

Sustainable Agriculture: A Strategy for the Future We Need

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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 examines the concept of sustainable agriculture, its components, principles, aims of sustainable agriculture and methods as well as benefits of sustainable agriculture. It concludes that sustainable agriculture is both philosophy driven and a set of concrete farming practices. It therefore recommends among others that sustainable agriculture should be organically focused to meet the need for the renewal of natural resources and secured environment and government should ensure the provision of the required facilities and infrastructures to enable farmers engage in complete cycle of production that is geared towards sustainability.

Keywords: Sustainable, agriculture, sustainability, strategy, future

1. Introduction

Agriculture is the science and art of cultivation of plants and rearing of livestock which gives rise to production, processing, storage, distribution, marketing and consumption of plants and animal products for the sustainable livelihood. Agriculture was the key development in the rise of sedentary human civilization, whereby farming of domesticated species created food surpluses that enabled people to live in cities (Gliessman, 2015). Whitemore (2010) asserted that the history of agriculture began thousands of years ago. Plants were independently cultivated in at least eleven regions of the world. Industrial agriculture based on large-scale monoculture in the twentieth century came to dominate agricultural output, though about 2 billion people still depended on subsistence agriculture in the twenty-first century. Modern agronomy, plant breeding, and agrochemical such as pesticides and fertilizers, and technological developments have sharply increased yields, while causing widespread ecological and environmental damage. Selective breeding and modern practices in animal husbandry have similarly increased the output of meat, but have raised concerns about human, animal welfare and environmental damage.

Environmental issues include; contributions to global warming, depletion of aquifers, deforestation, antibiotics resistance, and growth hormones in industrial meat production. Agricultural sustainability rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs. Therefore, long-term stewardship of both natural and human resources is of equal importance to short-term economic gain. Stewardship of human resources includes consideration of social responsibilities such as working and living conditions of labourers, the needs of rural communities, and consumer health and safety both in the present and the future. Stewardship of land and natural resources involves maintaining or enhancing the quality of these resources and using them in ways that allow them to be regenerated for the future. Stewardship considerations must also address concerns about animal welfare in farm enterprises that include livestock (Miguel, 2014). These aforesaid issues give impetus to the dire need for sustainable agriculture.

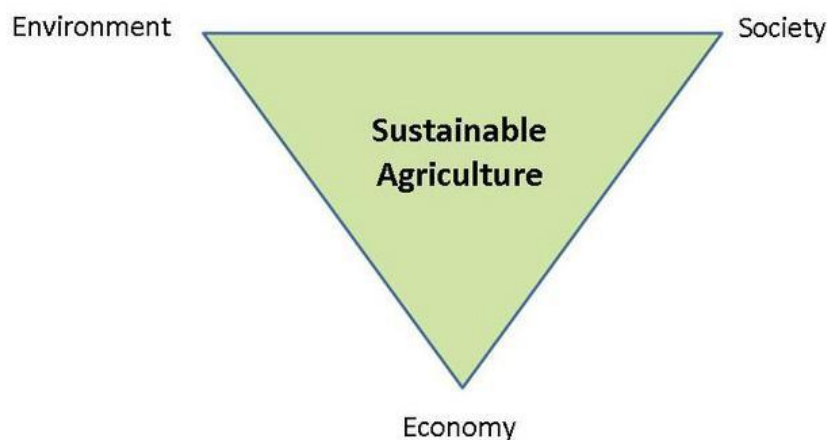
Sustainable agriculture is a subject of great interest and lively debate in many segments of the world. Sustainable agriculture is defined as a system that over the long term, enhances

environmental quality and the resources based on which agriculture depends; provides for basic human food and fibre needs is economically viable, and enhances the quality of life for farmers and society as a whole (Keeney, 1989). From this statement numerous definitions emerged but the concept surrounding agricultural sustainability remains the same. Sustainable agriculture is also described as a commitment to satisfy human food, fibre needs and to enhance the quality of life for farmers and society as a whole, now and into the future. Investopedia (n.d.) opined that sustainability hinges on a combined focus on environmental changes and their impact on society (people), the environment (planet) and economic value (profit) known as the “triple bottom line (TBL) theory” propounded by John Elkington in 1994. Increasingly, it is being recognized that people, profit, the planet dimensions are interlinked, and an important challenge for public and private policy is to take them jointly into account (Abubakar & Attanda, 2013).

