SOILLESS AND SACK FARMING: CREATIVE OPTIONS FOR AGRICULTURAL PRODUCTIVITY IN HOMES, SCHOOLS AND COLLEGES

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Abstract
Soilless farming is slowly gaining grounds among young persons in the agricultural sector to meet the rapid demand for food in Nigeria. With an increasing population in the country, there is need to address the challenges in food production by seeking alternative sustainable medium. Despite the vast amount of arable land in Nigeria, agricultural production remains below potential due to several factors such as the problems of soil degradation, declining soil fertility, soil erosion, flooding, desert encroachment and drought. Hence, this has become a major challenge facing land use for food production and has worsened by the effect of climate change. Soilless farming possesses a potential method of growing plants without the use of soil in which the nutrients required for growth are supplied through other means; soilless farming is a way for youth especially in schools and colleges with interest in the sector to explore because it has proved to be less rigorous, more efficient, high yielding and supports non-seasonal food production through inclusion of technology in hydroponics, aeroponic and aquaponic methods. Sack farming is also a form of soilless farming as soil or inert medium can be used, it is a method of growing crops in soil-filled sacks bags that allows people to grow in their backyards, rooftops and other places. It is a good option for landless households to ensure food and nutrition security, give solution for people who have land with low soil fertility or too rocky to support cultivation. This in no doubt create interest among youth in farming. This study provide an understanding of the concept of soilless farming, techniques of soilless farming, benefits of soilless farming, potential limitations and challenges, sacks and bags farming and recommendations on soilless farming systems in homes, schools and colleges.

Keywords: Soilless farming, Sustainable, Hydroponics, Aeroponic, Aquaponic.

Introduction

As the world grapples with the challenges of food security, sustainability, and climate change, with rapid growth in megacities, Agriculture needs to undergo a revolution in order to address the problem of food scarcity and hunger by thinking creatively about how to produce food in non-traditional settings. Schools and colleges in particular offer a unique opportunity to integrate agricultural production into education by providing hands-on learning experiences for students in promoting sustainable food systems. One promising approach is through soilless farming (hydroponics), which involves growing crops without soil but

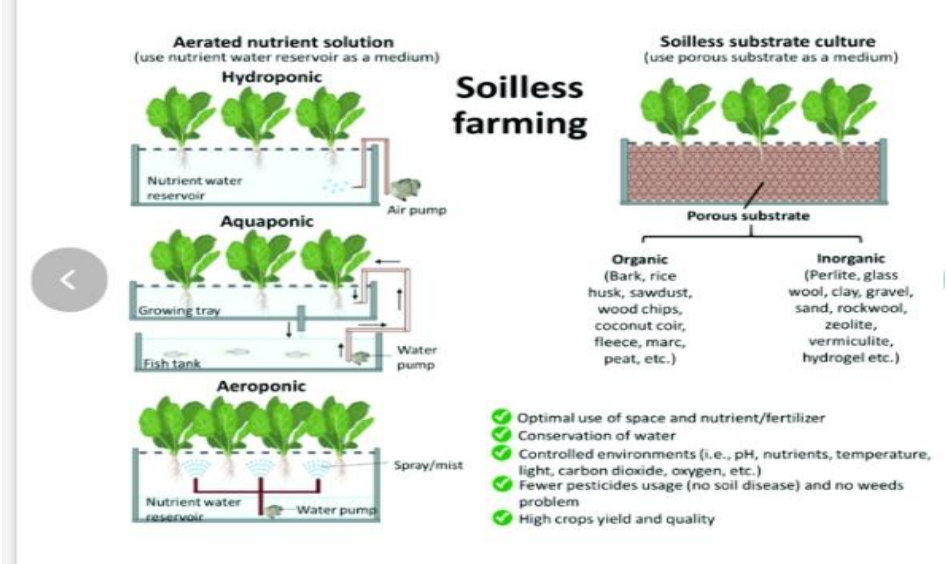
instead using a supplementary nutrient mixture (Aires, 2018).

