit). An essential issue for public and commercial policy is to take people, profit, and the planet factors into consideration as it is becoming more widely understood that they are interconnected (Abubakar & Atanda, 2013). Understanding sustainability requires a perspective on agro-ecosystems and food systems. From specific fields to whole eco-zones, agroecosystems are envisioned in the widest meaning. Agroecosystems, as well as the components of food distribution and consumption, are a part of food systems that similarly connect farmers with local communities and the world's population. Emphasizing a system's viewpoint enables a thorough analysis of our agricultural production and distribution businesses and their effects on local people and the environment. On the other hand, a system perspective also equips us with the means of evaluating how human civilization and its institutions affect agriculture and the sustainability of the environment. Studies of many natural and human systems have shown that robust, adaptable, and extremely diverse systems are often those that endure across time (Gliessman, 2015). According to Gliessman (2015), resilience is essential since most agroecosystems deal with circumstances that are sometimes very unexpected and seldom stable over the long term, such as climate, insect populations, political situations, and others. It may not always be feasible or desirable for an agro-ecosystem to resume the same shape and function it had before to a disturbance, but it may be able to alter itself and take on a new form in the face of changing circumstances, making adaptability a vital component of resilience. Diversity often contributes to adaptation since it gives a system additional tools and opportunities to adjust to changes, whether that variety comes from different kinds of crops or cultural knowledge.

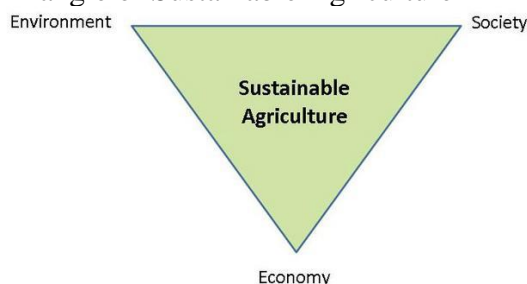
Agro-ecological and food system approaches are examples of a multifaceted approach to study, instruction, and action. Moving toward greater agricultural sustainability requires the involvement of not just scholars from diverse fields but also farmers, workers, retailers, customers, lawmakers, and anyone who have an interest in our food and agricultural systems. Last but not least,

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there is no definite goal for sustainable agriculture. Current issues, opinions, and views have an influence on science's understanding of what constitutes sustainability in terms of the environment, society, and economics. For instance, agriculture's ability to adapt to climate change is now receiving greater attention, even though it wasn't considered a major issue 20 years ago. Additionally, the intricacies of what constitutes a sustainable system might differ based on a number of variables (such as soil types, climate, labour expenses), as well as from one cultural and ideological standpoint to another, making the word "sustainable" itself a contentious one. Therefore, thinking of agricultural systems as ranging along a continuum from unsustainable to very sustainable is more informative and germane than categorising them into the sustainable/unsustainable dichotomy (Sarah et al., 2015).

### Triangle of Sustainable Agriculture



Adapted from Smythe (2014)

### Concept of Sustainable Agriculture

Humanity should see sustainability as the ultimate objective of human-ecosystem harmony. Sustainability is the process of sustaining change in a balanced environment where resource exploitation, investment direction, technology development direction, and institutional change are all in harmony and improve both present and future capacity to satisfy human needs and ambitions (Gold, 2009). According to Gold's additional claims, sustainable agriculture is a kind of farming that focuses on providing food without harming the environment and enhancing community livelihoods. This suggests that agriculture must strike a balance between aims for output, the environment, and community development. Sustainable agriculture is an integrated system of plant and animal production techniques that are site-specific and will, over time, meet human needs for food and fibre, improve the environment and natural resources (agriculture), the economy, and the standard of living for farmers and society at large. Using sustainable agriculture's economic, environmental, and social objectives as a benchmark may be a helpful way to track a farm's performance and development through time. Because it can be used on farms of various sizes and types, this strategy makes sustainable agriculture relevant to all farmers (Gold, 2009).

### Components of Sustainable Agriculture

Sustainable agriculture in the submission of Pretty et al., (2002) is broken into three components, namely:

- Economic profitability
- Environmental stewardship
- Social responsibility

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**Economic profitability:** Sustainable agricultural methods may benefit a farm's bottom line. Adding several products and markets to the farm, for instance, may assist to lower financial risk. The value of the farm may increase over time as a result of better soil and water quality, as well as other environmental advantages from sustainable practices. The cost of production can be influenced by sustainable methods; for instance, the cost of fertiliser and pesticides is typically lower on a sustainably managed farm because, for example, legumes and crop rotation are typically less expensive than their synthetic alternative. Selling products directly to local markets in the community also reduces shipping and fuel costs and may potentially lower transportation costs. Planting material costs may be cheaper for farmers who save their own seeds or make their own stock since labour expenses are often greater than those of traditional methods (McCullum, 2009). The authors further opined that appropriate technology transfers for rural areas indicated the achievement of economic sustainability in the following ways.

