INTERNATIONAL JOURNAL OF VERSATILE RESEARCH AND ANALYSIS (IJVRA)
© 2026 IJVRA | Volume 4, Issue 3, March 2026 | ISSN: 2984-8903 | IJVRA.ORG

Hydroponic Farming

Kiran Wagh, Kanika Satam, Mahek Shaikh
Students, ITM IHM
Avinash Bamania
Assistant Professor, ITM IHM

1. Introduction

Hydroponic Farming: Transforming the Food System

The economy of India is centred with farming and over the past sixty years, we have seen a clear correlation among agricultural development and financial stability. India's current farming system is a combination of remarkable successes and lost chances. If the country hopes to rise to significance in the global economy, its farming output has to match of the nations that have been recognized as the world's greatest economies. We need a new and rising technology which may increase continually the yield, revenue and efficiency of agricultural practices (Nalwade, and Mote,2017).

The greenhouse is one of the technologies used in India, and although it existed for centuries, it is still relatively new and developing in the Indian context. Geographical factors as well as stress on farming are important causes of underdevelopment and income inequality in India. These facts can be accomplished using other, innovative methods of agriculture like hydroponic (Nalwade and Mote,2017).

With rising pollution levels and unpredictable climate changes, traditional farming methods may no longer be sufficient to meet the growing global demand. In terms of productivity and quality, the hydroponic system, which grows crops without soil and produces organic vegetables without the use of fertilisers or pesticides, outperforms traditional farming. Crops can be grown conveniently indoors with a hydroponic system, which requires very little user involvement. When compared to the conventional agricultural approach, it boosts productivity and uses 80–90% less water. Considering increasing levels of pollution along with climatic fluctuations, the standard agricultural method could not become less able to meet the world's expanding food need (Kondaka, Iyer and Jaiswal, 2023).

Hydroponic Farming is a system where the crops are grown without soil. It uses no fertilisers or pesticides which produce organic and healthy crops. Compared to traditional farming the results are better because of yield and quality of crops. Crops can also be grown efficiently within with s hydroponic growing system, that needs very little involvement of users. When in comparison to the usual agricultural approach, it boosts production and uses 80-90% less water. A modern Hydroponic Farming System which utilises a model trained with machine learning to regulate and adapt conditions like weather, water flow or nutritional value, sunlight duration, etc. to grow a variety of crops (Kondaka, et al., 2023).

2. Main Body

2.1. Development of a sustainable food system that supports Hydroponic Farming

2.1.1 Reduction in environmental degradation

• Ecological balance is emphasized in Sustainable Agriculture. It aims to curtail the environmental degradation that occurs through conventional farming. The practices necessitate the development and utilization of energy sources with minimum environmental impacts, for instance, solar, wind, and hydropower. With increased food demand, technological advances have been felt in agriculture. However, there is a resultant loss in natural resources. Therefore, sustainability in agriculture has become a dire need due to pressures emanating from population growth and economic development. A balance should be created between economic, environmental, and social issues of farming. (Dodiya, et al., 2025)

2.1.2 Adaptation of different Hydroponic Systems

• Types of Hydroponic system

➢ **Wick System**

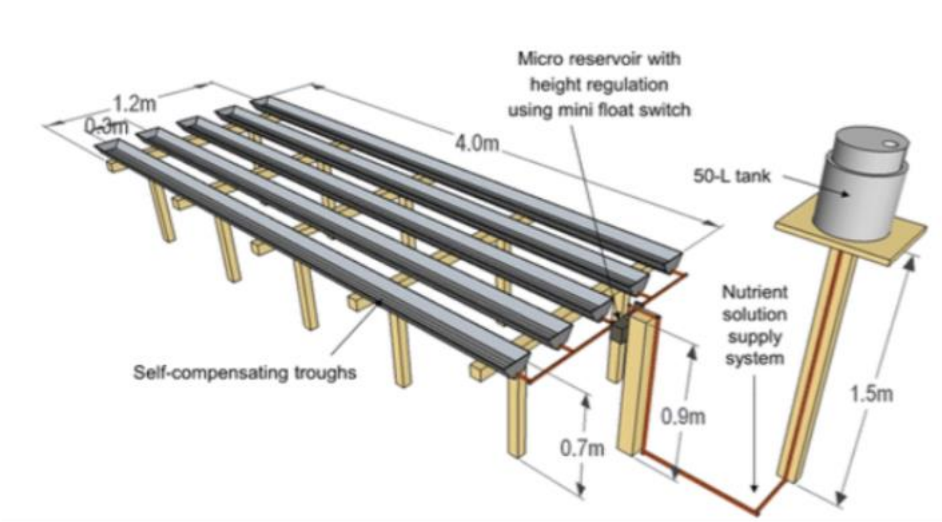

Figure 1. Wick System (Ferrararezi and Testezlaf, 2016).

The water culture system is the simplest type of active hydroponic system to use and understand. Usually made of polystyrene, the platform that supports the plants floats directly on the top of the nutritional solution. The nutrient solution bubbles and provides oxygen to the plant roots when air is pumped to the air stone (Shrestha and Dunn, 2010).