Soil is the most available growth medium (GM) for plants. It provides anchorage, nutrients, air, water etc. for successful plant growth. Different soil types sometimes also pose serious constraints to plant growth, such as inappropriate soil PH, unfavorable soil compaction, poor drainage, degradation due to erosion, presence of pathogenic organisms etc. moreover, conventional cultivation of crops requires resources such as space, often irrigation and weather dependent. Soilless farming can be extremely successful in homes, schools and colleges if given adequate considerations. Likewise sacks farming has another forms of soilless farming is an effective way of growing crops in sacks, garden bags, containers or plastic with or without soil. This method saves space, water, money and time of farming. By learning about soilless farming in the classroom, it helps students to be educated on the entire process from setting up to harvesting crops, thus, able to troubleshoot and make improvements. Young students are excited and eager to get involved in a hands-on activity combined with the right measures. Implementing soilless farming in homes, schools and colleges can provide education as well as nutritious food source for children and staff (Stajano, (2003).

Concept of Soilless Farming

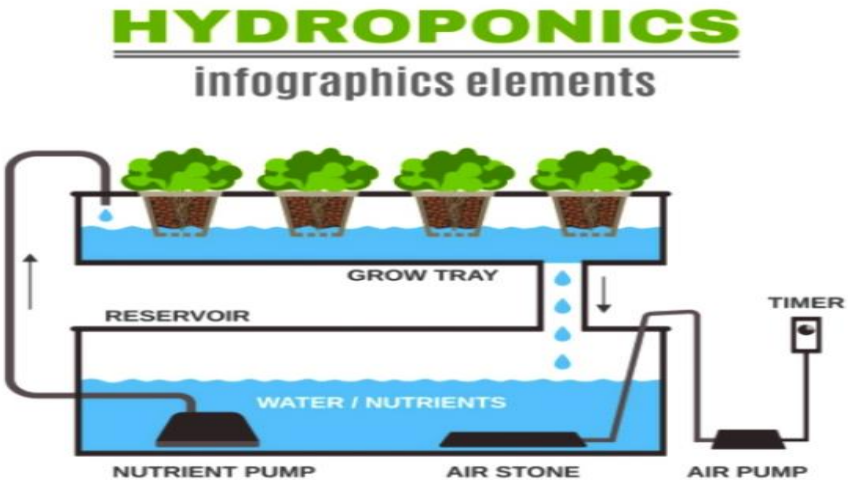
Soilless farming in simple term is growing of crops without soil, it is important to note that soilless farming isn't a way to replace soil but rather to complement soil (Ogbole Samson, 2019). Unlike the traditional method using soil where crops need to 'hustle' with weeds for nutrients, water, space, sunlight, all these are absent in soilless farming. In fact, crops grown under this condition suffer less from pests and diseases attacks, also it saves a lot of water and resources. Soilless farming is already gaining ground in Nigeria. Onafowora, (2017) acknowledged to be the pioneer of soilless farming in the country, has already trained about 10,000 students on how to go about this method of farming. But if this can be incorporated in urban schools and colleges this will invariably reduce food scarcity.

Techniques of Soilless Farming

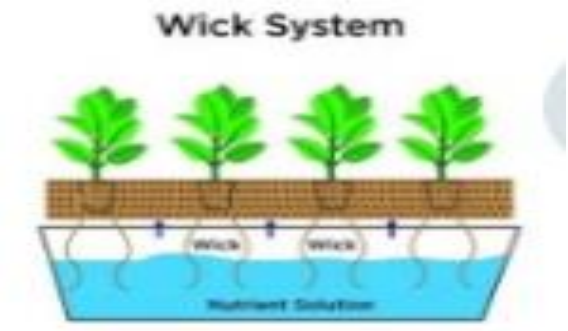


There are three (3) major techniques of soilless farming, with five essential things that must be fulfilled by each technique for crops to thrive. (i) Acidity of the medium (water, culture etc.) must be suitable for the plant growth (ii) Oxygen must be readily available, ordinarily, plants grown on soil get oxygen needed for respiration from air in the soil (iii) The right proportion of nutrients must be supplied at the right time (iv) A structure must be put in place to give support to the plant root or the aerial part of the plant (v)The required amount of light must be made available as well.