- a. The family's net worth or savings are constantly increasing.
- b. The family's debt is steadily decreasing.
- c. The agricultural business routinely generates a profit from year to year.
- d. Less people are buying fertiliser and feed from outside farms.
- e. Less people rely on government assistance.

**ii. Environmental stewardship:** Sustainable agriculture is based on considerations for the environment. Sustainable agricultural techniques are typically defined as those that have little or no negative impact on natural ecosystems. Sustainable agriculture, however, also aims to benefit the environment and animals. This sometimes entails taking action to undo the damages caused by destructive farming practices, such as undoing soil erosion or draining wetlands. In sustainable systems, renewable natural resources are conserved, recycled, and even replaced. Healthy soil is essential for sustained production, with the guiding principle that "the soil feeds the crops" when it comes to management measures (Gold, 2009). Reiterating this viewpoint, Gold (2009) said that ecologically, sufficient soil organic matter and biologically based inputs—which nourish soil organisms and help them release nutrients for plants—are what make soil fertile. Utilizing nitrogen-fixing legumes, green manure, and animal manure, avoiding or eliminating tillage, and maintaining year-round soil cover are sustainable techniques that increase soil fertility and promote soil health. The method does not forbid the use of artificial fertiliser, which may be added to natural inputs as a supplement. Other sustainable ideas include increasing variety via intentional crop rotation, intercropping, and companion planting, preserving water quality, composting, year-round soil cover, fusing soil and animal production, and using soil conservation techniques, among others. In sustainable systems, weeds, illnesses, and insects are managed rather than eradicated. Sustainable pest control techniques place an emphasis on prevention via sound agricultural and cultural practices. Crop rotation, increasing soil quality, maintaining excellent hygiene, using optimal planting densities, scheduling planting and transplanting operations, using biological control, cultivating resistant cultivars, etc. are some of the tactics used. To stay ahead of possible issues, pest monitoring via regular crop inspections and precise identification is crucial.

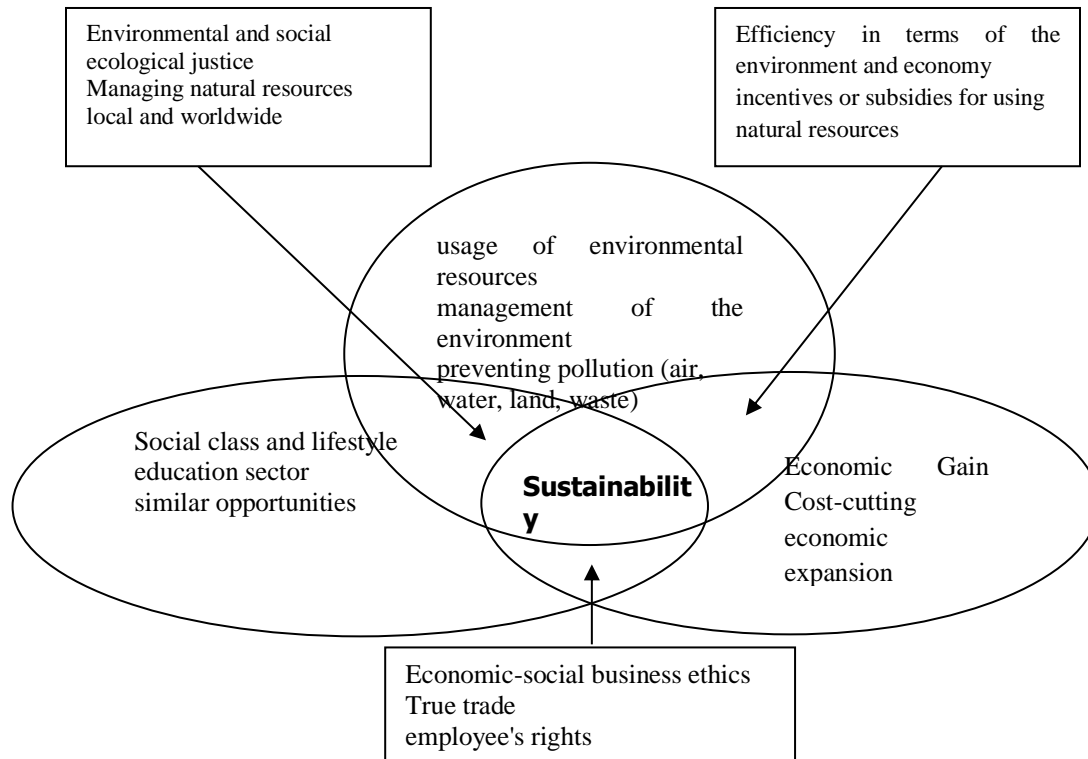
**iii. Social responsibility:** Social sustainability refers to the standard of living for both agricultural workers and residents as well as members of the neighbourhood. Some of the factors taken into account in social sustainability include treating employees fairly, cultivating good farm family ties, interacting with clients directly, and choosing to buy goods locally (rather than from a more distant

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market). Another method a sustainable farm may benefit the neighbourhood is via community supported agriculture. Farmers' markets, cooperatives, and on-farm activities are some such examples (McCullum, 2009).