➢ **NFT System**

Figure 2. NFT System (Smolen and Kowalska, 2013)

Allen Cooper's innovation in the 1960s led to the development of NFT, which is now commonly used in modern hydroponic farming systems. The pipes holding the plants are constantly filed with the nutrient-rich fluid. When the solution reaches the final stage of the canal, it is returned towards the system's initial position. N contrast to DWC, the NFT technique does not completely bury the plant roots (Crisnapati, et al., 2017).

- **DWC System**

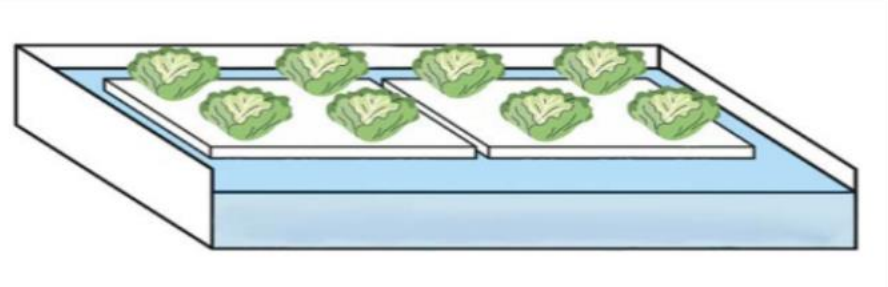

Figure 3: DWC System (Gillani, Abbasi and Martinez, 2023).

DWC is a hydroponic cultivation technique that supplies the soil with nourishment solutions. The roots of plants will always be covered in a healthy substance. This system helps to plants to grow in box. TL lams can be replaced with sunlight for growing (Gillani, Abbasi and Martinez, 2023).

- **EBB System**

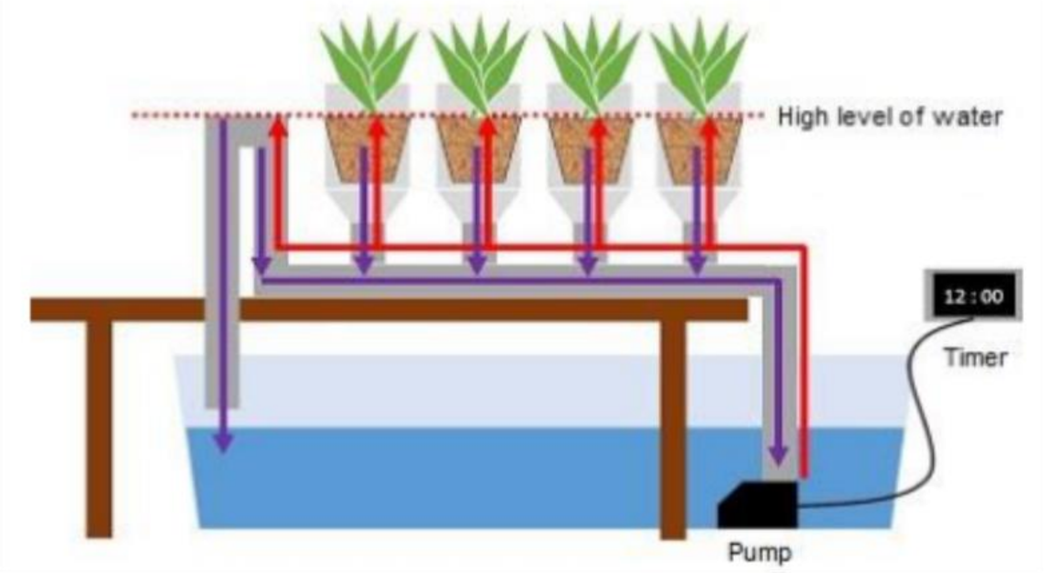

Figure 4: EBB System (Daud, Handika and Bintoro, 2018).

Various mechanical cultivation system, such as ones with flexible columns and warmed floors made of concrete, use the ebb and flood technique. Its ability to distribute nutrients, oxygen and water through plant roots in an easy and monitored method without requiring continuous piping routes for refilling or emptying is only one of its primary benefits, additionally, nutrients and water go upward towards the roots base during the flood stage, guaranteeing adequate circulation of oxygen and moisture exchange. At the specific time, just a little quantity of minerals is removed away, which assists in sustaining balance in the root area. This recycling system keeps water, decreases disposal, and promotes a sustainable environment by gathering and reusing any remaining water (Giacomelli, Weel and Blok, 2020).

➢ **Drip System**

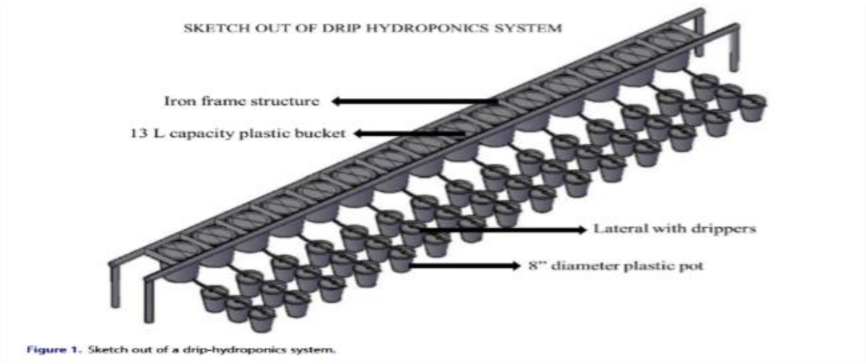

Figure 5: Drip System (Azeezahmed, et al., 2016).

