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The Potential of Hydroponic Farming as A Sustainable Alternative to Traditional Agriculture: A Quantitative Investigation

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Abstract

Plants may be grown in water without soil using a technique called hydroponics. It is a subset of hydro farming and a sort of horticulture. The plants require some sort of passive medium for sustaining the root system, and the water must be supplied with nutrients. The basis of hydroponic farming is a technique that, among other things, replaces soil with a solution of nutrient-rich water are seen as a far more sustainable method than traditional agriculture since they use so few resources. Furthermore, hydroponic plants may be grown inside. Growing plants don't always need soil. It alone offers all the macronutrients and micronutrients required for plant growth and development. The disadvantages of soil-based traditional agriculture include soil deterioration, excessive use of chemical fertilizers, waste of irrigation water, high land requirements, etc. The need for a significant amount of nutrient-dense food to meet the huge demand of the global population warrants the introduction of new and sophisticated technologies and practices in agriculture that synchronize water and nutrient requirements to produce the highest yield.

Keywords: Hydroponic Farming, Sustainable Farming, Soilless Farming, Traditional Farming, Hydroponic Farming, Sustainable Alternative

Introduction

One of the biggest issues humanity has is environmental preservation, and some of the existing agricultural practices are dangerous. It is one of the most frequent anthropogenic sources of soil contamination, along with other industries. The sustainability of the existing paradigm is called into question by deforestation, which is mostly brought on by conserving soil for agricultural purposes, as well as the greenhouse gas emissions created by the farms themselves. A more environmentally friendly solution for production that may be used in urban areas to be nearer to people is hydroponics. In other words, hydroponics is a crop technology that produces plants in a water solution rich in nutrients without the use of soil. In addition, the used water could be recovered and used again, and the nutrients may originate from a variety of places, such fish feces. It's not new to grow plants without soil in water. It used to be a growing method that was frequently employed in labs, but in recent years it has gained importance as a technique to produce food with a better yield and less usage of energy, water, and land. The use of

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hydroponics is encouraged as a means of halting climate change, reducing the environmental damage caused by intensive farming, and averting the extinction of species. Additionally, it enables more intelligent use of water, a scarce resource. Hydroponic crops have the potential to be a weapon in the fight against hunger and to enhance food safety, particularly in developing countries, as they are more profitable and controllable (Dholowani, Marwadi, Patel, Desai, 2018).

In contrast to hydroponics, which is a science in which all the factors that affect plant development are under control, traditional agriculture may be described as an art. An important element in Hydroponic technique is nutrient rich water. The nutritional solution must have sufficient levels of nitrogen, potassium, phosphorus, calcium, magnesium, and sulphur, as well as other elements in lesser proportions, in order to create the solution. Many are made from salts, but they may also be used in addition to or even as a replacement for them by using organic fertilisers like cow manure or bird guano. Other potential sources of nourishment include seaweed, grain or wood byproducts, fishmeal, and other organic materials. In hydroponic farming, the plants take up the nutrients from the liquid, but they still need support, and the roots must receive enough oxygen. Different sorts of substrates are employed to make it feasible. Very light and porous stones, such as perlite, pumice, or vermiculite, which hold water while allowing air to pass through the roots are used in hydroponic farming. Rice husk, wood fiber, or wool are also used as these materials break down slowly yet are particularly effective at keeping the roots oxygenated: Rock wool is made by melting basalt rock and extracting filaments that combine to produce a resilient sponge-like material. Contrary to normal farming, hydroponic farming demands greater technology and accuracy. The effectiveness of the procedure is assessed using a variety of tools. The amount of dissolved nutrients and whether they require replenishment are determined by the electrical conductivity of the nutrient solution, which is measured with conductivity meters. Since the ideal level for each crop varies, pH meters are crucial for controlling the acidity of the solution and substrate. To increase yield, one can employ natural light, artificial light, or a combination of the two. Due to their low usage, LED lights have become more popular recently. In order to enhance the amount of CO2 in the air and boost fertility, air control is utilised in enclosed spaces (Van Passel, 2013 and Lakkireddy, Kasturi, Sambasiva Rao 2012).

