

Contemporary Farming Practices for Sustainable Resource Management and Export- Market Opportunities for Sustainable Agro-Business

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Abstract

Awareness is growing about contemporary farming practices in developing countries in consideration of the burgeoning population with rising poverty and increasing risk of food insecurity and environment degradation and in consonance with the renewed emphasis being given to the world. Although the agricultural sector, for example, in Nigeria, has demonstrated improved performance since the inception of agricultural transformation agenda (ATA) in 2011, financing bottlenecks remains; and the major concern is the little or no emphasis on contemporary farming practices. This paper, among others, advocates for financing mechanism to support a transforming agenda that moves agriculture away from activities that are nature degrading and environment polluting to those that are able to sustain resource management, nature preserving and environment friendly and culminate in export-market opportunities for sustainable agro-business. It briefly highlights the conventional farming practices and some of the attendant benefits. It also discussed the contemporary farming practice, some of the benefits and demerits. It is, as well encouraging/supporting the financing framework to engender contemporary farming practices in Nigeria which must be pursued within the context of sustainable development and poverty alleviation in which the integration between economic, social and environmental pillars of development are recognized and sustained.

Keywords: *Contemporary Farming Practices, sustainable Resources Management, Export-Market Opportunities, Sustainable Agro-business.*

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Background to the Study

Agriculture is the most important sector for many countries, Nigeria inclusive, in terms of its potentials to influence a wide range of issues that are critically related to sustainable development, including the economy, employment food security, trade flows, poverty, human health, climate change, the use of natural resources (especially land and water), and biodiversity (UNEP, 2011). Nigeria has the ambition of diversifying her economy from crude oil dependency. The country also faces a food crisis problem with growing population becoming increasingly dependent on imported foods (Nwajiuba, 2013). Majority of the farmers are in rural areas, and they are smallholders in terms of scale and they rely on the earth's land, forests and water resources to contribute to the food supply (Olomola, 2014).

Agricultural production in Nigeria has been confronted with myriads of challenges among which is climate change. Among the global topical issues currently is climate change. Its variation constitutes a major threat to the environment and biodiversity (Idumah, Owombo & Adesina (2014). It has adversely impacted natural resources, food security, human health, the environment, economic activity and physical infrastructures (Djoudi & Brocklouis, 2011). The impacts are evident in the threats posed by drastic changes in rainfall patterns, temperature, relative humidity, radiation and general alterations in the trends of climatic elements. Water scarcity and degradation are also increasing and have been attributed to economic and population growth, poor water management, and the impacts of climate change (Danielou, 2012). In addressing the problem of the environment occasioned by climate change and variation as well as the roles played by education in this regard, stakeholder's education policy formulation and implementation in modern agricultural practices to ameliorate the situation becomes necessary (Idumah, *et-al*, (2014). The agricultural sector is most vulnerable to the impacts of climate change and every aspect of the agricultural sector including crop production, livestock, forestry, fishery and food processing value chain play a vital role in the transition to modern agricultural practices. With the modern practices, agricultural practices in all the sectors will have to be increasingly low carbon, resource efficient and socially inclusive for improved productivity to ensure food and nutrition security (FAO, 2012).

Working in challenging environments, on degraded land or with little agricultural technology, the rural poor still produce 60% of the country's food (UNEP, 2011). This means smallholder farmers are key interface between the environmental and agriculture and supporting these farmers can lead to both economic and environmental benefits. Well-managed, sustainable agriculture cannot only overcome hunger and poverty, but can address other challenges from climate change to loss of biodiversity (New Age, 2012). Its value and contribution to multiple economic environmental and societal goals need to be recognized in the income and employment prospects for the entire smallholdings across the country. Encouraging this kind of scenario in agriculture is the place of contemporary farming practices. According to Peterson, Burnett and Sanchez (2018). To this regard, much needs to be done in favour of contemporary farming practices in Nigeria. Therefore, the objective of this paper is to discuss the concept, types of contemporary farming practices and the attendant benefits.