The Drip System is a simple irrigation method where a timer-controlled motor gradually delivers fertilizer solutions straight to every plant's root base. Any extra liquid can be drained out or recycled be returning it to the original reservoir. When successfully set functioning, a drip irrigation method takes minimal treatment while supplying crops with a regular and consistent intake of water and additional nutrients (Yuvraj and Subramanian, 2020).

2.2 Difficulties in Hydroponic Farming

2.2.1 Rising consumer demand for healthy, organic food

• Farmers in India are successfully growing crops like carrots, gourds, and potatoes by controlling the critical elements associated with this form of soilless farming with the aid of patented technology (Zaheed, et al., 2023). The consumers being more concerned about the quality of intake of food are ready to pay a premium price for organically grown fresh, safe, and healthy produce (Anusree and Pillai, 2024).

2.2.2 Influence of customer awareness

• The population in this study is consumers who buy hydroponic vegetables. Respondents in this study were 102 respondents. The sampling technique used was random sampling. Methods of collecting data through questionnaires, interviews, and documentation. Meanwhile, the dependent variable is the buying behaviour of the consumers (Shende, et al., 2023).

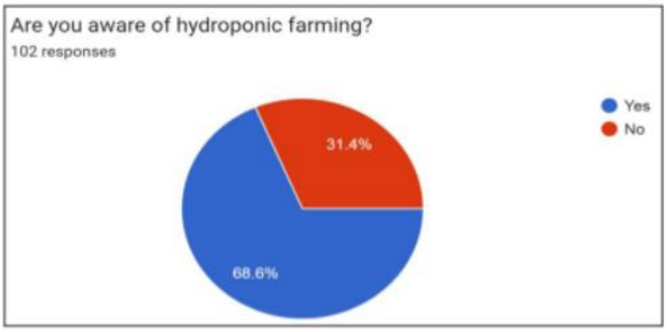

Figure 6: Awareness about hydroponics (Shende, et al., 2023).

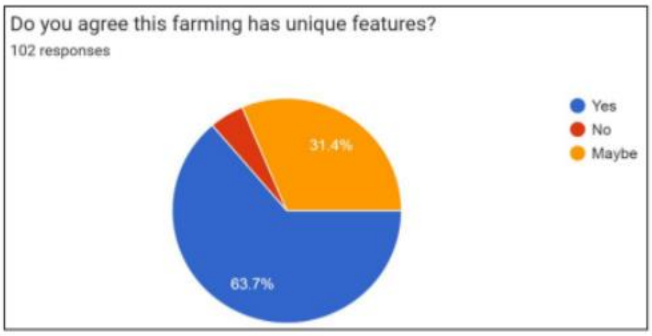

Figure 7: Agreement on unique farming (Shende, et al., 2023).

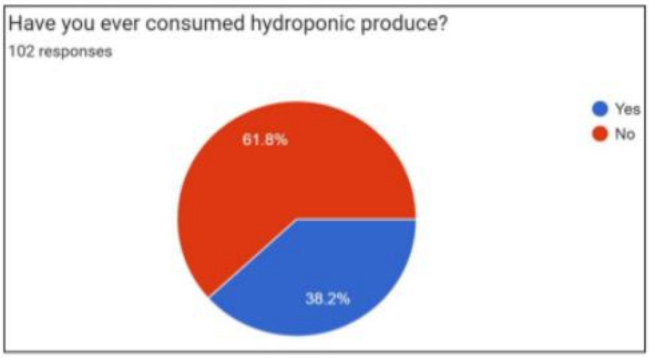

Figure 8: Consumption of hydroponic produce (Shende, et al., 2023).

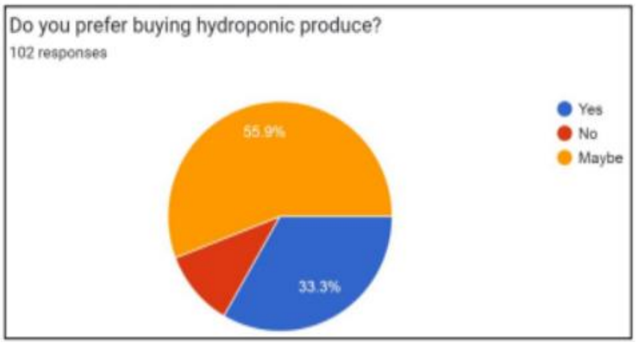

Figure 9: Consumer buying preferences (Shende, et al., 2023).

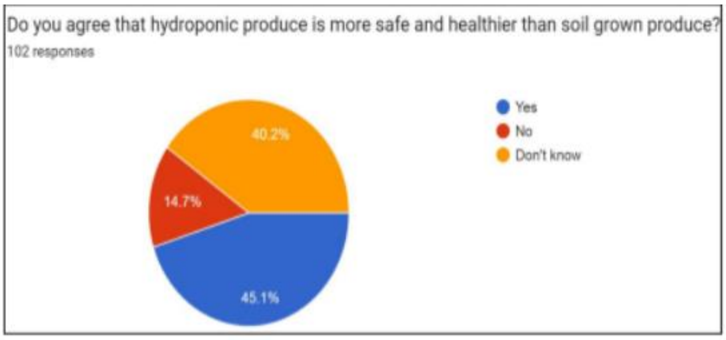

Figure 10: Health benefits of hydroponic produce (Shende, et al., 2023).