Literature Review

A study found that hydrophobic farming produced greater yields because it ensured that plants received the right amount of nutrients that came into direct touch with the roots. Microclimates also facilitate year-round growth and more rapid agricultural rotations. Modern farming practices provide yields that are noticeably higher by integrating all these elements. Most fruits and vegetables take many months to mature when cultivated properly. Plants may need some time to receive nutrients from the soil. They typically lose the nutrients they absorb as they mature. Between 30 and 50% more fast than a plant cultivated on soil, a hydroponic plant grows. When employing hydroponics, nutrients are more easily accessible for the plant to eat. Every aspect of the growing process, including light, heat, nutrients, hydration, pests, and more, is entirely within

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the farmer's control. This suggests that the process may be sped up for plants that grow bigger, faster, and yield more (Sardare, Admane, 2013 and Khan, Kurklu, Ghafoor et.al. 2015)

In a research it was found that Hydroponic farming needs no pesticides or herbicides. Herbicides, which are used to eradicate any undesirable plants in the field, are also not necessary when growing plants hydroponically. Similar to pesticides, herbicides may travel great distances when sprayed, killing local plants that are beneficial as well as endangering the health of agricultural workers. Herbicides are practically unnecessary when grown hydroponically because seeds can't blow in and start growing in nearby soil. Contamination of soil, water, and air can result from the use of pesticides, herbicides, and fertilizers. These substances may be harmful to both people and the natural world. They may also have harmful impacts on health. Pesticides damage the rivers for fish and other aquatic species living there as they flow off into creeks or streams during rainstorms. Additionally, groundwater sources that people use for irrigation and drinking get contaminated as a result of chemicals from fertilizers, such as nitrogen (Maharana and Koul, 2011 and Aires, 2018).

In a research it was observed that hydroponic farming uses less land than conventional farms and it is one of their most evident advantages. Every plant buried in the ground in traditional farming has a defined space that it occupies for the duration of its growth. In hydroponics, plants are cultivated in a smaller area since their roots don't need as much room to spread out. In contrast to dirt, the growth fluid has a distinct distribution of nutrients. The quantity of land required can also be reduced by growing numerous crops in the same location. Commercial hydroponic farming is thought to require 50% less land and 90% less water than conventional farming. Traditional farmers encounter a lot of difficulties because of soil erosion. Billions of tons of topsoil are eroded away each year by wind and water. Topsoil loss lowers the land's production and promotes desertification. There is no need to disturb the soil while growing plants in a water-based solution. As a result, the plants' roots are protected from wind and water erosion. Hydroponic farms can also aid in enhancing the soil's quality. There is less runoff from these farms since they require less water. As a result, less fertilizers and chemicals wind up in the soil, which may eventually result in better soil quality (Sonwane, 2018 and Thakare, Budhe, Belhekar, Sinde, 2018).

In a research it was estimated that hydroponic farms utilise less fossil fuel than conventional farms do. This is due to the fact that one of the main causes of greenhouse gas emissions is food transportation. Local food production can cut down on the quantity of fossil fuels required for long-distance food transportation. Additionally, hydroponic crops often consume less energy. There is no requirement for irrigation or other energy-intensive agricultural techniques because the plants are produced in a controlled environment. Additionally, it was shown that plants grown in hydroponic systems had a 20%–25% higher yield than those produced in standard agriculture systems, with an efficiency that was 2–5 times greater. Plants cultivated in controlled environments have access to the best circumstances for growth, which accounts for the higher growth rate. The ideal quantity of light, water, and nutrients are given to them. They can develop

to their fullest capacity as a result. Hence it is considered as one of the best sustainable technique of agricultural practices (Naik, Swain, Singh, 2015)

According to a research the usage of hydroponics is urgently required as water becomes a more important and scarce resource, and it is anticipated that it will increase in popularity in the coming years. Hydroponics saves between 70 and 90% more water than soil-based farming since the water is collected, filtered, replaced, and recycled. In soil farming, the majority of the water provided to the plants is absorbed by the soil and not available to the roots. In hydroponics, however, the root zone is continually encircled by a film of nutrients combined with water, keeping the root zone wet and fed. An alternate water source for hydroponic crop cultivation is waste nutrient solution. The use of hydroponics is encouraged as a way to counteract climate change, as well as to lessen the harm that intensive farming does to the environment and the extinction of species. Additionally, it permits the more effective use of finite water resources. Additionally more lucrative and manageable, hydroponic crops are powerful tools in the battle against hunger and for enhancing food safety, particularly in underdeveloped nations. Herbicides and pesticides are frequently employed in conventional agriculture to protect crops against natural hazards, but their adverse effects on people and the environment are coming under closer scrutiny. Since water is recycled in hydroponics, there is little chance that fertilizer or pesticide would run off and contaminate nearby waters. As a result, it has less of an impact on the environment and is more effective. Commercial producers can situate their greenhouses nearer to their target markets or distribution routes thanks to hydroponic greenhouses. Therefore, less expensive transportation is required. This boosts hydroponic producers' earnings while cutting down on transportation-related emissions (Sardare, And Shraddha, 2013 and Nguyen, McInturf, & Mendoza-Cózatl, 2016).