Statement of the Problem

Improving the footprint of agriculture while increasing production needs concerted efforts in two areas: first, closing the uptake gap of existing best practices and technologies by focusing on knowledge sharing and creating supportive extension services networks; and second, investing in innovation and research to provide the solution for tomorrow and ensure agricultural policies are science-based. Enhancing sustainable productivity must be the centre of efforts to make agriculture both environmentally sound and economically dynamic. There is need to achieve more crops per drop of water and per measure of inputs. This is essential to ensure that little or no land resource is involved in order to preserve biodiversity. Producers need to be integrated in value chains and new activities need to be developed in processing and other sectors to improve rural incomes and ensure that growth in productivity is translated into better livelihoods. To this regard, is where contemporary farming practices are essential. Traditional or conventional practices long before now have been the basis for agricultural production in many countries, especially developing countries. These practices are shifting cultivation, bush-fallow, crop rotation, agro-forestry, among others, which are very much demanding, especially in terms of space, labour and in most cases leading to low output. There is therefore, the need for contemporary farming practices to help offset the demerits of traditional practices.

Contemporary Farming Practices (Modern Agricultural Practices)

According to Peterson, et al., (2018) just like every other sector, the agricultural sector is being transformed by innovative technological practices. These practices are fast replacing traditional methods like bush fallowing, rotational farming, grafting and agro-forestry. A typical contemporary farming practice is vertical farming and the attendant components and dimensions.

Vertical Farming

According to Capua, Akin, David and Kevin (2011), this is the practice of using indoor farming techniques and controlled-environment agriculture (CEA) technology in vertically inclined surfaces. These facilities utilize artificial lightning and environmental control systems (humidity, temperature, gases, etc) that are similar to green houses where natural sunlight is augmented with metal reflector. Vertical farming yields 10 times more than traditional agriculture. In areas where urbanization overpopulation has entrenched into farmlands, this method will be of great benefit to farmers.

There are 3 types of vertical Farming.

- 1. Hydroponics:** Is the vertical farming method of growing plants without soil by using mineral nutrients in a water base. The nutrients include byproduct of fish waste, duck manure, chemical fertilizers, etc. most hydroponic reservoirs are built of plastic, concrete, glass, metal or wood. The nutrients solution is changed on a scheduled or when the concentration drops below a determined level.
- 2. Aeroponics:** Was introduced by the National Aeronautical and Space Administration (NASA) in the 1990s. It is the technique of growing plants in air or mist without soil and very little water.

3. **Aquaponics:** Is used to grow fish and plants in the same ecosystem. The fish waste provides the nutrients for the plants and in return, plant help filter the water.

What is Hydroponic Farming?

The basic concept of a hydroponic farm is that water is substituted for soil. Solutions are then added to the water to provide easily accessed nutrients for a healthy yield. The nutrients added to the water may include phosphorus, nitrogen, calcium, potassium and many more, depending on the plants need.

What are the benefits of Hydroponics?

There are many advantages to a **hydroponic vegetable garden**. They can help solve problems without excessive use of space or water, are known to produce vegetables with high nutrient content, and produce vegetables faster than traditional growing methods. It seems all but certain that this method of agriculture will become a primary source of fruits and vegetables in the future.

i. Maximize Space

Hydroponics require far less space than plants grown in soil. Depending on the system, when hydroponics are combined with vertical farming techniques, they can use up to 99 percent fewer lands than typical farming techniques. One reason for the smaller footprint of hydroponic plants is that the roots do not have to spread out to search for nutrients and moisture. Water and nutrients are delivered to the roots directly, either intermittently or constantly, depending on the hydroponic technique being employed. This means that each plant's root system can take up far less space, resulting in the ability to grow more plants in a smaller space. When one adds in vertical stacking methods, it's easy to see how a much smaller area is needed to produce a hydroponic garden than a traditional one.

