



SOILLESS FARMING

In This Issue

Soilless farming: Evolving market dynamics holds potential to transform the horticultural ecosystem

Challenges for soilless farming and industry preparedness to address these challenges

Advances in Soilless farming technology provide avenues for business expansion

How Sathguru can help

Agri Spotlight

Sathguru Management Consultants Pvt Ltd

+91 40 6627 6200

agribusiness@sathguru.com
vijayp@sathguru.com

www.sathguru.com

Soilless farming - An Introduction

The art and science of growing crops without soil is called “soilless farming” fundamentally referring to the technology of not having soil as the rooting medium. The plants receive their nutrition through a nutrient solution, that is recycled and the excess of which is drained off, recycled, and reused. This not only controls the nutrient uptake but also saves water and optimizes the need for pesticides. It also saves time, space, labour and renders pollution free plants which can be traced back to their source. Soilless farming systems help to obtain better produce quality and higher yields. Soilless farming is not affected or restricted by natural conditions and does not depend on the type of soil or the quantum of available water and hence can be implemented across the globe irrespective of the climatic conditions. Soilless cultivation addresses challenges posed by soil-based agriculture such as soil-borne diseases, soil degradation and limited water availability. It can reduce the environmental impacts posed by conventional agriculture.

There are mainly three soilless production systems commonly used which include hydroponics (use of water), aeroponics (a subset of hydroponics using mist rather than running water) and aquaponics (food production system that combines hydroponics and aquaculture that raises marine life in a symbiotic system with plants). High-tech greenhouse setups offer a potential to control the required supply of nutrients and plant protection production as well as enable year round production. These farms are set up mostly in urban or peri-urban settings with different business models. The adoption of these technologies depends on the ease of implementation, accessibility, competitive cost effectiveness as well as consumer benefits from the quality produce using soilless cultivation.

Soilless farming: Evolving market dynamics holds potential to transform the horticultural ecosystem



Soilless farming has the potential to transform the development of urban horticulture offering fresh, safe, healthy, and residue free produce. The technology has the potential to address countries diminishing availability of additional agricultural land, fertile soil to meet the demands of the ever growing population. Soilless cultivation is the best choice to overcome the problems of soil and for efficient utilization of water and nutrients.

The Indian agribusiness ecosystem has witnessed a significant evolution in the soil less farming industry in the last five years. Today more than 40 commercial hydroponic farms are operating actively across the country. These farms are largely concentrated in the outskirts of metro and Tier I cities close to the demand centers for ease of logistics. Albeit the industry is still in its nascent stages with low awareness levels and minimal competition, the southern and western belts of India are home to a majority of these farms. The Indian hydroponics market (the major form of soilless cultivation) is expected

2027. Changing dietary diversity of the health-conscious urban consumers, high disposable income, urge to adopt an improved lifestyle among urban consumers and growing awareness for healthy low-carb, keto/detox diet and organic menus have significantly increased demand for residue free leafy and exotic vegetables. This, coupled with the entry of more salad-based outlets are creating opportunities for hydroponic farms. India is importing 85% of its exotic vegetables and which is further expected to grow at a rate of 15 – 20% per year. Moreover, salad consumption has increased by 25-30% in the last 5 years. The major crops being grown using hydroponic systems include leafy greens like lettuce, pakchoi, arugula and Italian herbs, as well as vegetables like tomatoes, cucumbers, bell peppers. Cherry tomatoes, bell peppers and cucumbers account for the major share in terms of volume and value followed by the leafy greens like lettuce. Companies prefer to grow leafy greens owing to short crop cycles, less space requirement and easier management. Nutrient film techniques are the most popular technology being adopted by farms in the Indian market owing to their low cost and high productivity nature. Drip system, ebb & flow/flood drain system are the other popular technologies used. A varied range of growth mediums is used as substitute

for soil in soilless farming systems like coco coir, perlite, wood, rice husk, rock wool, sand, peat moss among others.

Industry research indicates that hydroponic farming is largely B2B business with 90 – 95% catering to demand of HoReCa (hotel, restaurant and café) and organized retail. Organized retailers and high-end specialty grocery stores offer better margins to hydroponic growers compared to HoReCa, while prices remain low and undifferentiated in the case of unorganized retail. However, attracting potential customers for organized retail shopping demands for innovative packaging and organizing awareness building initiatives.