An agro-ecosystems and food systems perspective is essential to understanding sustainability. Agro ecosystems are envisioned in the broadest sense, from individual fields to eco-zones. Food systems, which include agro ecosystems plus distribution and food consumption components, similarly span from farmer to local community to global population. An emphasis on a system’s perspective allows for a comprehensive view of our agricultural production and distribution enterprises and how they affect human communities and the natural environment. Conversely, a systems approach also gives us the tools to assess the impact of human society and its institutions on farming and its environmental sustainability. Studies of different types of natural and human systems have taught us that systems that survive over time usually do so because they are highly resilient, adaptive, and have high diversity (Gliessman, 2015). To Gliessman, resilience is critical because most agro ecosystems face conditions (including climate, pest populations, political contexts, and others) that are often highly unpredictable and rarely stable in the long run. Adaptability is a key component of resilience, as it may not always be possible or desirable for an agro-ecosystem to regain the precise form and function it had before a disturbance, but it may be able to adjust itself and take a new form in the face of changing conditions. Diversity often aids in conferring adaptability, because the more variety that exists within a food system,

whether in terms of types of crops or cultural knowledge, the more tools and avenues a system will have to adapt to changes.

An agro ecosystems and food system approach also implies multi-pronged efforts in research, education, and action. Not only researchers from various disciplines, but also farmers, laborers, retailers, consumers, policymakers and others who have a stake in our agricultural and food systems have crucial roles to play in moving toward greater agricultural sustainability. Finally, sustainable agriculture is not a single, well-defined end goal. Scientific understanding about what constitutes sustainability in environmental, social, and economic terms is continuously evolving and is influenced by contemporary issues, perspectives, and values. For example, agriculture's ability to adapt to climate change was not considered a critical issue 20 years ago, but is now receiving increasing attention. In addition, the details of what constitutes a sustainable system may change from one set of conditions (e.g., soil types, climate, labor costs) to another, and from one cultural and ideological perspective to another, resulting in the very term "sustainable" being a contested term. Therefore, it is more useful and pertinent to think of agricultural systems as ranging along a continuum from unsustainable to very sustainable, rather than placed in a sustainable/unsustainable dichotomy (Sarah, Julia, Nicolas & Jens, 2015).



Triangle of Sustainable Agriculture

2. Concept of Sustainable Agriculture

Sustainability is the process of maintaining change in a balanced environment, in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations, sustainability should be viewed as humanity's target goal of human-ecosystem equilibrium (Gold, 2009). Gold further asserted that sustainable agriculture is an approach to agriculture that focuses on producing food in a way that does not degrade the environment and contributes to the livelihood of communities. This implies that agriculture must balance production, environmental and community development goals. The term sustainable agriculture refers to an integrated system of plants and animal production practices having a site-specific application that will over the long term; satisfy human food and fibre needs, enhance the environmental quality and natural resources (agriculture), economy, the quality of life for farmers and society as a whole. The economic, environmental and social goals of sustainable agriculture can serve as a useful yardstick for measuring farm's performance and the progress overtime. This approach makes sustainable agriculture relevant to all farmers because it can be applied to farms of every size and type (Gold, 2009).