Methodology

This study is descriptive in nature in which data is obtained from 230 respondents who have used hydroponic farming in place of traditional way of farming. A checklist question was used to analyze and interpret the data. In a checklist question respondents choose “Yes” or “No” for all the questions.

Table 1 Hydroponic farming as a sustainable alternative to traditional agriculture

SL. No.	The Potential of Hydroponic Farming as a Sustainable Alternative to Traditional Agriculture	Yes	%Yes	No	%No	Total
1	Hydroponic farming reduces the use of pesticides and herbicides	215	93.47	15	6.52	230
2	Hydroponic farming produces greater yield	210	91.30	20	8.70	230
3	Hydroponic farming promotes the use of less land	204	88.69	26	11.30	230
4	Hydroponic farming contributes in sustainable farming	198	86.08	32	13.91	230
5	Hydroponic farming promotes the use of recycled water	194	84.34	36	15.65	230

6	Hydroponic farming conserves soil	180	78.26	50	21.74	230
7	Hydroponic farming produces nutrient rich food	209	90.87	21	9.13	230
8	Hydroponic farming enables intelligent use of water	206	89.56	24	10.43	230

Table and Figure 1 show that 93.47% respondents agree that Hydroponic farming reduces the use of pesticides and herbicides while 91.30% respondents agree that Hydroponic farming produces greater yield. 90.87% respondents agree that Hydroponic farming produces nutrient rich food. While 89.56% of respondents agree that Hydroponic farming enables intelligent use of water. 88.69% respondents agree that Hydroponic farming promotes the use of less land while 86.08% respondents agree that Hydroponic farming contributes to sustainable farming. 84.34% respondents agree that Hydroponic farming promotes the use of recycled water while 78.26% respondents agree that Hydroponic farming conserves soil.

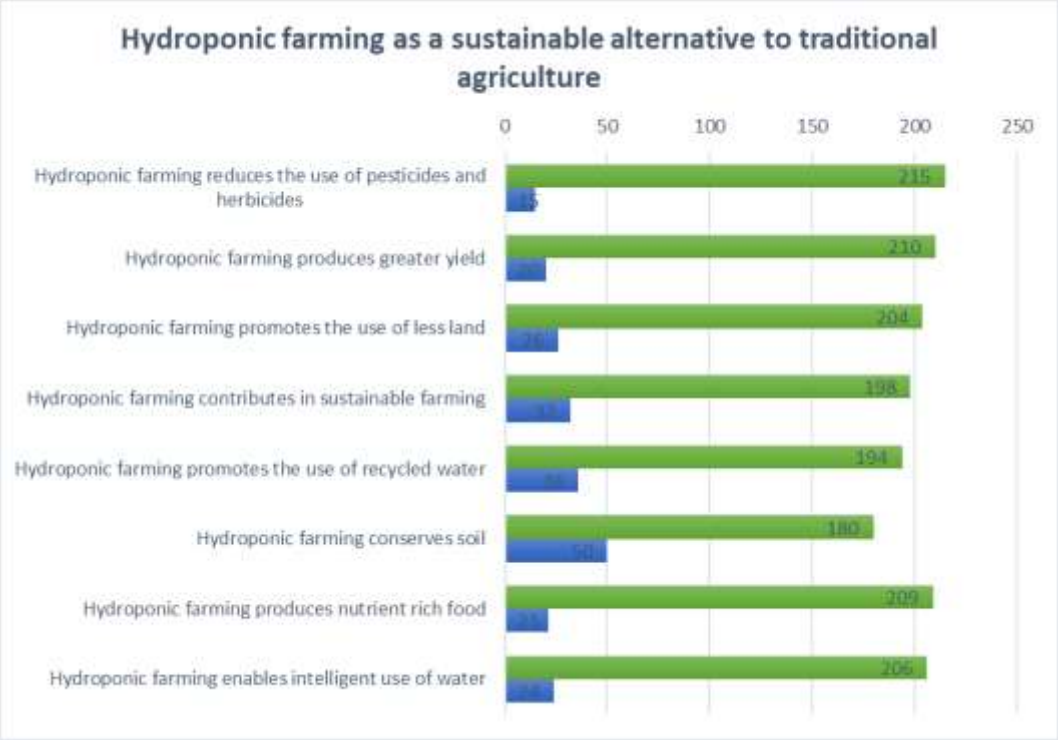

Figure 1 Hydroponic farming as a sustainable alternative to traditional agriculture