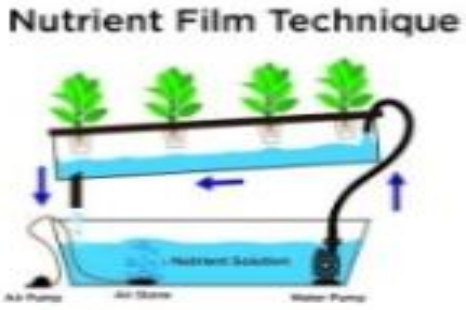
Meanwhile the types include: hydroponics, aeroponics and aquaponics



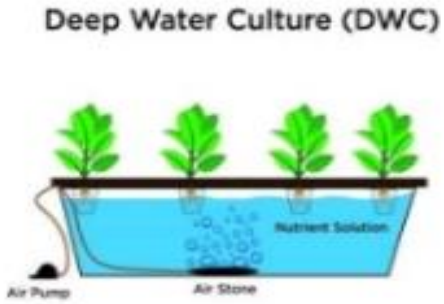
1. Hydroponics: the definition of hydroponics has been broadened to mean "the cultivation of plants without soil" (Soreno, 2009). To be exact, hydroponics is the genesis of soilless farming before some variations were developed. In hydroponics, plants are grown in an inert medium such as rice husk, coco coir fiber, sawdust and are fed with nutrient-rich solution, the nutrients are carefully balanced to meet the specific needs of each plant. The purpose of the inert medium is to give the plants access to oxygen for proper growth. It is a suitable method for growing fresh vegetables like spinach, lettuce, bell pepper, tomatoes, cucumber, herbs like mints, chives, flowers and fruits like strawberry in urban areas where the arable land is polluted. Plus, studies indicate that this system of soilless farming has a 20 to 25% higher yield than traditional farming practices. The following figures from 1 to 5 show some kind of hydroponics mainly used, but any person can put his own design according to his need and the kind of plants, according to the main target and the aim of hydroponics function. The following are a brief of five systems mainly used.



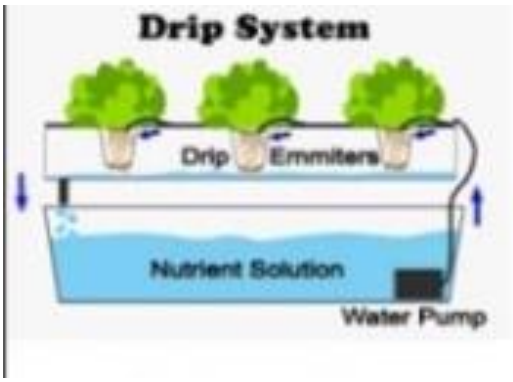
i. Wick system: the wick system (figure 1) is the simplest of all types of hydroponic systems. That's because traditionally it doesn't have any moving parts, thus it doesn't use any pumps or electricity. However, the wick is the connecting part between the potted plant and food solution in the existing reservoir. Because it doesn't need electricity to work, it's also quite useful in places where electricity can't be uses or is unreliable. The wick system is an easy type of system to build when first learning about hydroponics or just to get feet wet first. This type can be used by teachers in classroom as experiments for students. In wick system the plants are cultivated in substrate by allowing wick to draw nutrient solutions to the plants roots.



ii. Nutrient film technique (NFT): a thin layer of nutrients-rich water runs around plant roots in the NFT system, giving a steady supply of essential nutrients EL-Kazzaz & EL-Kazzaz, 2017). A shallow stream of nutrient-rich water flows over plant roots, this method ensures consistent nutrients delivery to the plants, promoting efficient absorption. The solution is pumped from a holding tank, through irrigators at the top of every slopping pipe and the run-off from the bottom of the channels is continuously recycled. It is possible to make the angle of the pipe smaller and add an overflow pipe similar to what's in an off and flow system. This would remain in the event of a power or pump failure. Because of the confined space of a PVC pipe and the requirement for nutrients to continuously flow over the roots, the nutrient film technique is particularly well suited to plants that have small root balls such as lettuce, strawberries, and herbs.