3. Components of Sustainable Agriculture

Sustainable agriculture in the submission of Pretty, Ball and Ravindranth, (2002) can be broken into three components, namely;

- Economic profitability
- Environmental stewardship
- Social responsibility

Economic profitability: Sustainable agriculture practices can have a positive economic impact on a farm. For example, diversifying the farm with several crops and markets helps to reduce financial risk. Over time, improved soil and water quality, as well as other environmental benefits from sustainable practice, may raise the value of the farm. Selling products directly to local markets in the community reduces shipping and fuel costs and can potentially decrease transportation costs; production costs can be affected by sustainable

methods, fertilizer and pesticides costs are generally reduced on a sustainably managed farm for example, legumes and crop rotation tend to be less expensive than their synthetic alternative. Labor costs are often higher than conventional systems planting material costs can be lower for growers saving their own seeds or producing their own stock (McCullum, 2009). The authors further opined that appropriate technology transfers for rural areas (ATTRA) indicated the achievement of economic sustainability in the following ways.

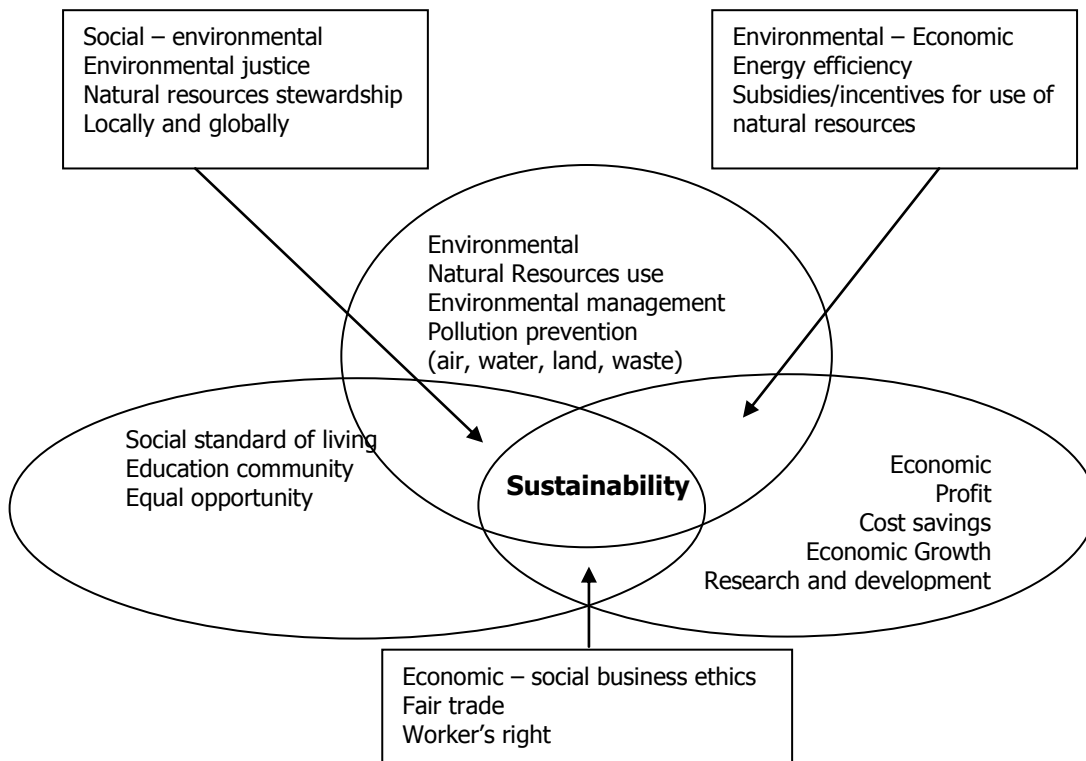
1. The family savings or net worth is consistently going up.
2. The family debt is consistently going down.
3. The farm enterprise is consistently profitable from year to year.
4. Purchase of off-farm feed and fertilizer is decreasing.
5. Reliance on government payments is decreasing.

