Journal of Research Administration
Society of Research Administrators International

A RISE OF HYDROPONICS THE FUTURE URBAN FARMING AND SUSTAINABILITY OF AGRICULTURE – AN OVERVIEW

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Abstract: *the looming threat posed by global change. We all understand that this catastrophe was inevitable given the continual depletion of fossil fuels, pure air, water, and other resources. However, one method to maximise the usefulness of the materials at hand is hydroponics. In this modern age Plants can be grown without soil using horticulture techniques, which in India is the greatest thing that could happen. That's because factors like trained labor, water availability, seed, soil quality, and weather have always been important in Indian agriculture. Additionally, the expansion of food output has always come at the expense of water availability. According to some figures, agriculture uses up more than 70% of the freshwater resources. Would you think that agriculture is also responsible for 70% of the water contamination in addition to all of the above? With the use of high-tech hydroponic farms and urban gardening, it is possible to produce food in urban areas. You wouldn't believe it, but hydroponic farming is gradually emerging as a powerful answer to improving nutrition and addressing disruptions in the food chain supply. The numerous benefits of hydroponics are what account for its worldwide and widespread adaptability in India. For instance, this farming technique produces better yields while requiring very little labour. Compared to conventional farms, plants develop more quickly. Growing concern over the food quality in the recent pas among the masses, one of a survey by Environment Management and Policy Research Institute (EMPRI)carried out where, five upscale supermarkets, five local markets, "organic stores," and Hopcoms were choosen to check for the presence of heavy metals, samples of ten different vegetables were analyzed: brinjal, tomato, capicum, bean, carrot, green chili, onion, potato, spinach, and coriander. Although the maximum amount of iron that can be consumed is 425.5 mg/kg, the concentration of 810.20 mg/kg of beans, 945.70 mg/kg of coriander, and 554.58 mg/kg of spinach were found in beans purchased from reputable organic stores. Onions had the highest iron content among the Hopcoms vegetables, with 592.18 mg/kg. The majority of the veggies analyzed, whether from small retail establishments or supermarkets, had levels of heavy metals higher than allowed. In the midst of unethical food farming, the study is to examine the new way of farming in urban India (Vertical Farming) to mitigate the pressure on the*

Agri sector in India. On the other hand, to streamline how Startup's can tap the growing demand for agri-ouputs in the urban conglomerates by keeping the food standards as per the FAO and to generate employment.

Keywords: *Population growth, hydroponics, climate change, food chain supply, food security, Startup's in India, nutrient film technique (NFT), Urban Farmers, unethical farming*

I. INTRODUCTION

Hydroponic systems can feed the poor in India and around the world more effectively than conventional growing methods.- Amy Zuckerman

"The global hydroponics market is likely to be worth US$ 12,106.5 million by the end of 2025 from US$ 6,934.6 million in 2016," according to a Transparency Market Research analysis. Growing plants hydroponically involves utilizing a water-based nutrition solution in place of soil, together with an aggregate substrate or growing media like perlite, vermiculite, or coconut coir. Commercial enterprises, hobbyists, and small farmers utilize hydroponic production systems. Numerous issues have gained attention because of the global population's rapid growth. The decrease in per capita land accessible for soil-based farming is one of these difficulties, which causes additional agricultural and environmental problems. To survive the current situation, it became necessary to create cutting-edge technologies and techniques under these extreme conditions. Despite numerous studies on the growth of plants in soil and in vitro, only a small number of these they focus primarily on soilless societies. A novel, promising technique for enhancing the cultivation of various cash crops is soilless agriculture. In addition to reserving and restoring cultivation lands, soilless farming, particularly the close-loop method, has the following benefits: It uses a fixed quantity of recycled water, conserves 85–90% of irrigation water, and can be used in unfavourable for ordinary farming, almost zero environmental pollution, better yield than conventional cultivation. The quantity of water used in hydroponics is about 20% less than it is in traditional cropping techniques. This soilless agricultural technique's ability to be used in a small area is a crucial plus. Additionally, the vegetation you. Because you can directly control the ambient temperature, plants don't rely on the weather outside. Since agriculture in India is so highly reliant on the monsoons, hydroponics is nothing short of a blessing in disguise. Farmers who use hydroponics can produce an abundance of food, grow crops that are out of season, and influence the dietary preferences of customers. Since this farming technique is not constrained by surface area, you must arrange the plants vertically. Nothing is more lucrative and useful for growing condiments and herbs than hydroponic farming. Since you can grow your crops indoors, the likelihood of a pest assault is very low. We are all aware that the locust assaults have had the greatest impact on the west coast of India. Last but not least, seeds don't need to manually push through the soil. As a result, hydroponics speeds up vegetable maturation and growth. The initial setup expenses for this technology can be a little higher, but it shows promise and is gaining popularity. These infrastructure expenditures, like those for the building, the sensors, the water pumps, the grow lights, and the plumbing system, are all one-time expenses.

