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An Overview of Smart Farming Production Technology for the Advancement of Home-grown Farmers in the Philippines

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ABSTRACT

This article explores the technologies that can be used to establish smart farming in the Philippines, as well as the various smart systems that have been used to aid home-grown farmers. The emergence of smart agriculture and farming is a method that heavily integrates digital technology in order to increase food production while minimizing input costs. The importance of this technology has a significant effect on farmers and investors as a result of technological advancements. It should also be recognized that numerous promotions requiring government funding for the establishment of smart farming technology in the Philippines has been addressed.

Keywords: Smart Farming; Hydroponics; Aquaponics; Aeroponics

INTRODUCTION

In the Philippines, almost half of the population lives in rural areas and relies on agriculture for a living; among them are indigenous people, landless farmers, and fishermen [1]. In general, farmers on different islands in the Philippines operate independently using conventional methods, and their management of farm produce to end-users is facilitated at low prices by middlemen. Micro-propagation protocols for bananas, coconuts, legumes, and oilseed crops are well known [2].

In the first quarter of 2021, the value of agricultural output fell by -3.3 percent at constant 2018 rates. This was attributed to a decrease in livestock and poultry demand. Crops and fisheries, on the other hand, also increased productivity [3]. Despite this condition, the Philippines is working to modernize and improve its agriculture industry, with both the government and private firms encouraging the use of advanced technologies and smart farming practices to raise harvests and reduce losses [4].

Agriculture's creation was a watershed moment in human history. The willingness of fully modern humans to change the atmosphere to produce enough food to support population growth is the first major improvement in the relationship between fully modern individuals and society. Agriculture ushered in a slew of new developments, ranging from the use of fire and cooked food to self-driving machinery [5].

Hence, smart farming is seen as the agricultural future because it produces higher quality crops by making farms more intelligent in sensing their controlling parameters [6].

SIGNIFICANCE OF SMART FARMING TECHNOLOGY

Agriculture routinely uses sophisticated technologies such as robots, temperature and moisture sensors, aerial images, and GPS technology. These cutting-edge devices, precision agriculture, and robotic systems enable businesses to be more profitable, efficient, safe, and environmentally friendly [7].

Thus, technology is critical to the development of the farming industry and the improvement of agribusiness. Researchers have successfully grown crops in deserts and other harsh environments using genetic engineering, which involves inserting traits into established genes in order to produce pest-resistant, drought-resistant, and plant pathogen-resistant crops.

Moreover, this technology will enhance insect or pest resistance, herbicide or drought tolerance, and disease resistance, providing farmers with a new tool for increasing crop yield. Farmers have used plant breeding and selection techniques to increase crop yield with the assistance of researchers. Technology is also used to protect crops by tracking growth and detecting plant diseases. Without the physical involvement of farmers, automation allows for the consistent distribution of fertilizers, pesticides, and water throughout fields [8].

Lastly, innovative agriculture ensures that new farming and agricultural development models emerge, introducing innovative techniques on how food is produced and distributed. These methods allow more economies and regions to keep up with changing trends and meet the demands of modern living while ensuring sustainably grown food. [9].

SMART FARMING TECHNOLOGY

Hydroponics Farming

Hydroponic farming is a method of growing plants in water without soil using mineral nutrient solutions. The hydroponic gardener controls the nutrient content of the liquid solution used to water the plants [10].

Common Types of Hydroponics System

1. Nutrient Film Technique (NFT)

A method of cultivating plants in which plant roots grow in shallow and circulating hydroponic nutrient layers, allowing plants to receive adequate water, nutrients, and oxygen. Plants grow in layers of polyethylene, with plant roots immersed in nutrient-rich water that is constantly pumped by a pump [11].

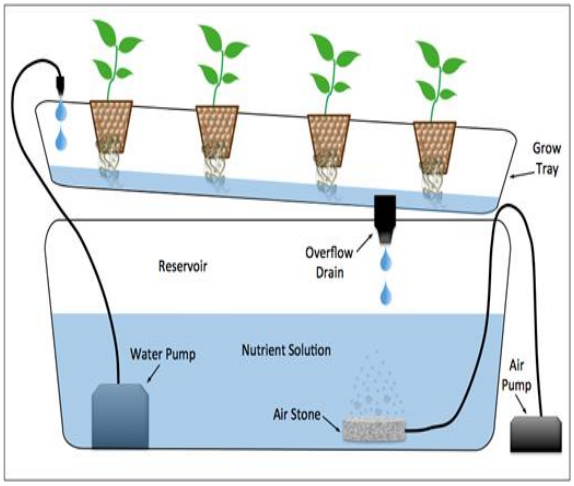

Figure 1. Diagram of the Nutrient Film Technique (NFT) hydroponic system [12]

2. Wick Systems

It is considered the most basic hydroponic device. The Wick system is classified as a passive system, which means it has no moving parts. Your unique Growth Technology nutrient solution is drawn up into the expanding medium through a number of wicks from the bottom reservoir. This device will work with a number of mediums, including perlite, soil, and coco [13].