A path-breaking concept of self-sustaining food parks within the peri-urban limits of large cities using different models of soilless (protected cultivation) farming technologies to produce and provide clean and organic fresh vegetables for the nearby cities and towns are expected



expected to drive growth for the industry. Tier II and Tier III cities are also expected to follow a similar disrupting trend in the coming years. The demand for hydroponically grown vegetables is growing faster than the rate at which farms are being built, creating a lot of opportunities for new players to dive in and offer clean and safer produce for the niche customers. Today companies like Barton Breeze and Envirevo Agritech are offering innovative solutions for the urban farmers by setting up rooftop farms equipped with remote-controlled systems and automated indoor farms for residential/commercial buildings, respectively.

In India, companies are evolving and bringing in state of the art technologies to soilless cultivation farms for improving efficiency and better management of these farms. AI based technologies are being deployed for seed profiling to determine the best germination rate, measuring optimal nutrient quantity, humidity and water content, maintaining pH levels and lectrical conductivity etc

Precision Artificial Intelligence (AI) technologies are further expected to improve the efficiency of hydroponic farms by enabling automated feed control and monitoring and thus reliving farmers from giving constant attention. Investments in startups working on AI in soilless farming models (primarily hydroponics) are also witnessing an upward surge. Agro2o is planning to launch smart hydroponic gardens equipped with IoT and AI growing algorithms to drive efficiency and optimize yields. Farm management software is being deployed which can alert the farmers on pest attacks, level of infestation as well as align approximate date of harvests and expected yield. More recent technologies include robots to determine the ripeness level of fruits for targeted harvesting, for weed detection and removal etc.

As more and more start-ups enter the space with innovative solutions, the sector is sure to witness a fast growth in the coming years with the doption of advanced technology. Automated technologies and systems will be the driving factor for transitioning into

urban modern tech farming thereby aiding to meet the demands of the growing urban population. The round the year production possibility makes soilless farming systems more promising to meet the needs of growing horticulture produce. With government promoting subsidies for soilless cultivation farms, more and more entrepreneurs are leveraging the opportunity to establish commercial hydroponic farms across the major tier I cities by collaborating with regional producers and international technology providers. The growth in the sector will parallel witness growth in demand for high quality seeds for these exotic leafy greens and vegetables as well as formulations for nutrients and pesticide for effective delivery under hydroponic systems. This opens up opportunities for the agri input industry to be prepared with novel products customized for the requirements of the soilless farming industry. Soilless cultivation technologies have the potential to transform the urban horticulture scenario.



Challenges for soilless farming and industry preparedness to address these challenges

Soilless farming is an innovative technology that forgoes the soil associated challenges such as poor soil quality, soil pests, soil arability, etc that hamper the growth of the plants. Although soilless farming has quite a few advantages over traditional farming, its adoption as an alternative farming technique has not been smooth, which might be attributed to:

- **High Initial Capital Costs:** Initial investments for setting up the infrastructure for soilless farming is very high and depends on the complexity of technological inputs for various types of set-up. The maintenance costs is also high owing to the use of electricity, lights and maintenance of a controlled environment.
- **Expert Knowledge:** Soilless farming requires skilled labour to maintain appropriate growing conditions to cultivate the plants. Plants react very quickly to poor/good nutrition, so the person must have the requisite **expert level** knowledge for maintaining the controlled environment and troubleshooting, if required. It is critical that the **expert** has the knowledge of the technical know-how for successful operations of soilless farming.
- **Optimization for each**



crop: For soilless farming, optimization needs to be done for every crop as it is uncertain, how each crop will react to the absence of soil. Also, the nutrient uptake and environmental conditions for achieving higher yields must be optimized for each crop. Soil microbes play an important role in nutrient uptake and the final composition of nutrients in the plants. The crop physiology and agronomy needs to be thoroughly studied and replicated. As the crops are grown in closed systems, manual pollination is relied on which is expensive and tedious.