In India, hydroponic farming has become more and more popular, mostly due to the declining profitability of traditional farming practices. Due to the lack of water and the less fertile soil, a number of innovative businesses have entered the hydroponic farming market with the goal of continuing to produce food in spite of the water crisis. Indian farmers are successfully cultivating crops like carrots, gourds, and potatoes by regulating the crucial elements linked to this soilless farming technique and utilizing patented technology.

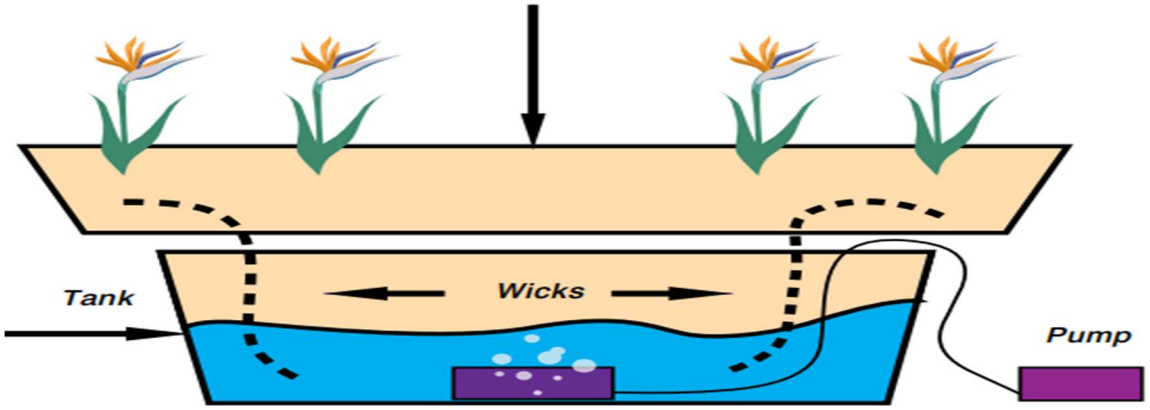
Noucetta Kehdi opined that, these days, providing food is getting increasingly difficult. Along with the global population increase rapidly flowing water growing less commonplace daily, as well as the effects of for transit, hydroponics is the finest option for business alongside indoor gardening. Now hydroponic vehicle cultivation, in modest to moderately sized family urban gardens and farms, is worldwide development. One of the numerous benefits of hydroponics is that it increases production by 20 to 30%. excellent fruits and flowers, cut back on nutrients and water consumption, and cultivate new food is found everywhere, even barren and unproductive territories, or in capitals and large cities. It is aids in reducing pricey middlemen and shipping expenses and cutting down on carbon imprint. Because it's user-friendly, that every determined grower can Use it effectively. Although lettuce has a high nutritious content, not all types of lettuce have the same attributes. In general, the primary nutrients found in lettuce are vitamin A, C, E, K, and folate, zinc, magnesium, calcium, and iron. There are various ways to cultivate lettuce and Hydroponic herb garden. Previously, numerous operations employed NFT channels, having subpar crops and persistent iron deficiency and root disease and unquestionably the AeroFlos that ensure optimal oxygenation and have high greater than any other system's temperatures.

India first saw the use of hydroponics in 1946 when the Bengali government established a test farm at the Darjeeling town of Kalimpong District, based on a summary the development of hydroponics published in India on the Website of Indianetzone. The farm's primary goal was to support hydroponic gardening, and the Problem back then was the price of the equipment needed to expand veggies. To make that clearer specific obstacle, the government inserted James Sholto Douglas is a British investigator eager to create hydroponic ways of planting, whose trials intended to "strip Because hydroponics is so complex gadgets and to show it to the the global and Indian populace as low-cost, simple method of expansion veggies devoid of soil," the reputed published source stated.