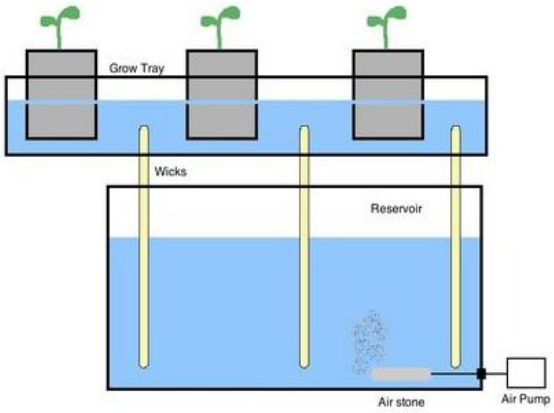

Figure 2. Diagram of the Wick System [14]

3. Deep Water Culture (DWC)

It is a hydroponic method of plant production by suspending the roots of the plant in a solution of oxygenated, rich in nutrients. This system uses rectangular tanks of less than one foot deep filled with a nutrient-rich solution and plants floating on

Styrofoam panels, also known as Deep Flow Technique (DFT), Floating Raft Technology (FRT), or Raceway [15].

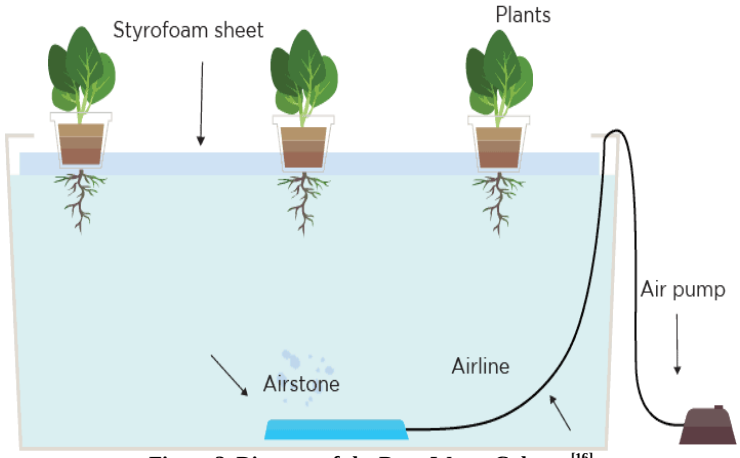

Figure 3. Diagram of the Deep Water Culture [16]

4. Ebb and Flow (Flood and Drain)

It is a hydroponics technique that involves flooding the growth media with nutrient solution for a set period of time, after which the unabsorbed nutrient is returned to the tank. Normally, this hydroponics device uses a timer to fill the water, resulting in inefficient usage of nutrient solution [17].

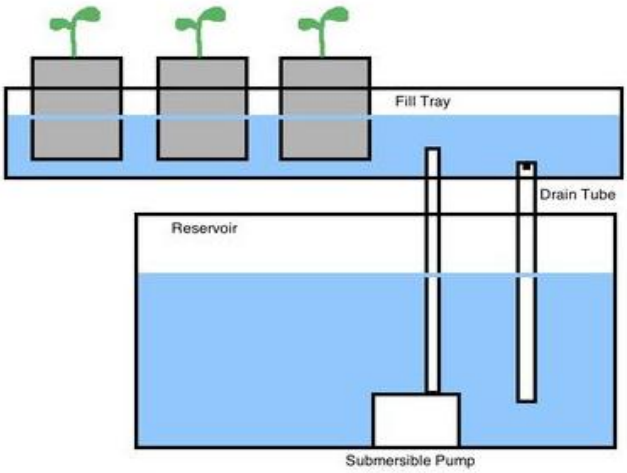

Figure 4. Diagram of the Ebb and Flow [18]