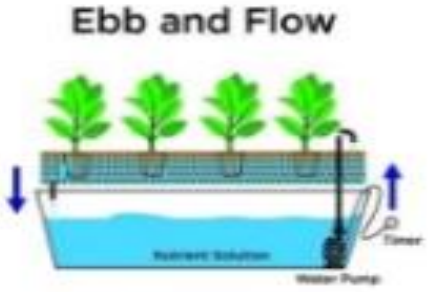


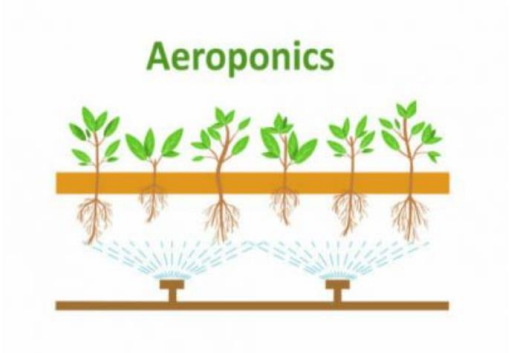
iii. Deep water culture (DWC): deep water culture involves suspending plants root into nutrient-rich solution (Khan, 2018). Oxygen is supplied by an air pump that runs continuously. A water culture system can easily be set up in glass basins, (fish ponds), plastic boxes, ice boxes, concrete basins or engraved basins covered with polypropylene sheets. Since the plants are floating and are continuously in contact with the nutrient solution, there is no risk of damage to plants in the event of a power outage or stop the air pump. The convenient plants in this system are Lettuce, strawberries, and herbs grow particularly well in this system.



iv. Drip system: drip hydroponic system is at least two containers, one on top or higher than the other. Plants are located in the top container, while the nutrient solution is in the bottom container. The nutrient solution is pumped up to drips located by the stem of each plant with a water pump, and an aquarium air stone is used to oxygenate the water. The nutrients filter down to the plant roots and are passed back to the bottom container. Typically, both the water and air pumps run continuously with this type of system. A crop of almost any plant will grow well with this system. Plants with larger root balls are particularly suited to drip systems. However, the plants are grown in supportive mediators

off intermittently (perhaps 30 mins, 15min off), to flood the grow



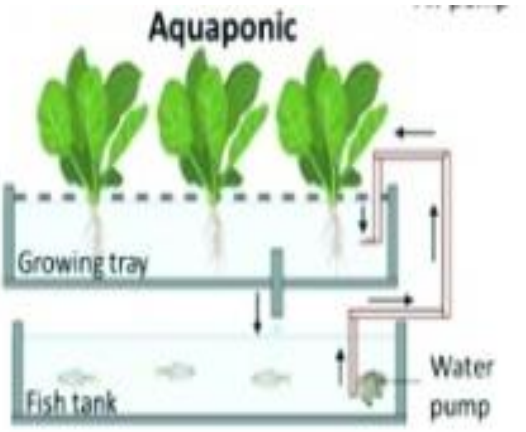


v. Ebb and flow systems: Ebb and flow system is another inexpensive type of hydroponics setup. The setup is very similar to the drip system, where there are two containers, the one on top containing the plants in pots with substrate, and the one on the bottom containing the nutrient solution. Rather than the nutrient solution being passed slowly to drippers at the stem of each plant, the nutrients are pumped in large volumes into the top container, flooding the container. An overflow pipe determines the height of the nutrients, typically to where the roots begins at the base of the stem, with excess liquid being recirculated through the overflow pipe back to the bottom container. With Ebb and flow system, the pump is switched on and tray periodically. When the pump is switched off, all of the nutrients are siphoned out of the grow tray via the pump line. The emptying period allows for oxygen to reach the roots, and for this reason an air stone is not absolutely required for ebb and flow systems. As with drip systems, almost any plant will grow well with this type of system. Plants with large root balls are also particularly suited to off and flow systems.

2. Aeroponics: Aeroponic is an environment-friendly way of farming in which the roots are suspended in the air and plants grow in a humid environment without soil. It is a variation of hydroponics where both growing medium and flowing water are absent. First the plants are propagated to a stage where their roots are already

emerging, such plant is then transferred into the aeroponic system where it will take nourishment from the misted solution that is spayed periodically. The system normally turned on for only a few seconds every 2-3 minutes. This is sufficient to keep roots moist and the nutrient solution aerated. This method reduces the usage of water and fertilizer. And no pesticides need to be used in this method because the plants are grown in a controlled environment.

3. Aquaponics: aquaponics is a symbiotic system that combines hydroponics with aquaculture. It involves cultivating plants and fish together in a closed-loop system. The waste produced by the fishes in ammonia form are converted by nitrifying bacteria into nitrite, the nitrate that is suitable for plant use. As the converted waste passes through a hydroponic plant growing section, it is filtered because the nutrients are nitrates are being absorbed, then the water is recirculated back in the fish tank for reuse. Aquaponics can be likened to a natural ecosystem that continuously recycles water, hence making the system use 90% less water when compared to traditional farming. In addition, like the other systems, aquaponics is environmental-friendly and sustainable. Under this system, food yield is maximized because it is possible to harvest both fish for protein source and fresh plant produce.