II. **TYPES IN HYDROPONICS**: In hydroponics there are a few dozens of hydroponic systems that can be categorized in six main types:

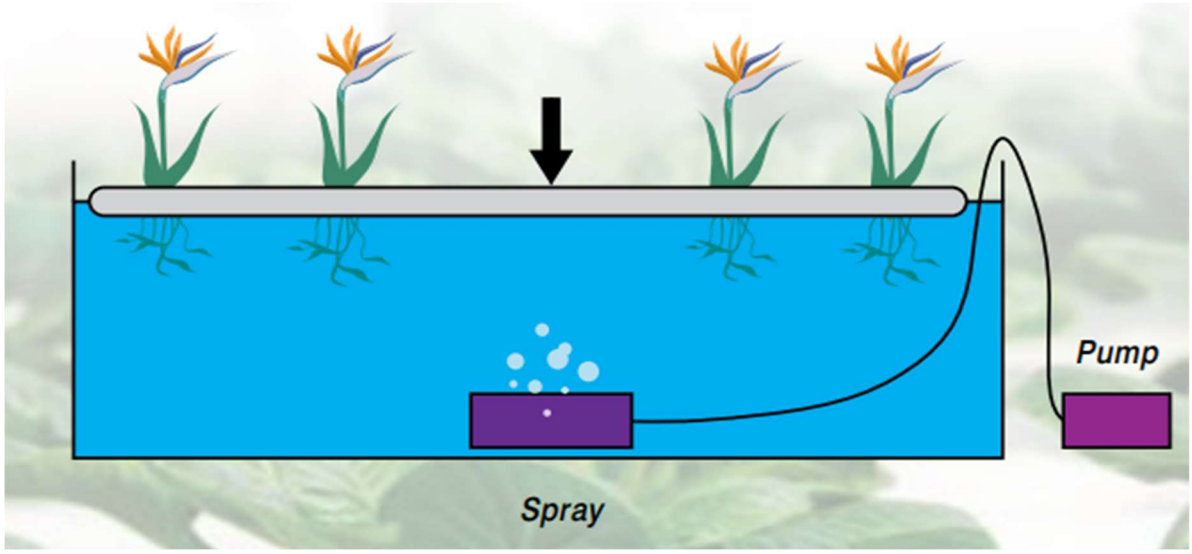
1. Wick system: The most basic kind of hydroponics system is this one. It is categorized as one of the passive systems and relies on the capillary force, which doesn't need any kind of mechanism.

Supplying nourishment to the roots using wicks to aid move from the substrate to the tank.



Source: Soilless technology

2. Deep water culture : The simplest basic hydroponics system is this one. The platform, which is often constructed of foam plastic, holds the plants in place. This platform floats in the reservoir. containing a nutritional solution. roots of plants are submerged in water continuously to obtain adequate oxygen. The airflow in the nutrient solution is carried out using a unique pump. On, the solution is modified at regular interval. This technique is perfect for growing small plants that grow quickly and require a lot of fluid (like salad, for instance). Still, it's not appropriate for large, enduring ones.



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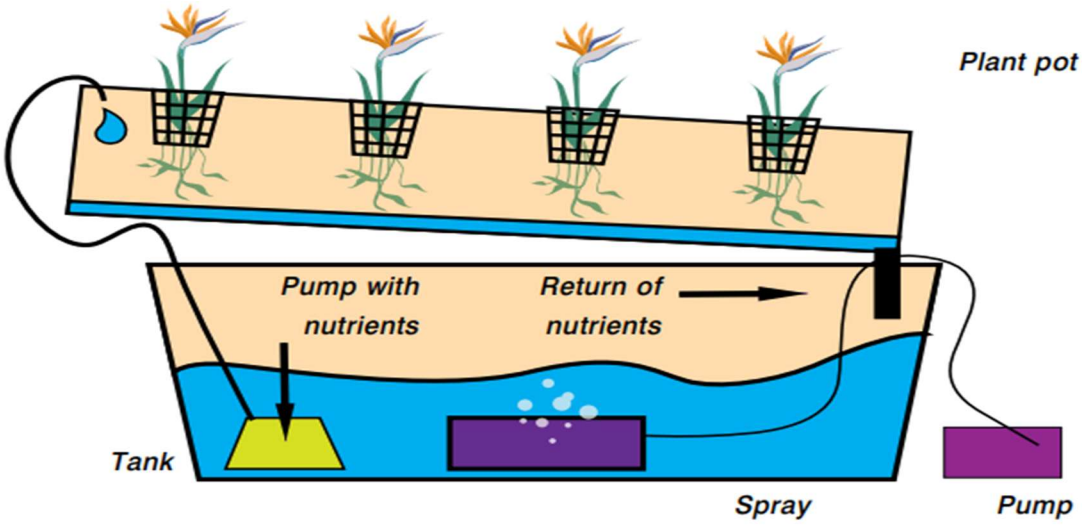
3. N.F.T system: The nutrition mixture is moved from the container to the tank where little containers hold the plants plastic mugs with roots holes to expand. The nutrient-based mixture is supplied with a pump's assistance. The fix targets the underlying issues and then returns to the tank. The flow is either continuously maintained or turned on by itself inside brief time intervals. The source is contact with a nutritional layer that is thin. a remedy that is continuously on the tank's base. Roots get adequate oxygen since the air above is humid nutrition mixture.