- **Water and nutrient requirements:** Nutrient costs are high and nutrient solutions must be optimized for every crop. The water required for soilless farming should be of a specific quality, otherwise the yields will be affected. The costs for maintaining good quality of water also adds to the operational costs.
- **Disease Management:** Although soilless farming restricts the soil borne diseases, any other disease due to non-maintenance of proper growing environment

will spread rapidly within a confined condition due to shared water and nutrients. This will lead to poor yields and affect the economic returns adversely.

In places with mild climate variation, and where low-tech greenhouses are currently in use, the use of soilless farming is not justified as the costs of soilless systems are not always recovered by higher yields; other factor such as high equipment costs and low return on investments may limit production. Unless there are critical problems with soil, water shortage or the environmental pollution by nutrient leaching is serious (Savvas and Gruda, 2018), the wide commercial adoption of this technology will be limited. To address these challenges, the industry is optimizing solutions such as use of LED lights to reduce electricity consumption and lesser heat emission to reduce the carbon footprint. Artificial intelligence (AI) and Machine learning (ML) are being explored for optimizing conditions for soilless farming to reduce the reliability on skilled labour. Extensive research is being done on managing diseases, nutrient uptake and maintaining quality of water.

Indian industry players have been actively adopting global technologies and working on solutions to overcome these challenges. To ensure that the plants do not suffer from stress

or strain of less and over watering, Jain Irrigation Systems has designed a suitable and affordable grower which protects the plants and delivers a measured quantity of water at the root zone of each plant at regular intervals. ITC also has developed a system where the water used for hydroponics may be reused after peroxide disinfection and nutrient

reintegration through conductivity control allow the utilization of water and nutrients that otherwise would be lost. Another example is the production of high quality sweet potato seed production by Central Potato Research Institute using aeroponics. The aeroponic system offers the potential to 3-4 times increase in the number of minitubers per plant.

Industry has been working relentlessly on overcoming the challenges and the Government has also been supporting these efforts by providing subsidies. Overcoming the various challenges will definitely boost the adoption of soilless farming and change the farming outlook across the globe.

Advances in Soilless farming technology provide avenues for business expansion



Soilless cultivation has proven to be a viable alternative for the agricultural production sector and is a growing niche industry. Currently, it is being widely used for production of different vegetables and fruits like various berries. Recent studies have also demonstrated the success of simple low-cost hydroponic system to produce quality green fodder. The soilless farming industry is collectively referred to as controlled environment agriculture (CEA). An ideal indoor farm requires controlled environment with respect to lighting, temperature, pollination, and proper arrangement of plants and needs a high initial investment for the infrastructure, equipment and

devices and is one of the major limitations for indoor farming. New technologies are required to decrease carbon footprint in indoor farming. Several studies are being conducted for different technologies used in indoor farming and to study the impact of these technologies on the shelf life of plants and the quality of the produce. Such advancements in technology and operations can drive optimization of the production costs of CEA. Few of those technologies are described below:

- **LED lighting systems:** Light-emitting diodes (LEDs) made vertical farming a possibility. In recent years, research on LEDs has highlighted their potential as a lighting system for plant growth and development. LEDs have replaced the conventional lighting technologies and also turned out to be the main component in many indoor and protected environments and resulted in rapid technological

evolution in the horticultural lighting industry. Energy saving is an important factor for growers for controlling costs when using artificial lighting for plant cultivation. Current LED technologies provide 28% efficiency and need to improve to at least 50-60 % for indoor farming to become cost effective for a variety of crops. Advances in water cooled LED lighting system that can be combined to heat recovery system are being developed to reduce the heat generated by LED lighting system. This kind of technological development could significantly change the economics and environmental footprint of vertical farming. LED grow lights and systems have the potential to maximize growth at an industrial scale.

- **Fibre Optic technology:** The usage of optical fibres is limited in indoor farming and is currently being explored for using them for daylighting. Though artificial light is a

popular choice for increasing and sustaining yields in vertical farms, natural light is still considered optimal for photosynthesis. Optical fibre daylighting systems (OFDs) utilizes optical fibres as a light delivery method. However, the technology is still developing and may soon replace electric grow lights.