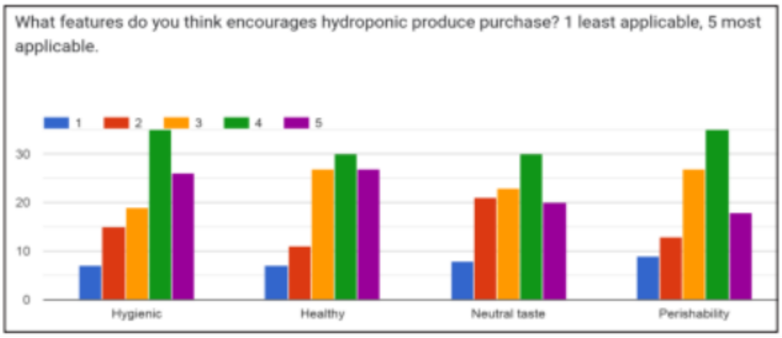

Figure 11: Consumer Buying features (Shende, et al., 2023).

2.2.3 Food Safety concern driving demands

• Hydroponic has various benefits, especially environmental and economic benefits. When it comes to ecological services, hydroponic products are safe for human consumption and does not use pesticides or other chemicals that may harm the environment. Therefore, certain customers who are worried about those problems can be in favour of hydroponic farming. Their degree of environmental care is correlated with their awareness of environmental protection issues. There were contradictory results concerning the effect of the ecological crisis on to purchasing intention of organic food. Purchase intention is improved by environmental concern, according to the study. Otherwise, shoe a negligible outcome (Balgiah, et al., 2020).

2.3. Systems approach in Hydroponic Farming.

2.3.1 Integration of IoT, AI and Big Data for monitoring

• Technology like Internet of Things (IoT), Artificial Intelligence (AI), and Big Data analytics plays crucial role in Hydroponic Farming. It also helps to optimize resources environment impacts, enhance productivity. It also helps to optimize resources use for supervising and overseeing critical limitations such as irrigation, weather, temperature, and nutrient levels. Their flexibility is further improved by the AI-powered predictive analytics, which allow for proactive responses to external stressors including harsh weather, pest infestations and scarce resources (Bouarroudj, Babba, and Touil, 2025).

• It is difficult to analyse the water quantity discharge in controlled hydroponic system because of various reasons like weather, development phases and plant spices. On the other hand, with a controlled hydroponic system, supply of fertiliser solutions is higher and nutrients may be recycled and roughly 30% of water can be conserved (Kumar and Cho,2014).

1.a.2 **Energy management solutions**

• There has been very little research done to discover effective approach to minimize the impact of waste disposal on the development of plants. In certain large commercial operation, recycling solutions is routinely examined in a lab, and complex worksheets are used to modify the levels of individual nutrients. Adjusting individual nutrients on a regular basis can be costly and technically difficult for farmers. As a result, many farmers choose to discard the nutrient solution instead of managing the concentrated levels of individual plant nutrients, as it is simpler and less time-consuming. (Miller, Adikari, and Nemali, 2020).

• Greenhouse crops have been identified by their substantial energy consumption, particularly in warmer regions. In the cold months, electrical power is utilized for warming up, while during warmer months, it uses electricity for chilling. To enhance effectiveness, an energy mixt that combines a solar power plant with heat pump technology can be working for warming and chilling in indoor farms that grow vegetables.

This technology offers an appropriate climate for crop development all year round, lowers expenses for electricity and enhances sustainability (Liantas, et al., 2023).

- To enhance urban agriculture and contribute to sustainable development goals the system offers a promising approach like integration of hydroponics, a soil-less cultivation technique and construction technology (Bendanillo, 2023).

2.4. Economic and environmental influences on the Hydroponic Farming.

2.4.1 Initial investments vs long-term gains

- The growth and popularity of hydroponic farming largely depend on whether it is economically practical. To ensure long-term success, the financial sustainability of hydroponic systems should be evaluated carefully by comparing costs with the benefits they provide, taking into consideration a host of economic factors such as initial investment vs ongoing expenses, quality and productivity of crops, consumer preference, and additional sources of revenue. By analysing all of this with similarities to traditional soil-based agricultural practices, consumers may determine if hydroponic agriculture is a possible and profitable choice. (Rout, and Sahoo, 2024).

2.4.2 Climate change pressure

- The main reason for this comparatively high energy consumption of hydroponic vegetables grown in controlled environments is artificial illumination. However, agricultural farming and environmentally friendly greenhouse cultivation have larger effects on the other sustainability factors since the require more chemicals, fertilisers, soil and water to grow crops. Using comprehensive data on fertilisers, pesticides and water consumption it shows that, except for the climate impact, open-field cultivation has higher impacts in every midpoint category. Endpoint analysis indicates that climate impacts from controlled environment hydroponic agriculture contribute more to human health and ecosystem than all the other impacts from both open-field and greenhouse production (Banboukian, Chen, and Thomas, 2025).