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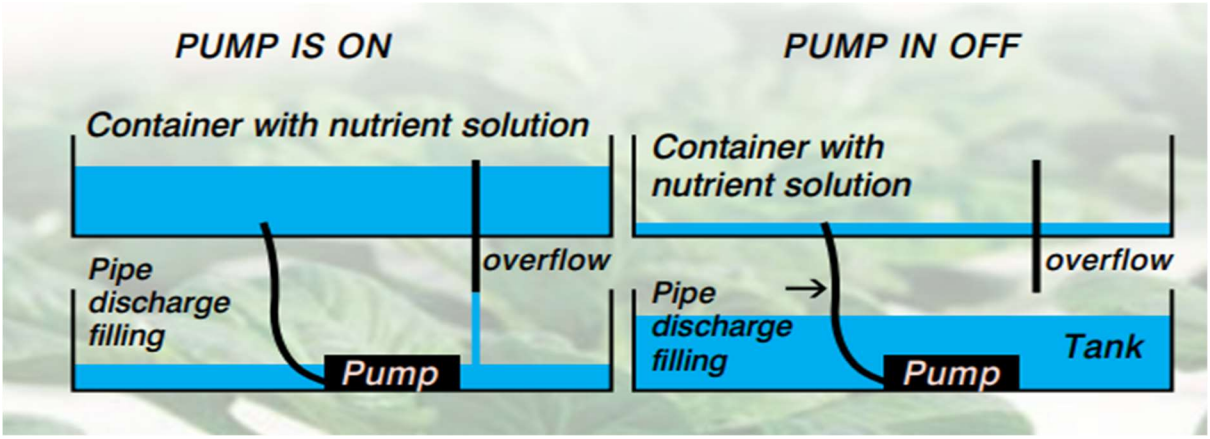
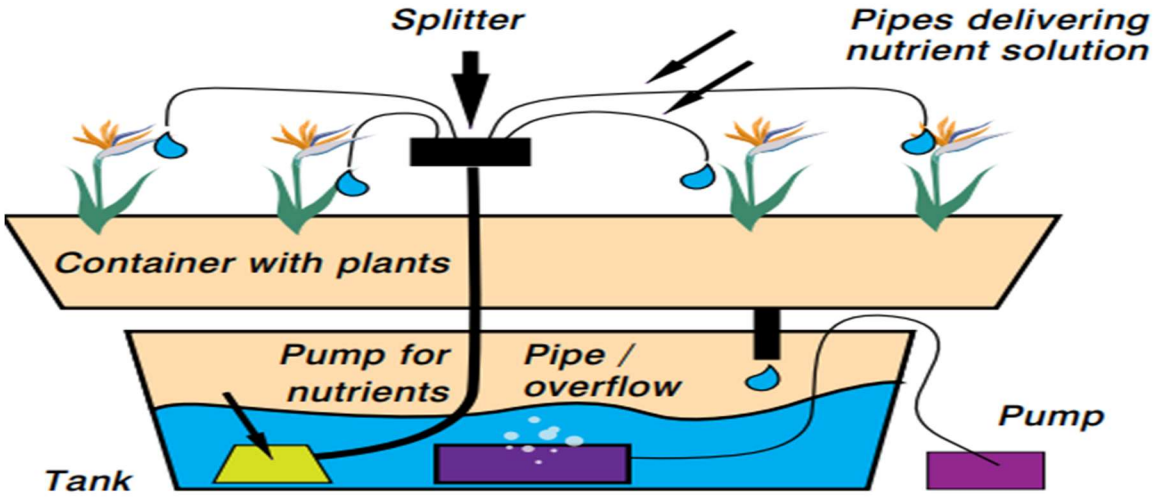
4. EBB & Flow system : The substrate (gravel, coir, pearl stone, etc.) has roots that receive nutrient solution, which runs over through the tank. It is an automatic process as the timer and pump are linked. The pump starts when the timer is set supplying the roots with nutritional solution. Once it is turned off, the solution enters the tank on its own.