Environmental stewardship: Environmental concerns are central to sustainable agriculture. Sustainable agriculture is frequently described as; ecologically sound practices that have little to no adverse effect on natural ecosystems. However, sustainable agriculture also seeks to have a positive impact on natural resources and wildlife. This can often mean taking measures to reverse the damage (e.g. soil erosion or draining of wetlands) that have already occurred through harmful agricultural practices. Renewable natural resources are protected, recycled, and even replaced in sustainable systems. A key to sustainable production is healthy soil, with a central tenet that management practices “feed the soil and the soil feeds the crops”(Gold, 2009). Reiterating this view, Gold explained that ecologically, this means that soil fertility is provided by adequate soil organic matter and biologically based inputs that feed soil organisms, which release nutrients to plants. Sustainable methods that enhance soil fertility and improve soil health include; using nitrogen fixing legumes, green manure and animal manure, minimizing or eliminating tillage and, maintaining year round soil cover. This approach does not preclude the use of synthetic fertilizer that can be used to supplement natural inputs. Other sustainable concepts include; maximizing diversity through planned crop rotation, intercropping and companion planting, protecting water quality, composting, year round, soil cover, integrating soil and animal production, soil conservation practices etc. Insects, diseases, and weeds are managed, rather than controlled, in sustainable

systems. Sustainable pest management practices emphasize prevention through good production and cultural methods. Some strategies include; using crop rotation, improving soil quality, practicing good sanitation, using optimum planting densities, timing planting and transplanting operations, employing biological control, growing resistant varieties etc. Monitoring pests through frequent crop inspections and accurate identifications are essential to keeping ahead of potential problems.

Social responsibility: social sustainability relates to the quality of life for those who work and live on the farm, as well as those in the local community. Fair treatment of workers, positive farm family relationships, personal interactions with consumers, and choosing to purchase supplies locally (rather than from a more distant market) are just some of the aspects considered in social sustainability. Community supported agriculture, farmers' markets, cooperative, and on farm events are also some of the ways a sustainable farm can have a positive impact on the local community. In essence, the community supports the farm (McCullum, 2009).

Pillars of Sustainability



4. Aims of Sustainable Agriculture

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

1. Produce safe and healthy food: Farm produce safe and healthy and high quality food.
2. Conserve natural resources: What is taken out of the environment is put back in, so that resources such as water, soil and air are kept in good condition for future generations. Chemical inputs such as fertilizers and pesticides are used judiciously. Sustainable agriculture also has a role to play in mitigating climate change and adapting to it.
3. Ensure economic viability: Farms generate enough income to keep going. Sustainable farms help to strengthen the economy and contribute to balance territorial development.
4. Deliver services for the eco-system: Biodiversity (habitats, genes, species) is protected, agriculture delivers valuable services, such as water and nutrient retention, soil conservation, amenity and carbon storage.
5. Manage the country side: Farm manage the land, pre-serving valuable habitats and biodiversity and maintaining attractive landscape which would not otherwise exist.
6. Improve quality of life in farm areas: Farming makes contribution to quality of life, for example by providing employment and offering decent working conditions. Social structures improve, creating an environment that is also attractive for tourists.
7. Ensure animal welfare: Animals cared for, they are fed with an appropriate natural diet and do not suffer from epizootics.

5. Principles of Sustainability

Sustainable agriculture encompasses many principles and practices that benefit growers, their farms, their communities, and the environment. Sarah et al., (2015) reported that the key principles for sustainability are to:

- i) Integrate biological and ecological process such as nutrient cycle, nitrogen fixation, soil regeneration, predation and parasitoid into food production process.
- ii) Minimize the use of non-renewable inputs that cause harm to the environment or to the health of farmers and consumers.
- iii) Make productive use of the knowledge and skills of farmers, people collective capacities to work together to solve common agricultural and natural resource problems, such as pest, water shed, irrigation, forest and credit management.

The idea of agricultural sustainability does not mean ruling out any technologies or practices on ideological grounds (McCullum, 2009). Recent empirical evidence shows that successful agricultural sustainability initiatives and projects arise from shifts in factors of agricultural production (e.g. from use of fertilizers to nitrogen-fixing legumes, from pesticides to emphasis on natural enemies, from plowing to zero-tillage).