ii. Conserves Water

It may seem counterintuitive, but growing plants in water actually use less water than growing the same plants in soil. In fact, hydroponic plants can grow with up to 98 percent less water than traditional growing methods. Why is this important? According to a 2019 Report from the World Health Organization (WHO), only 71 percent of the world's populations have a safely managed water drinking service. By 2025, half of the world's Population will live in water-stressed areas. Conserving water is likely to become more and more crucial as time goes on, making irrigation for agriculture more difficult and less profitable. Of the water taken in through a plant's roots, only about 0.1 percent of the water taken in is actually used by the plant itself. Most of which are then released into the air through evapotranspiration. Hydroponics systems make use of re-circulated water; allowing plants to absorb what they need, then return the rest to the system. As global food production continues to increase year over year. It's consuming more water than ever before. It is estimated that it takes about 3 gallons of water to produce a single crop of lettuce through traditional methods, 2.7 ounces serving of broccoli takes about 11 gallons of water to produce. And for every 4.3 ounces of tomatoes you consume, 8 gallons of water have been used in the growing process. It seems that if we want to be serious about conserving water, hydroponics is an important part of the process.

iii. Facilitates a Micro-Climate

Hydroponic gardens can be easily contained within a hydroponic greenhouse or other structure. This means they can have their own micro-climates, insulated from many of the difficulties that traditional farmers must work to address. They aren't left to the mercy of pest and don't need to be treated with a wide range of insecticides. In temperature-controlled facilities, plants can be grown year-round regardless of the climate or weather outside. And with artificial grow light, even the amount of sun available isn't a problem.

iv. Produce Higher Yields

Creating ideal conditions ensures plants receive the perfect amount of nutrients, which come in direct contact with roots. Additionally, microclimates allow for year-round growth and faster crop cycles. All of this adds up to create for higher yields than traditional farming methods. In fact, we've found that our hydroponic greenhouse can produce about 240 times the yield of other farming practices.

v. Require Less Labor

Without the need for tilling, weeding, herbicide and insecticide application, and other labor-intensive farm jobs, hydroponics offers a lighter load for laborers and can easily be managed with far fewer man hours. This both cuts back on the cost of producing crops and frees up time for other pursuits. In fact, a small hydroponic greenhouse can be entirely managed by a single part-time worker.

vi. Needs No Soil

The world is quickly losing workable soil. It is estimated that half of the world's topsoil has been lost in the past 150 years. This is due to erosion, compaction, loss of soil structure, nutrient degradation and salinity. What does this mean for agriculture? We have a growing number of mouths to feed and a shrinking amount of soil to plant. Additionally, there is a wide variation in soil quality from one location to the next, and many plants have strong preferences for a particular soil type. This means traditional farmers can only grow crops suited to the soil in their areas. In large parts of the world, few crops can be grown using traditional methods. With hydroponic gardens, the soil is not a concern; hence, farmers can grow whatever crops would be most beneficial to their community without concern for soil degradation.

vii. Produce Higher Quality Food

When it comes to fruits and vegetables, fresher is unmistakably better. Few people happen to live in an area where they can get fresh produce year-round due to climate and soil conditions. So how do we get high-quality food into the hands of the majority of the world's population, even in the off-season? With traditional farming, the answer has been to pick the produce before it's ripe and then let it ripen in warehouses and along the supply chain. At times, ethylene gas is used to artificially ripen food that has been picked too early. This is necessary if traditionally farmed crops are going to reach consumers in far-off places. Food that ripens naturally, on the plant, typically has more nutrients and better taste too. Because hydroponic gardens contain their own micro biomes, these crops can be grown just about anywhere. This means they can be picked at the peak of ripeness since they don't have far to go before they reach the homes and restaurant where they will be enjoyed.

viii. Reduce Supply Chain

Of course, there are more benefits to growing produce locally than the ripening process and its benefits. At traditional commercial growing operations, lots of water and energy is used to grow crops and maximize outputs. Then crops are harvested using even more energy. They're transported long distances on fuel-burning refrigerated trucks or trains to their supermarket destinations. Finally, they're often preserved using chemicals that increase the product's shelf-life. Of course, with hydroponics, a great deal of this energy use can be cut out. Hydroponic greenhouses can be erected in neighborhoods where traditional farms could never thrive. This means they can fulfill the needs of their local communities without wasteful transport and questionable preservation processes. This simplification on the food chain means high-quality produce can be grown locally, even in urban areas, then distributed to the community with less waste and greater freshness.