Source: soilless technology

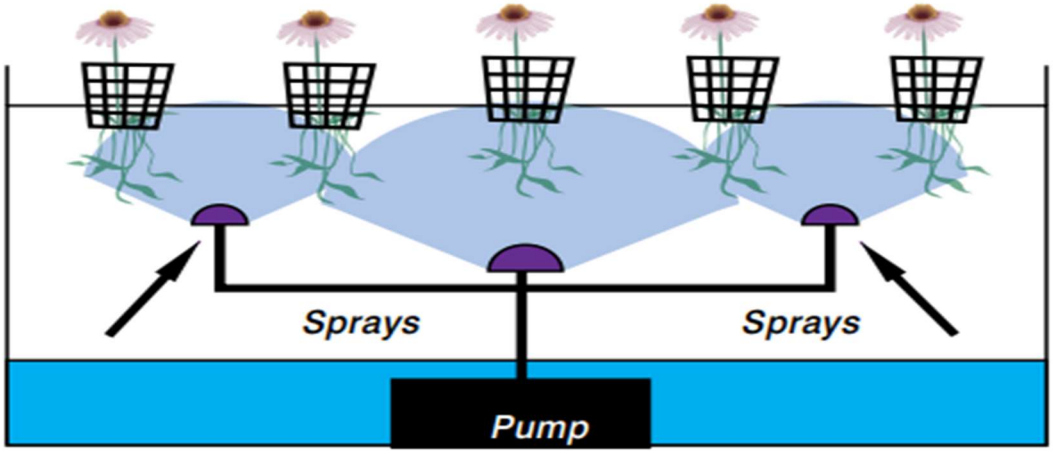
5. Drip System: The most often used hydroponics system is this one. Nutrient solution is delivered by the timer-operated pump, which passes through pipes and drips at every plant's root. Plant roots are positioned within the base.It can be utilized separate pots to facilitate removal and to alter or remove the plant.The Drip system comes in two varieties:a) Drip Recovery System. The excess runs back and is taken back to the tank. You won't require an precise water management strategy so you can to an easy timer. However, you should maintain an keep an eye on the pH and the equilibrium of the solution.b) The Drip System Without Recovery. The answer is never twice used. This is the reason the timing needs to be carefully set. To stop roots from rotting, it should be more precise and avoid any overstretching. This framework takes less time to maintain because of the pH level and the nutritional balance are constant, thus preventing the need to check it.This

approach is susceptible, just like any other running system. energy scarcity in addition to the pump and timer collapse. In addition, pipes may clog.



Source: soilless technology

6. Aeroponics: The most advanced hydroponics system is aeroponics. The plants are fastened to the container's top. Hanged are they and the air is their root system. Within the sprays that are activated within the container by the pump and the timers. Spritz often provide nutrition solution to the roots (The time interval is computed using the amount of time needed to absorb). Thus, the roots continuously in an oxygen and nutrient mist answer. Greater aeration promotes shorter times for development. Setting up is crucial when using hydroponics. the clock accurately. It will continue to be brief. cycle and turn the pump on for a brief moment each minute. The roots drying out is a system drawback in the event of a lack of energy or timer and pump breakdown.



Source: soilless technology.