6. Methods of Sustainable Agriculture

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

1. Crop rotation: Crop rotation is one of the most powerful techniques of sustainable agriculture. Its purpose is to avoid the consequence that come with planting the same crops in the same soil for years in a row. It helps tackle pest problems, as many pests prefer specific crops. If the pests have a steady food supply, they can greatly increase their population size. Rotation breaks the reproduction cycles of pests. During rotation, farmers can plant certain crops, which replenish plant nutrients. These crops reduce the need for chemical fertilizers.
2. Cover crops: Many farmers choose to have crops planted in a field at all times and never leave it barren, this can cause unintended consequences. By planting cover crops, such as clover or oats, the farmer can achieve his goals of preventing soil erosion, suppressing the growth of weeds, and enhancing the quality of the soil. The use of cover crops also reduces the need for chemicals such as fertilizers.
3. Soil enrichment: Soil is a central component of agricultural ecosystems. Healthy soil is full of life, which can often be killed by the over-use of pesticides. Good soils can increase yields as well as creating more robust crops, it is possible to maintain and enhance the quality of soil in many ways some examples include leaving crop residue in the field after a harvest, and the use of composted plant material or animal manure.
4. Natural pest predators: In order to maintain effective control over pests, it is important to view the farm as an ecosystem as opposed to a factory. For example, many birds and other animals are in fact natural predators of agricultural pests.

7. Benefits of Sustainable Agriculture

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

1. **Contributes to environmental conservation:** The environment plays a huge role in fulfilling our basic needs to sustain life. In turn, it is our duty to look after the environment so that future generations are not deprived of their needs sustainable agriculture helps to replenish the land as well as other natural resources such as water and air. This replenishment ensure that these natural resources will be able for future generations to sustain life.
2. **Public health safety:** Sustainable agriculture avoids hazardous pesticides and fertilizer. As a result, farmers are able to produce fruits, vegetables and other crops that are safer for consumers, workers, and surrounding communities. Through careful and proper management of livestock waste, sustainable farmers are able to protect humans from exposure to pathogens, toxins and other hazardous pollutants.
3. **Reduction in cost:** The use of sustainable agriculture reduces the need for fossil fuels, resulting in significant cost savings in terms of purchasing as well as transporting them. This in turn lessens the overall costs involved in farming.
4. **Biodiversity:** Sustainable farms produces a wide variety of plants and animals resulting in biodiversity during crop rotation, plants are seasonally rotated and this results in soil enrichments, protection of diseases, and pest outbreaks.
5. **Prevents pollution:** Sustainable agriculture means that any waste a farm produces remains inside the farms ecosystem. In this way the waste cannot cause pollution.

8. Conclusion

Sustainable agriculture is a commitment to satisfy human food and fibre needs and to enhance the quality of life for farmers and society as a whole now and into the future. Sustainable agriculture aims to satisfy human food and clothing (cotton, wood, leather) needs, enhance environmental qualities and natural resources, use non-renewable resources more efficiently, take better advantage of on-farm resources to better the environment and promote agriculture in a more sustainable status. Sustainability covers environment, economic and social issues. Agricultural

sustainability lays emphasis on the potential benefits that arises from making the best use of both genotypes of crops and animals and their agro-ecological management. Through a set of concrete farming practices such as 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.

8.1 Recommendations

The main goal of agricultural sustainability 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. Farmers in our society should be trained to focus on organic farming, which will consider their needs and the society to ensure their sustainable livelihood.
2. Farming should focus on food security and farmers' profitability, in other to boost their economic growth.
3. Agricultural development programmes should be made functional in every state for better extension services to farmers in other to avoid the use of practices that are not environmentally friendly.
4. Agricultural agencies should be focused on food and natural resources security and biodiversity; to avoid environmental devastation and degradation.
5. Government at all levels should provide the required facilities to enable extension agents and agencies reach out to local/rural farmers in other to meet up their needs and responsibilities.

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