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INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/14504

DOI URL: <http://dx.doi.org/10.21474/IJAR01/14504>



RESEARCH ARTICLE

THE SUSTAINABILITY OF HYDROPONIC FARMING: FARMERS VIEW IN INDIA

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Manuscript Info

Manuscript History

Received: 25 January 2022

Final Accepted: 28 February 2022

Published: March 2022

Key words:-

Hydroponic Farming, Global Framework, Sustainability

Abstract

The India is a country where fresh fruits and vegetables exported worth Rs.8,06,807.32 lakh and 27,15,601.36 MT in the financial year 2020-21. Refurbishment of agriculture styles and methods to improve productivity is indispensable. Hydroponic farming method is one among them. Hydroponic farming is one the contemporary mode of farming, where crops or plants are grown without soil. In hydroponic farming method the plants are grown in water which is rich in nutrients and mineral supply. As the population grows, availability of land for growing food (scale) decreases and to supply sufficient quantity food with minimum land resource may be a challenging task for the country. Hydroponic system is the technology that requires minimum land (i.e. 1/5th of the land required for soil-based farming), water and resources. Crops grown hydroponically will grow faster, healthier, zero carbon food and also it can be grown more organically. In India at initial stage, no estimates are available and most of the projects are in trial and sample stage and also many farmers are struggling because of lack of technology, skills and proper infrastructure for hydroponic farming but this constraint can be removed with the aid of training, education and with skilled labor. Some of the market research in India and business intelligence firm predicts that Indian hydroponic market would likely to grow at annual growth rate of 13.53% between 2020 and 2027*. So it's very important to know that where hydroponic farming sustainability in India. In this study we have tried to analyze the hydroponic farming sustainability in India.

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Introduction:-

The term 'Hydroponic' extracted from the Latin word 'Hydro' which means water and 'Ponics' means labor. Tank farming or hydroponic farming is refurbish mode of farming where plants are grown in the water without soil but they make use of water and nutrient solution which is having ample of nutrients that are essential for healthy growth of the plant. Since the nutrient water is directly supplied to the roots of the plants, growth rate will be 30-50 percent faster compared to traditional farming or soil-based farming. It is said to be that the plants grown hydroponically will be healthy, disease free, no pesticides are required and also they can be grown organically. We can also save 80-90 percent of the water which is required for soil based farming. In open ended system we can recycle the water and can be used further. Importantly India is a country where agriculture depends on monsoon if we embrace

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hydroponics for growing crops it help to produce any kind of crop at any time since it is fully controllable system that is light, temperature and nutrient level.

History of hydroponic farming:

All around the history, numerous civilizations handed down the hydroponic system or technique. Best example for hydroponic culture is Hanging Garden of Babylon, which is one among ancient Seven Wonders of the World which is first occurrence hydroponics. Floating garden of Aztec where Mesoamericans depended on small region of fertile arable land for the purpose of growing crops above shallow lake beds in Mexico. Because of lot of welfares were experienced, horticulturist and many scientists were conducted experiments for different mode of hydroponics. This was also consolidated by NASA into space program by considering practicality of growing crop and food in space machines for long term and this program which is known as Controlled Ecological Life Support System.

John Woodward is the first person who created nutrient solution for hydroponic farming in the year 1699. In early 1600's growth experiments was conducted by Val Helmont's Willow. Dr. William Gericke invented the term 'Hydroponics'. There is a massive growth of evolution in hydroponics in last century. Now the hydroponic system grown to the extent that growers can monitor and combined with full automation, which helps in faster growth rate, improve the productivity, decrease in diseases, no use of pesticides and decrease in wastage of resources like land and water.

Attributes of Hydroponics:

1. Water required is less: For hydroponic farming water required is 10-20 percent that is required for the soil-based agriculture. And also recycling of water is possible in hydroponic farming.
2. Hydroponic system is automated which results in reduction in labor: as we discussed previously many experiments were conducted to modernize technology and make the process easier. Now hydroponics system /technology became more automated where requirement of human resource is very less which mean just to operate and supervise the system.
3. Soilless and sarculation is not required: hydroponic farming is growing the crop in the nutrient water with or without use of medium but not in soil. And there no need of weeding since there will be any unwanted plants with the crops.
4. Diseases free and pesticides free growing: In hydroponics since the plants are not placed in soil we can able to avoid soil based diseases and also when there is no diseases or few diseases then need not want to use pesticides so we can grow the crops more organically and healthy crop.
5. Can have authentic harvest and can grow for commercial purpose too: Hydroponics farming is reliable farming where we can have authentic harvest both in quality and in quantity compared to soil-based agriculture since the nutrient rich water directly supplied to root of the plant.
6. Space: In vertical farming the space required is less and in small place we can grow large quantity of crop. So it is even suitable for the area where there is a scarcity of land for growing crops. Many of the people who stay in urban area prefer to install hydroponics on their terrace at least for the house hold purpose so that the can have organic and healthy food.
7. Faster growth rate: In hydroponic system of farming we can harvest early to the extent of 30-50%.