III. LITERATURE SURVEY

Bikram Pradhan and Bandita Deo (2019) The world's population is growing at a rapid rate, which has brought several concerns to light. One of these difficulties is the decline in the amount of land per person that is suitable for soil-based farming, which exacerbates other environmental and agricultural problems. It became essential to create cutting-edge technologies and methods in order to survive the current situation in light of these dire circumstances. While many studies on soil and in vitro plant cultivation have been conducted, relatively few of primarily focus on soilless civilizations. A novel and potentially effective technique for enhancing the production of many cash crops is soilless agriculture. In addition to reserving and restoring agricultural land, Soilless farming offers several benefits, particularly with its close-loop approach. It makes use of recycled fixed quantity of water, which conserves 85–90% of irrigation water, can be used in adverse for typical farming, nearly less environmental damage, and higher yield than traditional farming. The study says that, while there are many benefits and drawbacks of soilless farming, new alternative technologies for large-scale agricultural production are required as arable land becomes less available globally. Even though it may not seem important right now, soilless farming has enormous possibilities for the future. Soilless culture involves a variety of technologies and approaches that can be referred to as "next-generation crop science" since, if appropriately investigated and assessed, it will provide access to create a new spacefaring society. On the other hand, Anil Kumar et al (2020) reviewed the scope of potentiality of vertical farming in India. The constant increase in population makes it necessary to maximize productivity—that is, food output per unit area. Numerous cutting-edge techniques, including as aeroponics, nutrient film technique (NFT), aquaponics, and others, are already well recognized, but their land usage is not very good. Thus, to reconcile this land issue The practice of vertical farming began. It makes use of the vertically wasted space, which or else neglected in other agricultural practices. Additionally, it makes it easier for folks to acquire a fresh haircut. veggies on a regular basis. Additionally, people these days are demonstrating a strong interest in their health, and salad veggies are the greatest solutions to satisfy their dietary needs for healthy food because of their nutritional ideals. Vegetables are packed with health advantages. The study opined that, when crops are grown vertically, the outcomes are significantly superior. Thus, it can be concluded that vertical farming offers more advantages than alternative growing techniques and is a superior substitute for crop cultivation in light of the current situation, in which population growth is accelerating. Should be analyzing the current population increase scenario, then what will happen to our state is predictable. be in the years to come. Therefore, we must locate a superior substitute, to sustain the population's need for food, and in order to do that, the Being vertical is a big deal. Over the above, Singh Rohit Umashankar et al (2020) studied the vertical farming proposal in India. India's population is growing at a rapid rate, which means that more land is needed to produce the food that the country needs. The idea of a vertical farm was presented as a solution to this problem. Stacking farms atop one another rather than branching out horizontally is known as vertical farming. Following the Industrial Revolution, the carbon footprint left by industry rose quickly, contributing to global warming and climate change. These factors negatively impacted agricultural production in numerous ways, including lowering crop quality and yield. A number of factors need

to be taken into account, including design, supporting technologies, and the quantity and quality of cultivation. Vertical farming refers to the method of generating layers of food and medication that are piled vertically, surfaces with a vertical inclination or incorporated into other constructions as in a shipping container, old warehouse etc., advantages of vertical farming over horizontal farming in terms of cost. The project's main goal is to apply hydroponic farming techniques for vertical farming. The project's ultimate societal benefit is that the population of the future be supplied with wholesome, organic food meals. The project makes the best use of available resources, including as land and water in order to attain optimum production conquer the future food shortage.

IV. STARTUP ECO- SYSTEM IN HYDROPONICS

Leading Hydroponics Businesses in India. Modern farming practices, like as hydroponics, are very common in suburban and urban regions. It is a technique for farming sustainably in areas with limited resources and high demand. In a nation such as India, where resources are distributed unevenly, hydroponics has become popular and is also providing encouraging returns. Here, this method is limited to cultivating foliage crops, ornamentals, herbs, and vegetables like tomatoes, cucumbers, and peppers. The best hydroponics companies in India are listed in this article, along with the reasons behind their dominance of the Indian market.

1. India's largest hydroponic farm is called **Nutrifresh**. The mission of Nutrifresh is to supply the public with sanitary, premium-quality, non-GMO, residue- and pesticide-free fruits, vegetables, and herbs. They are always developing new technologies and making adjustments to ensure agriculture is sustainable. They offer reasonably priced products that are delivered straight from the farm to customers' doorsteps through an online shopping platform. It is possible to schedule a visit to the farms and observe firsthand the methods used for growing and preserving their fruits and vegetables. Here, in order to guarantee the delivery of consistently high-quality items, they have implemented a "PLUCKED TO ORDER" procedure whereby they carry out the plucking process following order confirmation.

2. Hydroponic kits and farm-fresh produce are delivered by **Urban Kisaan**. Together with fresh, wholesome food, they concentrate on growing more. Their goal is to make agriculture sustainable in the future. The finest, most nutrient-enriched products are grown at Urban Kisaan and harvested right before they are delivered to customers. Compared to traditional farming, they save up to 95% of the water and produce 30 times more with a much smaller carbon footprint. Their goal is to enable medium-sized and small-scale farmers. They offer fresh avocados, limes, bell peppers, and more. They also sell hydroponic kits and farm bowls.