ix. Predictability and Seasonality

We've all seen it. Buy strawberries in the middle of the summer and they're cheap, fresh and delicious. Try to buy them in the winter months and you might pay as much as three times the price for berries that don't taste nearly as good. Seasonality is an unfortunate reality for traditional farming methods. Farmers also have to contend with unpredictable weather problems that can wipe out an entire crop in a matter of days. Floods, fires, drought, pest problems and more are a fact of nature and can happen anytime and anywhere. And when the area that supplies a particular crop has a major catastrophe, it can have a ripple effect across the entire food chain. In a hydroponic greenhouse, conditions are controlled by the grower. This means you can grow your strawberries and harvest them in the dead of winter. And if a locust swarm comes through, the greenhouse will protect your precious crops from damage, no matter how many of critters infest fields nearby. For growers, this means that ability to enter into longer-term wholesale contracts with fixed pricing. And they'll be sure to deliver, come what may.

x. Crops Grow Faster

Most fruits and vegetables take several months to reach maturity using traditional methods. Plants must take their nutrient from the soil, which can be a slow process. What nutrients they absorb are often wasted through the maturing process. The growth rate for a hydroponic plant is 30-50 percent faster than a plant grown in soil. With hydroponics, nutrients are most easily available for the plant to absorb. The grower can control light, heat, nutrient, hydration, pests and all other aspect of the growing process. This means the whole cycle can be streamlined for larger, faster-growing plants with a higher yield.

Aquaponics

According to Perterson, Burnett and Sanchez (2018), aquaponics combines *aquaculture* and hydroponics (growing plants in water instead of soil) to cultivate vegetable crops. Aquaponics relies on the nutrients produced by the interaction of freshwater fish and plants as they develop a symbiotic relationship in a controlled environment. Involving a water system that constantly recirculates to propagate the nutrient exchange between plants and fish, aquaponics does not required pesticides or herbicides to artificially support plant growth.

What are the Elements of an Aquaponic System?

Plants in aquaponic system grown without soil. An aquaponic system begins with obtaining a fish tank that accommodates the size of your garden. Fish excrete waste containing nutrients beneficial to plant growth. The species of freshwater fish populating your aquaponic system will determine what kind of food fish need. For example, bass should be fed high protein pellets or flakes while carp can be feed insects and aquatic plants. Green, leafy vegetables such as lettuce, spinach, okra watercress, basil and various herbs thrive in an aquaponic system due to moderate nutritional requirements. Although they have higher nutritional needs than leafy vegetable, other plants like bell pepper, cucumbers tomatoes and strawberries also grow well in an aquaponics garden.

What are the Benefits of Aquaponics?

i. Organic and Nutritional Benefits

Nutritionally, food grown in an aquaponic garden is healthier, fresher and genuinely organic. Plants and fish are not contaminated with pesticides or weed killer. Everything used to cultivate vegetable and fruit-producing plants is natural and chemical-free, including fertilizers formulated to improve the overall operation of an aquaponic system.

ii. Food is Grown all year Round

Leafy greens grown in aquaponic setup. With the ability to regulate temperatures throughout the year, aquaponics farmers do not have to depend on weather conditions to cultivate organic food.

iii. Reduce Water Usage

Compared to backyard gardens and commercial farms, water waste is significantly minimized. Since water used for sustaining and aquaponics system is constantly recycled and reused, there is no need to rely on additional water to support plant and fish growth.

iv. No Soil, No Weeding

Lettuce and cabbage grown in hydroponics system and aquaponics system using garden beds. Some plant may occasionally give rise to unwanted sprouts that need removed but with no soil or atmospheric spread of seeds. Weeding is nearly eliminated.

v. Accelerated Plant Growth

Plants naturally grow faster when they have access to rich amounts of nutrients and natural fertilizers 24 hours a day. A constantly regulated water source also enhances plant growth.

vi. Two incomes in for Commercial Aquaponics Farmers

Larger aquaponics operations can enjoy two sources of income: the vegetables and fruits they grow and the fish that can also be sold to food manufactures.