### Pillars of Sustainability



Adapted from USDA (n.d)

### Aims of Sustainable Agriculture

In the submission of Sarah et al., (2015), sustainable agriculture aims at the following;

1. Create healthy, safe food: Farms produce high-quality, nutritious food.
2. Conserve natural resources: Recycle waste products into the environment to maintain the quality of resources including water, soil, and air for future generations. Prudent use is made of chemical inputs like insecticides and fertilisers. Additionally, sustainable agriculture may help with climate change adaptation and mitigation.
3. Ensure economic viability: Farms produce enough revenue to remain in operation. Sustainable farming contributes to a healthy economy and balanced territorial development.
4. Provide services to the eco-system: Biodiversity (habitats, genes, species) is maintained; agriculture provides beneficial services including fertiliser and water retention, soil conservation, amenity, and carbon sequestration.
5. Take care of the countryside: Farms take care of the land, preserving important ecosystems and wildlife while maintaining a beautiful scenery that would not otherwise exist.

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6. Improving the standard of living in rural areas: Farming contributes to the quality of life by, among other things, delivering appropriate working conditions and jobs. Social structures develop, resulting in a setting that is also appealing to visitors.
7. Ensure animal welfare: Cared for, provided a suitable food made from natural ingredients, and free from zoonoses.

### **Principles of Sustainable Agriculture**

The term "sustainable agriculture" refers to a wide range of ideas and methods that are advantageous to farmers, their farms, their communities, and the environment. According to Sarah et al., (2015),

- I. Integrating biological and ecological processes including the nutrient cycle, nitrogen fixation, soil regeneration, predation, and parasitism into the food production process is one of the essential elements for sustainability.
- II. Reduce the use of non-renewable inputs that are bad for the environment, farmers' health, and consumer health.
- III. iii) Make effective use of farmers' knowledge and abilities, as well as the group's ability to collaborate to address challenges related to pest control, water conservation, irrigation, forestry, and credit management.

The concept of sustainable agriculture does not imply ideological exclusion of certain technology or practises (McCullum, 2009). Recent empirical research demonstrates that changes in agricultural production parameters are the root cause of effective agricultural sustainability efforts and projects (e.g. from use of fertilisers to nitrogen-fixing legumes, from pesticides to emphasis on natural enemies, from ploughing to zero-tillage).

### **Methods of Sustainable Agriculture**

While describing methods, Whitmore (2010) enumerated the following as methods of sustainable agriculture.

1. Crop rotation: One of the most effective methods of sustainable agriculture is crop rotation. Its goal is to prevent the negative effects associated with repeatedly growing the same crops in the same soil. Since many pests like certain crops, it helps in the fight against pest issues. The population of the pests may grow significantly if there is a consistent source of food. Rotation disrupts the bugs' reproductive cycles. Farmers may plant certain crops during rotation to restore plant nutrients. The need of chemical fertilisers is decreased by these crops.
2. Cover crops: Many farmers decide to always have crops grown in a field and never leave it fallow, but this practise may have unforeseen effects. The farmer may accomplish his objectives of reducing soil erosion, inhibiting the development of weeds, and improving the soil quality by planting cover crops, such as clover or oats. Utilizing cover crops also lessens the demand for fertilisers and other chemicals.
3. Soil enrichment: The foundation of agricultural ecosystems is the soil. Pesticide overuse often kills the life that a healthy soil contains. It is possible to maintain and improve the quality of soil in various ways, some examples include using decomposed plant material or animal manure. Good soils may boost yields in addition to producing more resilient crops.

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4. Natural pest predators: It's crucial to consider the farm as an ecosystem rather than a factory in order to maintain effective control over pests. For instance, many birds and other animals are in reality pests of agriculture in their native environment.

Other methods of sustainable agriculture in the submission of Conserve Energy Future (2022) include; bio-intensive integrated pest management, polyculture farming, bio-dynamic farming, agroforestry, better water management and permaculture. Bio-intensive: Crop rotation is used in this strategy to control pest infestation, as opposed to chemical approaches. Growing numerous crops in one space is known as polyculture farming. This method allows producers to produce a wider range of goods on a single plot while using all available resources as effectively as possible. Bio-dynamic farming: This technique applies the concepts of organic manuring while incorporating ecological and holistic growth methods. Agroforestry: This combines agricultural and forestry methods for long-term, profitable, and effective land use. It entails planting trees and bushes alongside crops or grazing (Conserve Energy Future, 2022).