3. Located in Noida, Akarshak Hydroponics/Akarshak Saffron Institute is a young but rapidly expanding company committed to producing high-quality, economically viable hydroponic saffron as well as indoor saffron. They also typically offer training utilizing the best training program in the world, "Indoor Saffron Hydroponics Farming in India." Apart from

providing trainings in polyhouse engineering from South Korea, advanced hydroponic farming in India, and microgreens cultivation, they also offer consultation services for commercial hydroponic agriculture and saffron cultivation projects. The company's mission is to use efficient education and knowledge dissemination to accelerate the conversion of India's unproductive agriculture into the profitable, productive, sustainable, and soilless cultivation of highly functional crops.

4. Balcony Crops: In 2020, they embarked on a hydroponic trip. Utilizing sustainable farming techniques that are adaptable to macro (commercial) operations as well as micro (home gardening) activities is their main objective. Compared to conventional agricultural methods, their innovative production techniques are 90% less water-intensive and yield higher profits.In order to fulfill its mission of promoting agriculture and introducing it to the urban populace, the company has developed a basic DIY grow kit. In people's homes, the method is used in the routine use of greens, vegetables, flowers, etc.

5. Evergreen Farms: They are always experimenting to cultivate novel crop varieties. There, in their climate-controlled polyhouse, they produce year-round. Everything is pesticide-free, locally grown, and freshly collected.

6. Kamala Farms: Kamala Farms is a hydroponic business that focuses on problems like food safety, food transparency, and the availability of wholesome food. The company wants to raise the standard of living for people in India by producing fresh, wholesome, pesticide-free food.In Kamala Farms, 3600 farming solutions are offered. They also help with the setup of hydroponic farms. They provide a repurchase service based on contracts. Through a variety of agricultural courses, workshops, and training programs run by professionals in the field, they not only develop but also share information.

7. Brio Hydroponics: Based in India, Brio Hydroponics aims to provide cost-effective and environmentally sustainable farming practices. With or without growing media, their cutting-edge technology provides plants with nutrient-rich water instead of dirt. Brio Hydroponics India is dedicated to helping farmers in this new era by offering tools and policies that are specifically designed to boost income.Techno-economic feasibility studies, crop selection frameworks, help raising capital, project design and site planning, project development, crop management, operational training modules, and marketing support are among the services offered by Brio Hydroponics.

8. The principal goal of India's Groflo Hydroponics startups is to support urban farmers. They generate larger yields while ensuring the effective use of scarce resources. Their goal is to assist commercial growers produce more by making farming more accessible to the general public.Groflo Hydroponics offers a wide range of reasonably priced, long-lasting products, including reservoirs, seedling trays, flood and drain trays, and water culture trays.

9. Rise Hydroponics: With a growing array of goods and services, Rise Hydroponics is expanding quickly and assisting numerous organizations. Growing healthful items and providing the greatest knowledge to projects of any size are their top priorities. They endeavour to disseminate the advantages of hydroponic farming as widely as they can throughout India through their diligence, commitment, and enthusiasm. Rise Hydroponics is focused on offering support and related solutions for the building of hydroponic farms both indoors and outdoors. In order to grow a variety of crops, they are also erecting polyhouse constructions. In addition to these, it offers courses, live instruction in hydroponic farming, and project development ideas.

10. India's Future Farms: Hydroponic Agriculture Future Farms is the top supplier of precision agricultural automation and hydroponic systems in India. Its team of professionals has worked on worldwide greenhouse projects in Thailand, the United Arab Emirates, and Germany. Future Farms offers growers comprehensive hydroponic solutions, effective installation, reduced commissioning procedures, and top-notch supplies and management techniques. Additionally, they offer top-notch remote automation for all kinds of crops.

V: CONCLUSION

The hydroponics market is expected to expand at a compound annual growth rate (CAGR) of 6.7% from 2017 to 2022. The market value for hydroponics is projected to increase from USD 1000 million to USD 31436.7 in 2016 million to 2022. Hydroponic farming seems to offer an edge over traditional farming in the current global scenario of diminishing water resources, as it uses around 90% less water, doesn't require pesticides, and has higher yields. One of the interesting study says that, crops grown with wastewater now have greater concentrations of heavy metals; EMPRI researchers evaluated 400 samples of ten different crops and discovered contamination over the Food and Agriculture organization's allowable limits.