2.4.3 Vertical farming innovation

- Global greenhouse gas emission of 30% is produced by the food sector, with the primary contributors getting down trees for agriculture, emission of methane from the cultivation of rice and cattle, and nitrous oxide emissions from synthetic fertilisers (Mesic, et al., 2024).
- An important innovation in the field of agricultural technology, vertical hydroponic system enhances lan and resource use efficiently in the cultivation of plants in vertically layered stacks, which is particularly helpful in urban situations where space is limited (Gageanu, 2024).

2.5. Aspects of the food system in Hydroponic Farming

Farmers are being encouraged to prioritise crop quality to satisfy customer demands due to the growing public awareness of healthy lifestyles. Polluted land creates a hurdle for farmers since there is not enough soil for farming, particularly in highly populated towns and cities. (Suyaningprand, et al., 2021).

The below survey shows attitude towards hydroponic and organic farming (Gilmour, Bazzani, Nayga, and Snell, 2019).

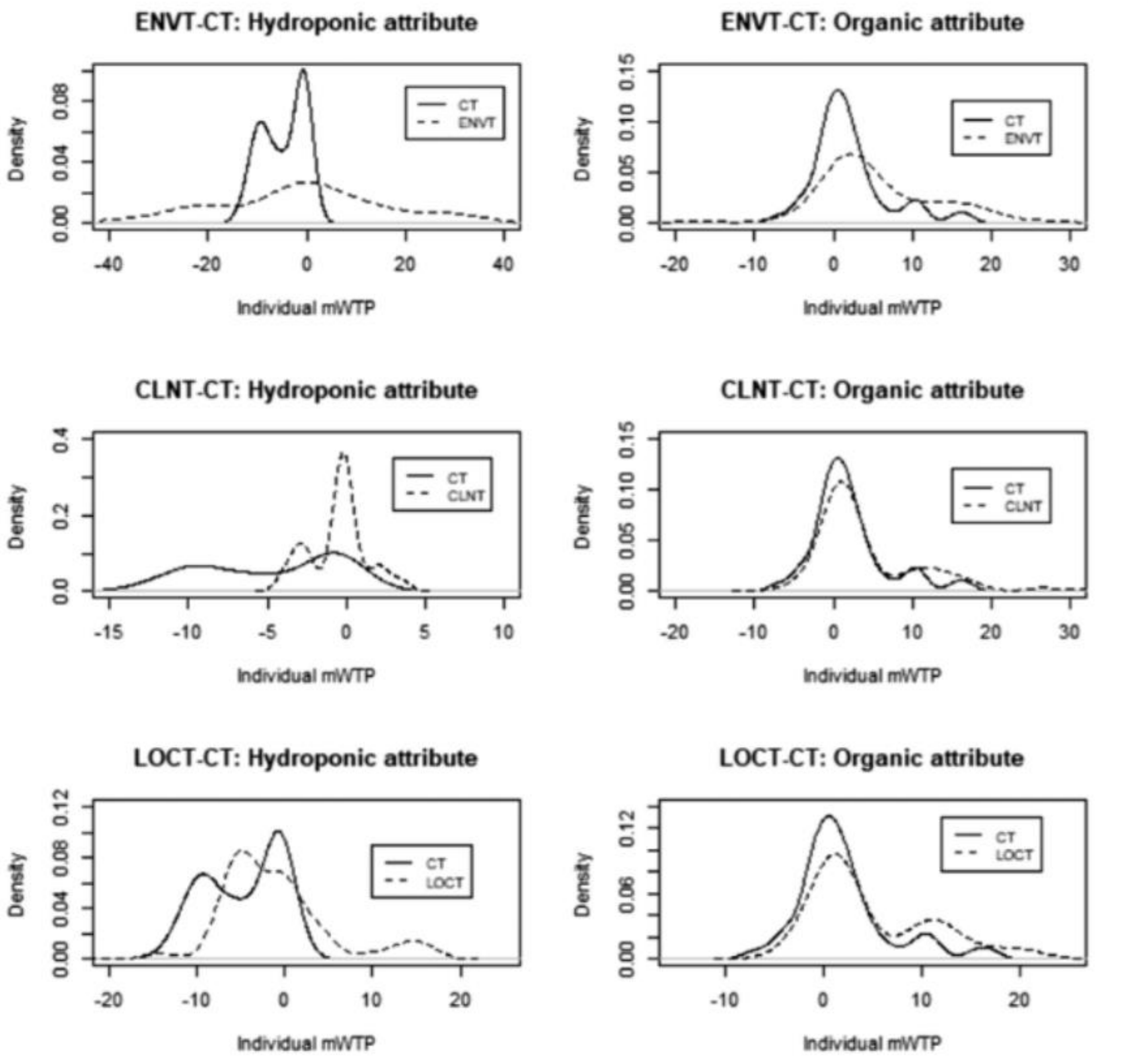

Figure 12: Consumer attitude towards Hydroponic Farming and Organic Farming

However, if an environmentally friendly and effective growth strategy matches with comprehensive growth in markets, hydroponic greenhouse farming for crop will offer enhanced and more profitable results. In addition to serving as a venue for interactions and transactions between buyers and sellers, the market is an essential economic force behind the advancement of agriculture (Dewi and Santhika, 2024).