Aquaponics Farming

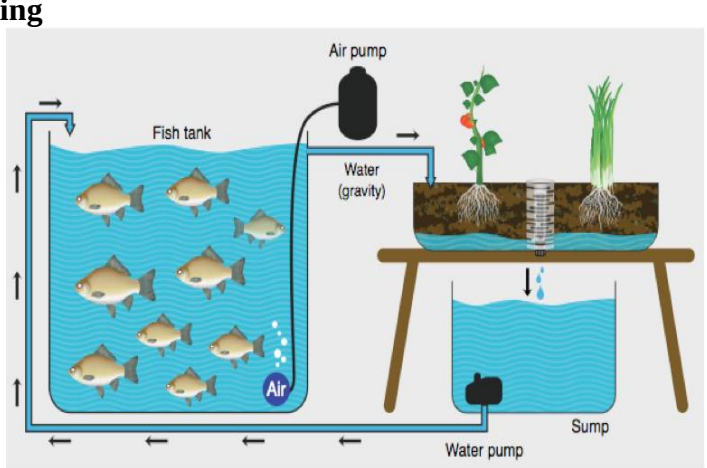

Figure. 5. Diagram of the Aquaponics [19]

In an aquaponics system, water from an aquaculture system is fed into a hydroponic system where by-products' are broken down by nitrifying bacteria first into nitrites and then into nitrates, which are used as nutrients by the plants [19]. A symbiotic relationship between two food production disciplines: (1) aquaculture, the farming of aquatic species, and (2) hydroponics, the cultivation of plants in water without soil. Aquaponics is a closed recirculating device that incorporates the two. A typical recirculating aquaculture system filters and eliminates organic matter ("waste") that accumulates in the water, ensuring that the water is safe for the fish [20].

Aeroponics Farming

In Aeroponics, the nutrient solution is sprayed onto the roots by moving it through misters inside the root region, either continuously or several times per hour [21].

The plant you want to develop is suspended in an air space with an atmosphere that is either completely closed or semi-closed. As a result, it is best achieved in a closed, regulated environment where you can monitor the amount of light, air, and nutrient-rich water spray that is fed into the plant [22].

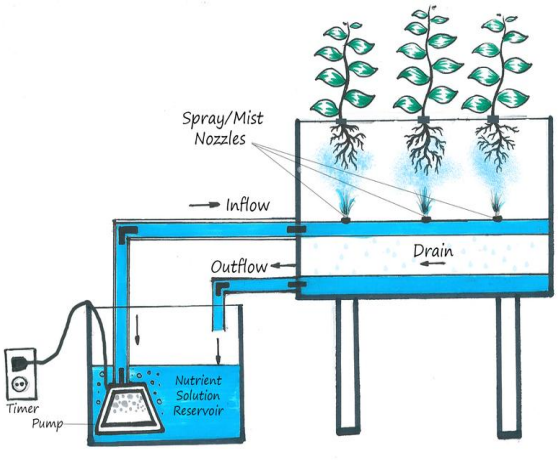

Figure 6. Diagram of Aeroponics [22]

GOVERNMENT SUPPORT TO SMART FARMING

In the Philippines, the local government, led by the Department of Agriculture, is aiming for a 2.5 percent growth this year through further incorporation of technology in agriculture to increase productivity, connectivity, and service delivery to beneficiaries. By focusing on and closely implementing 'Agriculture 4.0,' or the fourth agricultural revolution that encourages the use of smart farming technology, the country would have a better chance of having a better 2021 in terms of agriculture [23].

Agriculture Secretary William Dar released a memorandum to all DA executives, attached agencies and companies, services, and regional offices directing them to "pursue an inclusive approach on these main strategies to accelerate the transition into a new and industrialized Philippine agriculture." [24].

Another agency distinguished in its Labor Market Intelligence report "Soils to Satellites," the Technical Education and Skills Development Authority (TESDA) has been published covering practical topics such as automation in smart greenhouses, agricultural drones, IoT solutions to agricultural problems, and case studies in selected ASEAN countries in smart agriculture applications [25].

CONCLUSION

Some technologies will need to be developed specifically for agriculture, while other technologies already developed for other areas could be adapted to the modern agricultural domain such as autonomous vehicles, artificial intelligence and machine vision and smart farming.

Moreover, as farming in the Philippines faces several problems, proactive solutions like ICT must be implemented together with the full support of the government. Similarly, other major players, such as multinational companies, agricultural and fisheries industry leaders and organizations, and agricultural state

universities and colleges (SUCs), should work together to elevate home-grown farmers in the country.

Lastly, if modern agriculture is applied widely in the near future, millions of farmers will be able to benefit from the acquisition and development of smart farming production technology.

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