More than a fifth of the state's population lives in Bengaluru, which sources its vegetables from farmer's networks in the surrounding cities of Bengaluru Rural, Bengaluru Urban, Kolar, Chikkaballapur, and Ramanagara. Just Hopcoms produces seventy tonnes of veggies. 400 samples were gathered from 20 locations in Bengaluru by the Environment Management and Policy Research Institute (EMPRI) – five upscale supermarkets, five local markets, "organic stores," and Hopcoms. To check for the presence of heavy metals, samples of ten different vegetables were analyzed: brinjal, tomato, capicum, bean, carrot, green chili, onion, potato, spinach, and coriander. Although the maximum amount of iron that can be consumed is 425.5 mg/kg, the concentration of 810.20 mg/kg of beans, 945.70 mg/kg of coriander, and 554.58 mg/kg of spinach were found in beans purchased from reputable organic stores. Onions had the highest iron content among the Hopcoms vegetables, with 592.18 mg/kg. The majority of the veggies analyzed, whether from small retail establishments or supermarkets, had levels of heavy metals higher than allowed. The FAO has set a maximum limit of 0.2 mg/kg for cadmium. However, brinjal purchased at a BTM Layout store contained 52.30 mg/kg of cadmium. Cadmium content in coriander was 53.30 mg/kg, spinach 53.50 mg/kg, and carrot

54.60 mg/kg. Cadmium is a hazardous substance that can damage the lungs and liver and weaken the immune system. "Purely toxic" lead shouldn't be more than 0.3 mg/kg. Although several vegetables showed measurable levels, commercial beans had 12.20 mg/kg, which raised questions about the health of those who regularly consume the vegetable. The levels of nickel in green chili, carrot, potato, tomato, and beans above the recommended limit of 67.9 mg/kg. The current study clearly shows that vegetables' edible parts are hyper-accumulators of heavy metals. Given the potential health concerns involved with eating these veggies, it is advised that waste water not be used in the production process. Farmers shouldn't use unethical farming methods, such irrigating crops with effluent and drainage waters. On the other hand, there are numerous hydroponic farming companies operate in India, not only cultivating crops but also offering a range of services like supplying kits and equipment for hydroponic farming, setting up hydroponic farms, offering workshops and training, and offering comprehensive solutions for any problems or inquiries pertaining to hydroponic farming. Their shared goal is to make India's agriculture sustainable and to supply the populace with food that is pesticide-free, hygienic, and nutritious. They should consider the ethics in farming by meeting the standard set by FAO.

References

1. Aditya Chaudhary. (2013, Februrary 1). Soilless Gardening. *Soilless Gardening in India*, pp. 1-48.

2. Anil Kumar et al. (2020). A review on scope and potentiality of vertical farming in India. *Journal of Pharmacognosy and Phytochemistry*, 766-770.

3. Bikram Pradhan and Bandita Deo. (2019). Soilless farming – the next generation green revolution . *Current science*, 728-732.

4. Chiranjeevi Kulkarni. (2023, october 25). *Research flags heavy metal contamination in vegetables across Bengaluru*. Retrieved from deccan herald: https://www.deccanherald.com/india/karnataka/bengaluru/research-flags-heavy-metal-contamination-in-vegetables-across-bengaluru-2740180

5. Forbes. (2023, November 11). *How India's hydroponic farmers are building businesses*. Retrieved from Forbes: https://greenstories.co.in/how-indias-hydroponic-farmers-are-building-businesses/

6. pc vinoj kumar. (2023, november 5). *This hi-tech farmer promotes hydroponics and reaps a turnover of Rs 2 crore*. Retrieved from https://www.theweekendleader.com/: https://www.theweekendleader.com/Success/2643/urban-farmers.html

7. Singh Rohit Umashankar et al. (2020). Vertical Farming Proposal in India. *International Research Journal of Engineering and Technology* , 5629-5639.

8. *Top Hydroponics companies in India*. (2023, november 12). Retrieved from timesofagriculture.in: https://timesofagriculture.in/top-hydroponics-companies-in-india/#google_vignette

9. Vivek Shukla. (2021, november 29). *Hydroponics farming in India- Furture Farming*. Retrieved from risehydroponics.in: www.risehydroponics.in