2.6. External influences and their impact on Hydroponic Farming.

2.6.1 Food security and Health trends

• Due to its great consumption and economic worth, lettuce, a cool-season green crop, is farmed all over the world. Consumer desires for hygienic and healthful produce are guaranteed by more sustainable production methods. A crop-growing technique called hydroponics was developed decades ago to produce fresh market green vegetables in a variety of environments. (Djidonou and Leskovar, 2019).

• The main question is whether agriculture can develop agricultural wealth and reduce poverty in both rural and urban areas while also sustainably meeting the shifting needs of urban populations. (Chan, et al., 2023).

• The increasing production and consumption of industrial crops like oil palm and sugarcane, which are seen to be parts of unhealthy diets, is a cause for concern. This demonstrates how industrial agricultural system can interact both positively and negatively with sustainable and healthful food (Lindgren, et al., 2018).

• It is in this sense that hydroponics presents a sustainable, plant-based method of food production that could be applied to urban areas. It could be used as an alternative in home micro production systems to traditional methods of food production (Sousa, et al., 2024).

Conclusion

Hydroponic farming has established itself to be an environmentally friendly alternative against conventional farming, particularly in the time when food demand is rising and resources such as water are becoming limited. The farming industry in India has benefited the country for many years but relies mostly on weather conditions, availability of water, and rich land. (Banboukian, Chen, and Thomas, 2025).

Compared with the traditional agricultural methods, hydroponics uses significantly less water and agricultural chemicals, resulting in healthier food for consumers with less of an impact on the environment. Agriculture in the urban areas is made possible by the ability to cultivate crops inside or under controlled circumstances, which reduces cost related to transportation, preserves the freshness of food, and lowers carbon emissions associated with long-distance food supply chains (Dodiya, Vahoniya, Rajwadi and Bagda, 2025).

The evolution in customer taste motivates businesses and farmers to adopt hydroponics as an earning method. At the same time, regular production from hydroponic farms contributes to supply stabilization, enabling markets to function better, and enabling consumers to more frequently obtain fresh food (Zaheed, Devi, Asan and Jakith, 2023).

A systemic approach enhances the benefits of hydroponic farming using innovation in management of energy, nutrition control, and automation. This system may develop into more profitable and efficient ways by applying renewable energy, artificial intelligence, and the Internet of Things. While challenges such as cost of setup and technical difficulty exist, innovations in technology and support from the government can lower barriers over time Miller, Adikari, and Nemali, 2020).

Recommendations

Affordable Kratky-based hydroponic growing systems for urban locations-urban agriculture: Implementation of simpler than greenhouse vertical Hydroponic farms systems using pipes made from PVC and passive Kratky technologies, which need no power source, pumps, or complicated monitoring. This system supports 60 lettuce plants every cycle on a 6x1m rack, saves 90% water compared with soil farming, enhances urban food availability, and achieves sustainability with a net current value of sixteen dollars, 12.57% rate of return, and 8-month payback. It forwards sustainable development goals such as zero hunger and befits resource-limited places by reducing land requirements and costs to $170.7 per cycle (Rajaseger, et al., 2023).

Track pH, EC, relative humidity, weather, and nutrients in hydroponic greenhouses in real time using Internet of Things, or IoT, devices, software-based data collection, and artificial intelligence-powered systems. By enabling remote farming, computerised surveillance for stressors like food as well as changing climates, and recycling of up to 90% of water and nitrogen, these advancements increase yields 20 times over conventional methods while reducing waste and pesticides. Farm integration maximises the use of urban area for continuous cultivation (Rajaseger, et al., 2023).

References

Anusree, G., Sajitha Rani, T. and Shalini Pillai, P. (2024) 'Exploring the potential of soil-less farming through hydroponics in India: A review', Journal of Experimental Agriculture International, 46(12), pp. 902–922. Available at: https://journaljeai.com/index.php/JEAI/article/view/3221

Azeezahmed, S.K., Dubey, R.K., Kukal, S.S. and Sethi, V.P. (2016) 'Effect of different nitrogen–potassium concentrations on growth and flowering of chrysanthemum in a drip hydroponic system', Journal of Plant Nutrition, 39(13), pp. 1891–1898. https://doi.org/10.1080/01904167.2016.1187749

Balqiah, T.E., Pardyanto, A., Astuti, R.D. and Mukhtar, S. (2020) 'Understanding how to increase hydroponic attractiveness: Economic and ecological benefit', in E3S Web of Conferences, Vol. 211, p. 01015. EDP Sciences. Available at: https://www.e3s-conferences.org/articles/e3sconf/abs/2020/71/e3sconf_jessd2020_01015/e3sconf_jessd2020_01015.html

Banboukian, A., Chen, Y. and Thomas, V.M. (2025) 'The challenges of controlled environment hydroponic farming: a life cycle assessment of lettuce', The International Journal of Life Cycle Assessment, pp. 1–14. Available at: https://doi.org/10.1007/s11367-025-02463-6

Bendanillo, A. (2023) 'A review of the integration of hydroponic agricultural gardening in urban areas and construction technology towards sustainability', International Journal of Arts, Sciences and Education, 4(3), pp. 129–149. Available at: http://mail.ijase.org/index.php/ijase/article/view/267