In hydroponics system of farming we can able to receive the benefits like- growers can able to grow off-seasonal crops by controlling temperature, light and by nutrient supply. Increase in yield and growth with the help of nutrient solution which results in increase in oxygen level. Density of plant can be increased. Plant can be grown any place, water required is less, only few pest issues and harvesting will be easy (containers will be at waist height). Limitations of hydroponics are- Installation cost is high, power consumption, need constant maintenance and monitoring is required. Pathogenic micro-organisms can damage the crops grown hydroponically at faster rate.

Crops grown in hydroponics:

Vegetables like- Tomatoes, Radish, Kale, Lettuce, Cucumber, Spinach, Beans, Chives, Basil and Mints. Fruits like- Strawberries, Blueberries and Pepper.

Framework of hydroponics both globally and in India:

Globally:

Hydroponic industry is anticipated to grow to \$27.29 billion by the year 2022 at an estimated CAGR of 6.39% from 2015-2022. It also estimated to grow at 9% per annum. And by 2050, 3 billion extra people can live on this earth.

In India:

Initially there were no estimates available, most of the projects are in pilot study stage and most of them are facing issues regarding technology, skills and infrastructure.

Process of establishing hydroponic unit:

Since hydroponics farming involves huge investment, technology and human resource there is a need of proper framework, system, process and procedure for the effective running of hydroponic units. The steps involved in planning hydroponics units are as follows-

1. Identification of crop: while planning hydroponics unit is to identify the crop. Identification of crop involves analysis of market, climatic environment, availability of resource with the help of which we can able to identify what are all the crops that are available for growing, which crop is to be grown.
2. Identification of hydroponic growing system: The next step is based on the crop that we have identified, we are going to identify the growing system and there are different types of growing system which includes soilless hydroponics growing system like growing bags, troughs, rhyzobags and trenches. Soilless growing media like cocopeat, rock wool, leca-ball and vermiculite. Nutrient Film Technique (NFT) like flatbed system, frame, tower and deep water culture.
3. Detailing to hardware- In hydroponic planning the next step is detailing to hardware which deals with selection of protected cultivation structure, hardware growing system, irrigation system, fogging system, agriculture tools, growing automation and support equipment
4. Installation of pilot project- After detailing pilot project the next step in planning hydroponic unit is installation of pilot study which includes trailing the planned things for the small quantity just to check the viability and possibility of success of the plan.
5. Developing software: It includes selection of crops, varieties, strategy of variety selection- mix of common and exotic varieties, diseases and insect resistant, high genetic potential, seeds brands before testing it for commercial adoption.
6. Product development: after developing software the next step is to develop a product which is nothing but introduction of product into the market which is also called as entire journey.
7. Commercial project blueprint: In pilot study we are going to test it in small quantity to check the viability of the project and when it seems viable then we will prepare a blueprint for commercial purpose.
8. Launch of commercial project: This is nothing but conversion of commercial project blueprint or process into action, where actual commercial activities start.

Objectives Of The Study:-

1. To evaluate the various factor that affect hydroponic farming.
2. To analyze the sustainability of hydroponic farming projects in India.

To attain above objectives following questions were established:

1. What are the variables that affect the sustainability of hydroponic farming?
2. Whether hydroponic farming is sustainable in India?

Literature Review:-

Author	Article	Tools and methods used	Results
Mahesh Singh, Dilip Singh Kachwaya, and KapilKalsi	“Soilless cucumber cultivation under protective structure in relation to irrigation coupled fertilization management, economic viability and potential benefits”	Cost-benefits analysis.	Low cost naturally ventilated greenhouses are more suitable and economical.
Sulma Vanessa Souza and ErlaineBinotto	“Economic viability for deploying hydroponic system in emerging countries: A differentiated risk adjustment proposal”	NPV, IRR, Modified IRR, Benefit-cost ratio, cash generating index and Discounted	It is minimum rate of return for a project or investment required by managers or investors for it not rejected.

		Pay Back period.	
HisashiUrayama, Hidetoshi Takama, and Sachio Maruyama	“Economic viability of coconut coir – based hydroponics as an alternative system for crop management in Thailand”	Economic financial affairs analysis methods.	According to the agriculture and livestock Industries corporation report (2007) indicate, In open field cultivation, 2.0kg per meter square per year but in hydroponic 8.5kg per meter square for 2.5 months farming season.