Vii. Reduces the Planet's Carbon Footprint

Sun in the orange sky has the importance of reducing planet carbon footprint. Acres of farmland are not needed to cultivate aquaponics crops. In fact, sustaining an aquaponic

system is a viable alternative in place where the land is rocky, unstable, nutrient-poor or prone to drought.

vii. Support a Self-Sufficient Way of Living

Living off the grid is increasingly popular lifestyles many people are adopting due to economic instability and rising food prices. A completely self-sufficient lifestyle that include solar power, well water resources and growing livestock would benefit substantially from an aquaponics system of cultivating food.

Aeroponics

The term aeroponics, meaning “working air” stems from the Greek work for air, “aer” and labor, “ponos. This form of hydroponic involves growing plants without the use of soil. Instead, it relies on air to deliver a nutrient-rich mist to the plant's roots.

The Current state of Farming

According to Peterson, et al., (2018) around the world, usable farm space is shrinking. Environmental pressures, including climate change and natural disaster, are exacerbating the issue of a growing global population. As the population grows, areas that once were farmland, now drained of nutrients and no longer usable are, transformed into urban centre and residential communities. As if these issues were not enough, traditional farming is losing its place as viable occupation. Younger generations, especially those raise in farming communities, see the amount of work and time that goes into a successful operation and opt for alternative means of work. With 60 being the average age of a traditional farmer, these older generations are aging out. Technology has opened the doors to new methods of growing and with it, a revitalized interest in cultivation.

The Aeroponic System

While the physical growing process of the plant is the same as in other forms of farming or hydroponics, aeroponics, differs in how nutrients and environmental conditions are delivered and controlled. With the goal of helping plants grow healthier, aeroponics is carried out in a closed environment in which the grower controls all aspect of the system. Plants are held in large vertical grow racks. Essential organic liquid nutrients, such as nitrogen, phosphorus and potassium, are added to a large water reservoir. These organic nutrients in pure form are more easily digested by the plants, making uptake faster and simpler. Plants do not have to go looking for sustenance as this nutrient-rich mist is delivered directly to the root zone. Indoor grow lights are optimized to fall within certain wavelengths to further promote plant growth. The overall enclosure is kept within certain limits for both temperature and humidity. This system maximizes nutrient absorption while putting less stress on the plant itself, leading to produce that is healthier overall. Plants grown through aeroponics contain higher nutritional value all while having better color, texture and taste.

Why Aeroponics?

Aeroponics addresses modern farming issues by offering an alternative way to produce greens and vegetables. Some important advantages of the system include:

- i. **98% less land:** Simply by the nature of the system, aeroponics uses 98% less land than traditional farming methods by making use of vertical space as well as horizontal.
- ii. **Year-round production:** Aeroponics falls into a family of practices known as “soilless Controlled Environment Agriculture” (CEA). This umbrella term applies to all types of indoor plant cultivation in which the environmental conditions, including temperature and sunlight, are controlled by the grower. Growing in a controlled environment improves a farm's ability to predict crop timing, growing quality plants and maintain high food safety standards.
- iii. **95% less water:** There is considerably less variability in a controlled environment, lending to less water and lower cost. Although aeroponic systems use water-based solutions to perform properly, they use about 95% less water than standard farming.
- iv. **More efficient:** Growers design their systems and nutrient solutions to maximize the growth and production of their plants. Plants grown in these indoor gardens are known to grow as much as 3x faster than those in outdoor farms.
- v. **Safer for the Consumer:** A close environment eliminates possible contamination from soil or crossover with Mother Nature, so there is no need for herbicides or pesticides, resulting in a more organic product.

What are the Benefits of Aeroponics

Hydroponic systems are the most common in vertical farms-you might have seen them in your local urban farm or in the increasingly popular grow-at-home kits you can buy. In this system, plant roots are immersed in a solution of water and nutrients, instead of using soil. However, there are other methods of soil-less growing; at LettUs Grow we use aeroponic systems.

i. Room to breathe

In an aeroponic system, plant roots are suspended in air, rather than in soil or water. Plant roots are exposed to a nutrient rich mist which provides the plants with all the water and nutrients they need to grow. Within an aeroponic chamber, plant roots have greater access to atmospheric levels of gases such as oxygen, which boost plant health. Just as overwatering your house plant can drown it, plant roots can become water-logged and oxygen deprived when submerged- an aeroponic system ensures this won't happen.