Benefits of Soilless Farming

Unlike conventional farming, soilless farming system offers numerous benefits such as:

- Absence of weeds competing with crops for space, water, light and nutrients.
- Year- round crop production to boost food security and maximize business profit.
- Help in optimal use of nutrients by giving the plants the exact nutrients needed.
- Temperature, humidity, light and air can be controlled under this system of farming.
- Soilless farming requires less water because water is circulated as run-offs, captured and returned to the system.
- Minimize pests and diseases with better growth rate.
- Contamination of fertile land does not exist due to the use of herbicides in controlling weeds.
- Space is utilized better as crops can be planted in a spare room, small apartments etc.

Potential Challenges and Limitations of Soilless Farming

While soilless farming offers numerous advantages, it's essential to acknowledge some of the challenges and limitations. Such challenges include:

(i) High initial investment costs for equipment and materials: setting up a soilless farming system require a higher initial capital compared to in towns and cities

(ii) Lack of expertise and training for teachers and students: successful soilless farming requires technical knowledge and expertise in managing nutrient solutions, monitoring environmental factors and troubleshooting system issues.

(iii) Balancing education with production and sustainability: it may be difficult for students to really balance their education with this system except it is integrated into the existing curriculum as the system requires time and commitment to avoid mistakes when dealing with crops. Supplying low or too high dosage of nutrients may cause a lot of damage.

(iv) If pests and diseases find their way into this system, they can be spread easily because of how close the crops are to one another.

Sacks and Bags Farming

Homegrown tomato plants sown in sacks

Sacks farming is a form of soilless farming as crops can be grown with or without soil but inert medium. Sacks' farming is good for crops that do not take long to mature, have shallow roots and do not grow too tall. These crops include vegetables such as cucumbers, lettuce, pepper, spinach, okra and tomatoes, onions, capsicums, cowpeas, sweet potatoes, vines and squash butternuts, ginger and others. In some African countries like Kenya, Malawi, Ghana, Cameroon many residents living in towns and cities are turning to urban farming, which is known as vertical sacks or bags farming to fight poverty, enhance food security and improve environmental sustainability.

This modern sustainable agricultural practice has been helping communities to understand the principles of good nutrition by championing the concept of vertical farming. The technology allows the growing of crops on soil or other growing medium such as coco peat, perlite and pebbles, in large sacks, bag-gardens and enabling farmers to grow vegetables on one square meter. Soil and manure should be mixed in the ratio 50:50. If soil is not use compost can be mixed with coco peat. There is need to check the nutrient level of the growing medium chosen, small pebbles like stones should be added to the growing medium to drain water well. Poor drainage can cause root rots for plants which can lead to the death of the plants and negatively impact the availability of oxygen in the growing medium.

Vegetables Grown In Buckets

Also pots or buckets garden follow the same pattern with sacks /bags farming except that holes must be made at the sides and bottom of the buckets to prevent water-logging. Buckets can be use majorly for planting vegetables and care must be taking in the choice of containers to avoid contamination.

However, sacks' farming and buckets garden are low-cost and economical but high-yielding food security technology developed to maximize land and water use. The systems and bucket garden does not require much from anyone who wants to venture into and relatively suitable to practice in urban schools and colleges. The approach is seen as low-cost, economical and healthy solution to food insecurity and runaway unemployment in the society. Most interesting thing about sacks farming and bucket garden is that it is suitable and efficient for offices, hospitals, informal settlements, and schools.

In Nigeria today as well as Ekiti state, people are looking for fresh vegetables and any youth who venture into these systems can become a supplier of fresh vegetables in his or her neighborhood.

Conclusion

Soilless farming in Homes, schools and colleges offers a unique opportunity to promote education, sustainability and community engagement. While there are limitations and challenges to be considered, innovative solutions, collaborations and resources can help overcome these obstacles. By implementing soilless farming initiatives, Homes, schools and colleges can provide hands-on learning experiences for students, foster community awareness and engagement, support local food systems and nutrition education and develop innovative solutions to food scarcity.

Recommendations

Based on the discussion, the following are recommended:

1. Students should be involve in economical methods thereby extend it to homes.
2. Advance soilless farming systems should be done in school laboratories in preparing students for careers in sustainable Agriculture.
3. Establishment of soilless farming club/Organizations to promote students interest.
4. Schools and Colleges should provide students with opportunities to work on soilless farming projects.
5. Schools should offer internships or apprenticeship with soilless farming companies
6. Government should offer grants and funding opportunities to support soilless farming initiatives and research projects in secondary schools and higher institutions all over the country.

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