Literature Review:-

Maresh Singh, Dilip Singh Kachwaya and KapilKalsi(2018)-

The study is about the productivity, economic feasibility and potential benefits of hydroponic farming. Productivity of hydroponic farming is 4 times greater than traditional farming, for unseasonal cultivation reflects in high economic returns, it also reduces soil borne diseases among different technology low cost ventilated greenhouses are more suitable and economical.

Sulma Vanessa Souza and ErlaineBinotto(2019) –

this paper examines the economic feasibility of hydroponic system using a distinguished approaches to treat investment risk at Brazil. Initial investment for deploying the hydroponic farming projects were estimated at \$89,653.00 with GAV \$103903.63 which showed - the Net present value \$177845.74, Internal rate of return 30.45%, MIRR 16.81%, EAV \$24856.30, BCR 2.13, CGI 2.29 and DPP 5.24 years.

HisashiUrayama, Hidetoshi Takama, and Sachio Maruyama (2017) –

The study is on comparison between coconut coir hydroponic farming with open field cultivation to assess the productivity and marketability of cucumber in rainy and summer season. They evaluated the financial feasibility of an energy saving hydroponic system using coconut coir as the growth medium in northeastern Thailand. According to the agriculture and livestock Industries corporation report (2007) indicate, In open field cultivation, 2.0kg per meter square per year but in hydroponic 8.5kg per meter square for 2.5 months farming season.

Other articles written by hydroponic farmers in India concerned with its sustainability-

1. **“How hydroponic farmers are building business?”**- Herbivore farms say that in Mumbai Andheri, in the area of 1000sqft they have grown 2500 hydroponic plants without soil but with water and without sunlight but with tube light. They say that we use 10%-20% of water which we use for soil based farming. In one month and in 1000sqft they could yield 100kg.
2. **“Hydroponic farming takes route in India”**- For one acre to 1.5 acre of land area it requires Rs.30,00,000 to Rs.40,00,000.
3. **“Is hydroponic farming is actually sustainable in?”**- says that traditional method of cultivation uses 90% more water when compared to hydroponics. They partnered with super markets like chain marks and spencer to grow fresh herbs in selected stores which are working with several retailers and chefs across the Europe.
4. Gotham greens specifically choose to build sustainable greenhouse with cities. Local cultivation helps the firms to reach needy quick with minimum energy consumption.
5. **“Why adoption of hydroponic farming in India is important?”** In India, fresh fruits and vegetables exported worth Rs.8,06,807.32 lakh and 27,15,601.36 MT in the financial year 2020-21. Which represent there is a demand for the agricultural products of the country.

Findings-

1. Hydroponic farming is affected by internal factors like growing media, nutrient solution, skilled labour, hydroponic farming system, climate control system, artificial intelligence and MRO(Maintenance, Repairs and Operations)
2. External factors of hydroponic farming demand for hydroponically grown crops in the market, government export- import policies and interest rates by financial institutions, subsidies and other financial support by government.

3. It is found that hydroponic farming is sustainable in India because there is an increase in demand for agricultural produce in India gradually from year to year and in 2020-21 there was an export of more than 27lakh MT.
4. Increase in population and decrease in land availability for agriculture indicates hydroponic farming is the solution for such issues that too in urban areas.
5. Farmers says that installation cost is very high and also consume power but they can able to recover expenses within short time since yield can be more than 4 times compared to traditional method of farming, fast growth rate, pest free production and high demand since its organically grown.

Conclusion:-

World is facing scarcity of food, malnutrition and many areas are suffering from hunger. This is due the population growth, availability of land for growing food (scale) decreases and to supply sufficient quantity food with minimum land resource may be a challenging task for the country, low purchasing power, scarcity of resources and failure to install organic method of farming system. Around 9.9% of world population is facing under nutrition in 2020. To full the hunger and to avoid malnutrition hydroponic farming is the best tool to reduce usage of water, pesticides free, there is demand for hydroponically grown crops since its organically grown, are required will be less water, yield produced will 2-4 times, unseasonal crops can be produced in any season so that the farmers can get good returns to their investments. Few research study states that although there is high installation cost, it can be recovered within 4 year with proper maintenance and care. Some of the market research in India and business intelligence firm predicts that Indian hydroponic market would likely to grow at annual growth rate of 13.53% between 2020 and 2027. Hence there is need of skilled labor, political and government support, financial support from banks and other financial institutions. If it is so then for sure hydroponic farming is sustainable in India. Majority of the hydroponic firms and farmers are having positive attitude towards it.

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