Healthy plants with a good root stock, grow faster. This results in more crop cycles per year and therefore a greater yield being produced in your farm.

ii. Tailored care

Lettus Grow's aeroponic systems provide the ability to apply nutrient solutions with great precision. The quantity of mist produced can be easily fine-tuned per grow bed, so that you can provide specific crops with a feed that will best suit their development needs. This control will enable you to consistently tune the quality of your crop and higher growth rates create a quicker turnover of your produce.

iii. Free from Pests

The position of roots means that plants are less susceptible to mould or other infections, largely due to seeds and growing media remaining dry within an aeroponic system. UV

sterilization and filtration is used during the recapture and reuses of water in the system, so this ensures that the chances of pests or disease outbreaks are kept to a minimum.

iv. Root Access

In an aeroponic system, plant roots are easy to see and access. This is useful for plant scientist and researchers who wish to observed plant roots without impacting plant growth or killing the plant by up-rooting it. This allows for more regular testing and observation.

v. Plants, People and Planet

Aeroponic system benefits you and your crops, but there are also environmental benefits such as dramatic reductions in water and fertilizer use. Water and fertilizer recapture and reuse also prevents fertilizer runoff into waterways, a type of water pollution which can damage ecosystems and kill aquatic life. There's no need for any harmful chemicals or pesticides inside these systems, so it's beneficial for other kinds of wildlife too. Want to talk more about the benefits of aeroponics and how these systems could improve the operational efficiency of your vertical farm? You can kick up a conversation with the team here (Peterson, et al (2018).

Policy Recommendations and Conclusions

The policy recommendations for contemporary agricultural financing in Nigeria should be tailored alongside to a sustainable transformation of the agricultural sector in Nigeria while actively linking all the players in the agricultural sector by creating an enabling environment for investment in it. Some policy recommendations are as discussed below.

1. First, there is a need for a comprehensive modern agricultural and green fiscal policy that can be incorporated in the agricultural transformation agenda. There should be a “modern print” for a modern agricultural economy. A well-informed policy layout for modern agricultural growth in Nigeria with an implementation plan that is backed with responsive action would not only improve the agricultural sector generally and make public sector finance worthwhile, it would also serve as the solid investment foundation that most private investments will required to invest in agriculture. For this to happen, policy must meet practice with the development of modern agricultural inclusive business models for agricultural programmes and involvement of farmers from the grassroots level. The comprehensive modern plan would also be a means for promoting private and public partnerships that government could leverage on for investment in modern agriculture.
2. Second, there should be improved modern agricultural technology and modern agricultural technology adoption mechanisms that can help increased farmers output through use of improve quality inputs for increase and sustainable productivity.
3. Third, there is a need for efficient agricultural financial risk governance for sustainable modern agricultural financial commitments from investors. Lending in agriculture is usually faced with a myriad of risks that investors are not willing to bear. Significant private investments are not attracted to green agricultural financing due to high risk and relative novelty is the essence of modern agriculture in Nigeria. With an effective risk coverage and risk monitoring in Nigeria agriculture, access to agricultural finance would increase and the outlook for lending by financial institution would be better and purposeful.

4. Fourth, climate and modern agricultural pricing policy is an essential tool for modernizing any economy and would go a long way in attracting modern agricultural finance. Nigeria needs to start attaching price on climate such that people are more aware of the environment. While financing the modernizing of agriculture is essential, having an active and sustainable market for, would also increase the chances of investing in modern agriculture in Nigeria.
5. Fifth, transition to a modern agricultural economy that is backed with financial readiness from investors would require public investment in modern agricultural infrastructure. As a good business strategy, investors are highly likely to be attracted to a place where they can get better infrastructure for their operations. While the infrastructural development in the country is commendable in recent times, there is still a huge infrastructural agricultural gap in Nigeria which has to be filled.
6. Finally, awareness, knowledge and capacity building for farmers and financial institutions to unlock the investment opportunities in modern agriculture is a necessity. For modern agricultural finance to actually work in Nigeria, all the players in the agricultural value chain must have adequate knowledge to what it takes to achieve modern agriculture. There should be adequate financing of the research and extension systems to enhance professional education in the area of agro-ecological production system and sustainable integrated production systems.

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