Bouarroudj, K., Babaa, F. and Touil, A. (2025) 'IoT-based monitoring and control for optimized plant growth in smart greenhouses using soil and hydroponic systems', Internet of Things. Article 101710. https://doi.org/10.1016/j.iot.2025.101710

Crisnapati, P.N., Wardana, I.N.K., Aryanto, I.K.A.A. and Hermawan, A. (2017) 'Hommons: Hydroponic management and monitoring system for an IoT based NFT farm using web technology', in Proceedings of the 2017 5th International Conference on Cyber and IT Service Management (CITSM). IEEE, pp. 1–6. https://doi.org/10.1109/CITSM.2017.8089268

Daud, M., Handika, V. and Bintoro, A. (2018) 'Design and realization of fuzzy logic control for ebb and flow hydroponic system', International Journal of Scientific and Technology Research, 7(9), pp. 138–144. Available at: https://www.researchgate.net/profile/Andik-Bintoro/publication/327869009_Design_And_Realization_Of_Fuzzy_Logic_Control_For_Ebb_And_Flow_Hydroponic_System/links/5baa677b92851ca9ed25cee9/Design-And-Realization-Of-Fuzzy-Logic-Control-For-Ebb-And-Flow-Hydroponic-System.pdf

Dewi, N.M.G.S., Susrusa, K., Arisena, G. and Bakhtiar, A. (2024) 'COLLABORATION among farmer's and intermediary traders in marketing of greenhouse hydroponic products in Greater Malang', Agrisocionomics: Jurnal Sosial Ekonomi Pertanian, 8(1), pp. 322–335. Available at: https://ejournal2.undip.ac.id/index.php/agrisocionomics/article/view/19825

Djidonou, D. and Leskovar, D.I. (2019) 'Seasonal changes in growth, nitrogen nutrition, and yield of hydroponic lettuce', HortScience, 54(1), pp. 76–85. Available at: https://journals.ashs.org/hortsci/view/journals/hortsci/54/1/article-p76.xml

Dodiya, B.A., Vahoniya, D.R., Rajwadi, A. and Bagda, B., (2025) 'Hydroponics: A Sustainable Way of Farming', Journal of Scientific Research and Reports, 31(7), pp.312–321. https://doi.org/10.9734/jsrr/2025/v31i73249

Ferrarezi, R.S. and Testezlaf, R. (2016) 'Performance of wick irrigation system using self-compensating troughs with substrates for lettuce production', Journal of Plant Nutrition, 39(1), pp. 147–161. https://doi.org/10.1080/01904167.2014.983127

Găgeanu, I. et al. (2024) 'Hydroponic vertical systems: enhancing climate resilience, water efficiency, and urban agriculture', INMATEH Agricultural Engineering, pp. 94–109. Available at: https://doi.org/10.35633/inmateh-73-08

Giacomelli, G.A., van Weel, P.A. and Blok, C. (2020) 'Ebb and flood nutrient delivery system for sustainable automated crop production', Acta Horticulturae, 1296, pp. 1129–1136. https://doi.org/10.17660/ActaHortic.2020.1296.143

Gillani, S.A., Abbasi, R., Martinez, P. and Ahmad, R. (2023) 'Comparison of Energy-use Efficiency for Lettuce Plantation under Nutrient Film Technique and Deep-Water Culture Hydroponic Systems', Procedia Computer Science, 217, pp. 11–19. https://doi.org/10.1016/j.procs.2022.12.197

Gilmour, D.N., Bazzani, C., Nayga Jr, R.M. and Snell, H.A. (2019) 'Do consumers value hydroponics? Implications for organic certification', Agricultural Economics, 50(6), pp. 707–721. https://doi.org/10.1111/agec.12519

Kondaka, L.S. et al. (2023) 'A Smart Hydroponic Farming System Using Machine Learning', A Smart Hydroponic Farming System Using Machine Learning, pp. 357–362. https://doi.org/10.1109/iitcee57236.2023.10090860

Kumar, R.R. and Cho, J.Y. (2014) 'Reuse of hydroponic waste solution', Environmental Science and Pollution Research International, 21(16), pp. 9569–9577. Available at: https://link.springer.com/article/10.1007/s11356-014-3024-3

Liantas, G., Chatzigeorgiou, I., Ravani, M., Koukounaras, A. and Ntinas, G.K. (2023) 'Energy use efficiency and carbon footprint of greenhouse hydroponic cultivation using public grid and PVs as energy providers', Sustainability, 15(2), p. 1024. Available at: https://www.mdpi.com/2071-1050/15/2/1024

Lindgren, E., Harris, F., Dangour, A.D., Gasparatos, A., Hiramatsu, M., Javadi, F., Loken, B., Murakami, T., Scheelbeek, P. and Haines, A. (2018) 'Sustainable food systems — a health perspective', Sustainability Science, 13(6), pp. 1505–1517. Available at: https://doi.org/10.1007/s11625-018-0586-x

Mešić, A., Jurić, M., Donsì, F., Maslov Bandić, L. and Jurić, S. (2024) 'Advancing climate resilience: technological innovations in plant-based, alternative and sustainable food production systems', Discover Sustainability, 5(1), p. 423. Available at: https://doi.org/10.1007/s43621-024-00581-z