### Organic Farming as Aspect of Sustainable Agriculture

One of the many methods used to achieve the goals of sustainable agriculture is organic farming. Numerous organic farming practises, such as intercropping, mulching, and integrating crops and animals, are not new to other types of agricultural systems. However, organic farming is governed by a number of rules and certification programmes that prohibit the use of practically all synthetic inputs and acknowledge soil health as the method's primary concern (Mustapha et al., 2012). A system that is created and maintained to produce agricultural goods using techniques and materials that preserve the quality of organic agricultural products until they are consumed is known as organic farming (Decock, 2005; Narayanan, 2005).

According to Bello (2008), organic farming is the practise of producing food without the use of synthetic chemicals (fertilizers, pesticides, antibiotics, etc.). Compost and manure are two examples of organic materials that are used in crop cultivation to preserve soil organic matter and provide nutrients. The rules regulating organic farming provide precise requirements on how certain livestock should be produced and nourished since animal welfare is a key component of organic farming. Enhancing soil quality and consequently agriculture's long-term viability are two additional advantages of increasing soil organic matter through organic farming. Organic farming uses trees, bushes, and leguminous plants to stabilise and feed soil, dung and compost to offer nutrients, and terracing to avoid erosion and protect ground water. Organic farming also helps to maintain and develop valuable resources such as the topsoil (Kutama et al., 2013).

### Benefits of Sustainable Agriculture

Several benefits of sustainable agriculture exist, Quinton (2016) posits the following;

**1.Contributes to environmental conservation:** The environment significantly contributes to meeting our fundamental necessities for survival. Likewise, it is our responsibility to protect the environment so that the requirements of future generations are met. Regenerative agriculture encourages the soil and other natural resources, such water and air, to regenerate. This replenishment makes sure that these natural resources can support life for next generations.

**2.Public health safety:** Sustainable agriculture steers clear of dangerous pesticides and fertilisers. Farmers are able to grow fruits, vegetables, and other commodities that are safer for customers, employees, and local communities as a consequence. Sustainable farmers are able to shield people

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from infections, poisons, and other dangerous contaminants by managing animal waste carefully and effectively.

**3.Reduction in cost:** By reducing the demand for fossil fuels, sustainable agriculture cuts both the purchase and transportation costs of those fuels. In turn, this lowers the total cost of farming.

**4.Biodiversity:** When crops are rotated periodically, a broad range of plants and animals are produced, resulting in biodiversity. This enriches the soil and prevents the spread of disease and insect outbreaks.

5.Prevents pollution: Sustainable agriculture entails that all trash generated by a farm is kept within the environment of that farm. Waste cannot produce pollution in this manner.

### **Conclusion**

The goal of sustainable agriculture is to meet the world's population's demands for food and fibre while also improving the standard of living for farmers and society at large. In order to meet human needs for food and clothing (made of cotton, wood, and leather), improve environmental conditions and natural resources, use non-renewable resources more effectively, and better utilise on-farm resources to better the environment, sustainable agriculture aims to do all of these things. It also aims to promote agriculture in a more sustainable status. Sustainability puts a focus on social, economic, and environmental challenges. The potential advantages that result from making the optimum use of both crops and animals as well as their agro-ecological management are emphasised by agricultural sustainability. Through a set of concrete farming practices such as organic farming, crop rotation, cover cropping, soil enrichment, disease and pest control, conservative tillage etc. sustainable agriculture can be achieved. It is important to note that sustainable agriculture aims at producing safe/healthy food, conserve natural resources, ensure economic viability etc. Sustainable agriculture is important because people will need more food in future due to increasing population as also creating of jobs for the present and future generation. Conclusively, a guided agriculture will bring about sustainability for our tomorrow.

### **Recommendations**

The main goal of sustainable agriculture is to meet the need of the present without compromising the need of future generations. Based on the foregoing, the following recommendations are made.

1. Sustainable agriculture should be organically focused to meet the need for the renewal of natural resources and secured environment.
2. Organic farming as an aspect of sustainable agriculture should be the focus of farmers in other to avoid the use of practices that are not environmentally friendly.
3. Policy makers at both the local and state government ministries and agencies of agriculture should focus on making policies that will impact on sustainable agricultural practices.
4. Farmers in our society should be trained on organic farming due to the abundant benefits it presents to the society and to ensure sustainable livelihood.
5. Farming should focus on food security and farmers' increased productivity, in other to boost their economic growth.
6. Non-Governmental and private organizations should be focused on implementing policy directions that favour natural resources security and biodiversity to avoid environmental devastation and degradation.

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