Conclusion

According to the studies mentioned above, hydroponics has recently gained attention as a viable method for growing a wide range of crops to feed a sizeable portion of the world's population. In a country like India where urban agglomeration is developing every day, there is no other choice but to adopt a soil-less culture, or hydroponics, to ensure the food security and quality of the nation's production. With a high yield and healthy crops, hydroponic technologies eliminate the risk of soil-borne illness or weed infestation. Organic food is produced in soilless cultures, and dangerous toxics and pesticides are never used. Gardening requires less room since plants with

short roots may be cultivated close to one another. In hydroponics, crops grow twice as quickly and produce twice as much food in the same amount of area. Water is not wasted since it is reversed in this approach, which utilizes just 1/20th as much water on crops as typical farming does. It also entails less work. Crops may be cultivated all year round, thus there are no concerns about the changing seasons. Due to its more sustainable approach to resource utilization than the traditional growing methods, hydroponic farming is quickly gaining popularity among farmers all over the world. Hydroponics helps plants to develop up to 50% quicker than they would in soil under typical conditions because it continuously and easily provides nourishment. Also, hydroponic gardening allows for year-round harvesting of fresh crops. Compared to regular farming, hydroponic farming essentially eliminates the need for herbicides and pesticides, which is great for the environment and the produced product. Additionally, hydroponic farming requires less freshwater since the water used in the system is retained and may be used again.

References

1. Nguyen, N., McInturf, S. A., & Mendoza-Cózatl, D. G. (2016). Hydroponics: A Versatile System to Study Nutrient Allocation and Plant Responses to Nutrient Availability and Exposure to Toxic Elements. *Journal of Visualized Experiments*, *113*.
2. Khan FA, Kurklu A, Ghafoor A *Et. Al. (2015)* A Review on Hydroponic Greenhouse Cultivation For Sustainable Agriculture. *Intenational Jounal. Of Agriculture, Envirnonement and Food Scince.*2 (2): 59-66.
3. Lakkireddy KK R, Kasturi K, Sambasiva Rao KRS (2012). Role Of Hydroponics And Aeroponicsin Soilless Culturein Commercial Food Production. *Journal Of Science and Technology* 1(1): 26-35.
4. Thakare, A., Budhe,P., Belhekar, P., Sinde, U. (2018). Decision Support System For Smart Farming With Hydroponic Style, *International Journal Of Advance Research In Computer Science*, 9(1) 427-431.
5. Sonwane,S..S. (2018). Hydroponics: An Upcoming and Innovative Way Of Future Farming, *International Archive Of Applied Sciences And Technology*,9(1)69-74.
6. Aires, A. (2018). Hydroponic Production Systems: Impact on Nutritional Status and Bioactive Compounds of Fresh Vegetables. *InTech eBooks*.
7. Sardare, M.D. And Shraddha, V.A. (2013). A Review on Plant Without Soil – Hydroponics. *International Journal of Research In Engineering And Technology*, 2(3): 299-304.
8. Van Passel, S. (2013). Food miles to assess sustainability: A revision. *Sustainable Development*, *21*(1), 1–17.
9. Dholowani, S.J., Marwadi, S.G., Patel, V.P., Desai, V.P. (2018). Introduction Of Hydroponic System and It's Methods, *International Journal For Research Trends And Innovation*, 3(3) 69-73.
10. Sardare, M.D., Admane, S.V. (2013). A Review on Plant Without Soil – Hydroponics, *International Journal Of Research In Engineering And Technology*, 2(3) 299-304.

ISSN 2515-8260 Volume 6, Issue 2, 2019

11. Maharana, L. And Koul, D.N. (2011). The Emergence of Hydroponics. *Yojana* ,55, 39-40.
12. Naik P.K., Swain B.K., Singh N.P, (2015). Production And Utilization Of Fodder, *International Journal Of Animal Nutrition*, 32(1)1-9.