Miller, A., Adhikari, R. and Nemali, K. (2020) 'Recycling nutrient solution can reduce growth due to nutrient deficiencies in hydroponic production', Frontiers in Plant Science, 11, p. 607643. Available at: https://doi.org/10.3389/fpls.2020.607643

Mishra, S.J., Rout, D. and Sahoo, D. (2024) 'Analysing the economic viability of hydroponic farming: A comparative cost-benefit analysis', International Journal of Progressive Research in Engineering Management and Science, 4(6), pp. 1806–1811. Available at:

https://www.researchgate.net/profile/Somabhusana-Mishra/publication/381550736_Analysing_the_Economic_Viability_of_Hydroponic_Farming_A_Comparative_Cost-Benefit_Analysis/links/6673b15b1dec0c3c6f93d73b/Analysing-the-Economic-Viability-of-Hydroponic-Farming-A-Comparative-Cost-Benefit-Analysis.pdf

Nalwade, R. and Mote, T. (2017) 'Hydroponics farming', 2017 International Conference on Trends in Electronics and Informatics (ICEI), pp. 645–650. https://doi.org/10.1109/icoei.2017.8300782

Nursyahid, A., Setyawan, T.A., Sa'diyah, K., Wardihani, E.D., Helmy, H. and Hasan, A. (2021) 'Analysis of Deep-Water Culture (DWC) hydroponic nutrient solution level control systems', IOP Conference Series: Materials Science and Engineering, 1108, 012032. https://doi.org/10.1088/1757-899X/1108/1/012032

Rafee, B.M., Zaheed, S.M., Devi, Y.S., Asan, J., Jakith, A.A., Ahamed, R.S., Ramesh, V., Kamanahalli, B. and Commerce, B. (2023) 'A rise of hydroponics: The future urban farming and sustainability of agriculture – an overview', Journal of Research Administration, 5(2), pp. 8325–8336. Available at: https://www.researchgate.net/profile/Mohammad-Rafee-2/publication/385130447_A_RISE_OF_HYDROPONICS_THE_FUTURE_URBAN_FARMING_AND_SUSTAINABILITY_OF_AGRICULTURE_-AN_OVERVIEW_A_RISE_OF_HYDROPONICS_THE_FUTURE_URBAN_FARMING_AND_SUSTAINABILITY_OF_AGRICULTURE_-AN_OVERVIEW/links/6717812768ac304149aa5a15/A-RISE-OF-HYDROPONICS-THE-FUTURE-URBAN-FARMING-AND-SUSTAINABILITY-OF-AGRICULTURE-AN-OVERVIEW-A-RISE-OF-HYDROPONICS-THE-FUTURE-URBAN-FARMING-AND-SUSTAINABILITY-OF-AGRICULTURE-AN-OVERVIEW.pdf (Accessed: 3 December 2025)

Rajaseger, G., Chan, K.L., Tan, K.Y., Ramasamy, S., Khin, M.C., Amaladoss, A. and Haribhai, P.K. (2023) 'Hydroponics: current trends in sustainable crop production', Bioinformation, 19(9), p. 925. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC10625363/

Rajaseger, G., Chan, K. L., Tan, K. Y., Ramasamy, S., Khin, M. C., Amaladoss, A. and Patel, K. H. (2023) 'Hydroponics: current trends in sustainable crop production', Bioinformation, 19(9), pp. 925–938. Available at: https://www.bioinformation.net/019/97320630019925.pdf

Rajaseger, G., Chan, K. L., Tan, K. Y., Ramasamy, S., Khin, M. C., Amaladoss, A. and Patel, K. K. H. (2023) 'Hydroponics: current trends in sustainable crop production', Bioinformation, 19(9), pp. 925–938. Available at: https://www.bioinformation.net/019/97320630019925.pdf

Shende, K.M., Joshi, S., Mhetre, P. and Gumaste, R. (2023) 'A study of hydroponic farming and its impact on consumer buying preference', Atithya: A Journal of Hospitality, 9(2), pp. 45–52. Available at: http://publishingindia.com/atithya/

Shrestha, A. and Dunn, B. (2010) Hydroponics. Oklahoma State University. Available at: https://openresearch.okstate.edu/bitstreams/23fd438f-f1c2-41b7-a877-96c8a0072c89/download

Sousa, R.D., Bragança, L., da Silva, M.V. and Oliveira, R.S. (2024) 'Challenges and solutions for sustainable food systems: The potential of home hydroponics', Sustainability, 16(2), p. 817. Available at: https://www.mdpi.com/2071-1050/16/2/817

Suryaningprang, A., Suteja, J., Mulyaningrum, M. and Herlinawati, E. (2021) 'Hydroponic: Empowering local farmer knowhow to gain value added on agriculture commodity', BIRCI-Journal: Humanities and Social Sciences, 4(1), pp. 787–796. Available at: https://bircu-journal.com/index.php/birci/article/viewFile/1676/pdf

Yuvaraj, A. and Subramanian, R. (2020) 'Different Types of Hydroponics System', Biotica Research Today, 2(8). Available at: https://bioticapublications.com/journal-backend/articlePdf/74a2e3925e.pdf