- **Artificial Intelligence (AI) and Machine learning (ML):** AI and ML are being used to optimize growing conditions and improve efficiency. AI can determine optimum growth for a plant and can recreate its growth trajectory. End to end automation is expected to become a viable reality in soil less farming technologies. Artificial intelligence can improve efficiency and reduce the costs associated with soilless farming, and also aid in optimizing the nutritional value of the crops.

- **Underground farming:** This technology utilizes the concept of CEA technologies and aims to create a stable underground environment where food is grown in constant, predictable and sustainable ways. This is a recent trend and an opportunity to be explored by companies.

A growing awareness and the focus on healthier lifestyles amongst people in India will help producers utilizing soilless farming techniques to achieve business profitability in the long term. With the technological developments happening in this area, it is expected that these new technologies offer higher yields per plant, and, in the long-term, at a significantly lower cost. The technologies can considerably decrease the seed production costs that will prove beneficial for the seed companies as currently they rely on conventional and contract farming on which they have

limited control. This is an exciting opportunity for seed companies to explore the seed production both for use in CEA as well as in the conventional settings helping them in reducing the cost and increasing the quality and volume of the seed produced all-round the year. Developing nations such as India, are anticipated to offer substantial growth opportunities for this kind of farming techniques. CEA has the potential to generate differentiated and quality products with competitive pricing and a more resilient, traceable, and trustworthy supply chain for quality produce – both seeds as well as safe and healthy food products.

How Sathguru can help



Opportunity assessment



Growth plan development



Technology access



Business plan development

AGRI SPOTLIGHT

Landmark acquisition to strengthen category of nutrient use efficiency products

Verdesian Life Sciences announced that it has acquired Cytozyme Laboratories, Inc. which will help in firming its position as The Nutrient Use Efficiency People. The acquisition helps in strengthening Verdesian portfolio of nutrient use efficiency technologies. This innovative new range of treatments will help in increasing yield of crops, building sustainability by augmenting soil health, stimulating seedlings and optimising plant performance

[Read More](#)

Nutrition rich super wheat varieties developed at SHUATS

Two semi dwarf, high yielding varieties, SHIATS-W6 and SHUATS-W10, that are sugar free, high in nutrition with high protein, zinc, iron, fiber contents, that use less water and are resistant to extreme Indian weather conditions were developed by a scientist at Sam Higginbottom University of Agriculture, Technology and Science (SHUATS). UP state Variety Release Committee has also formally released these two varieties for cultivation.

[Read More](#)

DNA of lettuce unravelled: The Journey from weed to table vegetable

Wageningen University & Research and the Chinese BGI carried out DNA analysis of 445 types of lettuce and is published in Nature Genetics. The study indicates that modern varieties of cultivated lettuces mostly resemble their wild predecessor *Lactuca serriola* from the Caucasus and the first cultivated lettuces must have been grown for seed and used for oil. Determining the DNA order of the material, in collections of Centre for Genetic Resources, the Netherlands (CGN), a part of WUR, will help science to trace the traits hidden until now, in thousands of varieties and wild populations of lettuce and other crops. This opens up the door for faster and more effective breeding of more resilient food crops.

[Read More](#)

Microsoft Corp signs MOU with Government to provide post-harvest management solutions

The use of bio-capsules will help to reduce the use of pesticides and chemical fertilizers in addition to improving soil quality and environmental conditions. The patent was issued for the method after detailed examination and analysis of the technology developed by the scientists of Indian Institute of Spices Research (IISR). IISR Bio-capsule is the first encapsulated bio fertilizer. The patented product is used for cultivation of spices, vegetables and other crops

[Read More](#)

Covid-19 Pandemic boosts vertical farming industry

As the pandemic is affecting people's health, vertical farming companies are using measures to ensure that the crops are growing safely. Also, the development of hydroponics and aquaponics has boosted the food security level. Through their automated farms, vertical farming companies are capable to flex their supply chain and are thriving in these testing times.

[Read More](#)

New patent for identification and detection of polymorphisms to enable streamlined and multiplex library preparation for sequencing

USPTO granted to KeyGene U.S. Patent No. 10,978,175 entitled "Strategies for high throughput identification and detection of polymorphisms, which covers a synthetic double-stranded adapter comprising a 3'-T overhang and an identifier sequence. These adapters find application in many workflows of Next Generation Sequencing methods, having a wide reach in medical and agricultural research and diagnostics, including scoring SNP markers linked to valuable traits in crops and animals as well as for detection of specific mutations associated with human diseases.

[Read More](#)

Wild barley accessions from Jordan exhibits high level of stem rust resistance

A recent study from the University of Minnesota has made advances in identifying resistance in barley to Ug99 races. A significant discovery found that a single dominant gene, Rpg7 was responsible for the high levels of resistance against stem rust. This gene will be a valuable addition to breeding programs.

[Read More](#)

Govt. expects rise in fertilizer consumption by 10% this year

Following a bumper harvest of rabi crop it is expected that there would be 10% rise in fertilizer consumption this year as farmers are planting more for the next season. The fertilizer consumption including urea has been assessed at 35.12 million tonnes with urea at 17.75 million tonnes, DAP at 6.51 million tonnes, MoP at 2.02 million tonnes, NPK at 6.19 million tonnes and SSP at 2.64 million tonnes.

[Read More](#)

Covid disruptions raises concern amongst seed companies before the start of sowing period

May-June are the critical months for the seed companies which procure the seeds from the farmers, situated mostly in the south, and distribute them across the country ahead of sowing season. Due to the current rising Covid cases, manpower has been hampered and the curbs on movement will further hamper impact the seed industry. Seed renewal delays are also a concern and so, NSAI has requested the State governments to approve the hybrids and give licenses for the season via video conferencing.

[Read More](#)

Another Nano Urea Plant now in Phulpur-IFFCO

Field reports on the efficacy of nano range of fertilizers were encouraging and stimulated IFFCO to set up another Nano Urea Plant, now in Phulpur for which the Bhoomi poojan was completed virtually. The first nano plant was set up at Kalol and IFFCO is gearing up to launch the Nano range commercially from this year.

[Read More](#)

Record prices for mustard produce cheering the growers

Farmers hold back the produce expecting further rise in rates and the price hike is attributed to rising edible oil demand, global price trends, speculation on the commodity exchanges and lower arrivals in the markets.

[Read More](#)

Kamatan acquired by Samunnati in an all stock deal

Kamatan, a logistics and supply chain company focusing on building agri chain solutions for small farmers across the country was completely acquired by Chennai-based Samunnati, a non-banking financial and value chain startup focused in a share swap deal. Samunnati plans to increase its outreach to new farmer producer organisations (FPOs), small traders, farmer aggregators, and agri SMEs across the country leveraging this acquisition.

[Read More](#)

India's first digital soil map promises to boost agriculture

The soil map created by IIT Kharagpur along with other institutes, is a digitally accessible resource that allows the prediction of soil properties even when field data is not available. The data is based on the collective data accumulated over the past three decades. It combines field and laboratory data with geographical and environmental information, and eventually uses mathematical modelling tools to infer soil properties for a location.

[Read More](#)

Kerala Startup has traceability feature facilitating monitoring of pesticide-free fruits and vegetables

The Kerala based startup, Farmers Fresh Zon, provides access to safe-to-eat fruits and vegetables that are directly sourced from the farmers to the urban customers. They have been disrupting the highly unorganised agriculture sector with their unique features of facilitating regular checks to ensure non-toxic and pesticide-free products.

[Read More](#)

SATHGURU INSIGHTS

Our sectoral expertise and multi-disciplinary team aids in holistic support services to advance your business



Blogs



Vertical Farming - A farming practice with lots of potential and untapped opportunity for growing fruits and vegetables



Increasing Relevance of Hydroponics



Growing Soilless

Reach us at agribusiness@sathguru.com or vijayp@sathguru.com

Disclaimer:

The articles are a consolidation of the news gathered from various sources on the particular subject which have not been independently verified by Sathguru Management Consultants. Neither Sathguru nor any person associated with either, makes any expressed or implied representation or warranty with respect to the sufficiency, accuracy, completeness or reasonableness of information set forth in this document, nor do they owe any duty of care to any recipient of this publication. This publication does not in any way constitute the provision of professional advice. Sathguru is not liable for any loss or damage howsoever caused by relying on information provided in this document. This document has been prepared without prejudice. All the images are used only for representational purpose and copyrights rests with respective owners.