

Impacts of COVID-19 on Vertical Farming in India

Drishti Kohli

ABSTRACT

Vertical farming has created hype since its spontaneous introduction in India and so does the COVID 19. However, during the pandemic, businesses, and start-ups of every industry suffered negatively.

Likewise, the agriculture sector of India faced the consequences even when it was excluded from lockdown restrictions. But in researches, it has also been found that vertical farming was flourishing even in the pandemic.

The objective of this dissertation is to bring out precise implications of COVID 19 on Vertical Farming Start-ups In India.

The first research question was to investigate what leads to the growth of vertical farming businesses during the pandemic. The second research question was to evaluate the reason why farmers faced consequences even when the agricultural sector was excluded from lockdown restrictions.

The final research question was to find out how vertical farming businesses are flourishing when the entire agricultural sector was suffering from losses. This paper attempts to understand the implications of COVID 19 on vertical farming start-ups as well as bridges the gap between the sufferings of the agriculture sector and growth opportunity for vertical farming businesses.

KEYWORDS – COVID 19 , Agriculture , Vertical Farming

JEL Classification - Q16 , Q15 , Q13

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I. INTRODUCTION

The creation of an effective agrarian program known as vertical farming suggests that it is promising for populations suffering from acute food vulnerabilities.

Earlier in studies, it was found that Vertical Farming is a limited solution to global food shortages as well as its influence on oppressed people from metropolitan areas. [1] But when vertical farming started growing it was clear that vertical farming has the potential to take over global food demand.

Furthermore, the implementation of Vertical Farming to metropolitan areas was expanding. Vertical farming has been the farming of crops perpendicularly employing modern farming practices, that further incorporate the building design or even farms in a greater configuration within towns. [2]

Social scientists and representatives from the agriculture sector asserted that urban areas would require to feed the population from within in need to answer to rising population and eliminate suffocating overcrowding, toxic environmental damage but also expensive food costs.

Recent revelations in farming techniques like hydroponics, aeroponics, and aquaponics has created a lot of potential for the vertical farming prototype [3]. In India, entrepreneurs and people interested in farming have created their own vertical farms and in the last few years, agriculture has become a potential business.

In the current scenario, vertical farming requires a specific type of light (mainly growing lights), a piece of enclosed land, a controllable temperature, and a nutritious solution to grow plants. Since the requirements were not very huge, vertical farming and its organic produce created huge hype all over the world.

The connectivity of organic food manufacturing more and more into densely populated urban areas was seen as a channel well with the greatest amount of people. At the same time, it helps to alleviate poverty, contributes to safe food & boosts pragmatic conservation as well as the well-being of living organisms [4]. Moreover, given the consciousness of people regarding health almost 80% of established vertical farms were flourishing until the wave of the pandemic.

The pandemic started in 2019 named COVID 19 by World Health Organisation (WHO) which was followed by lockdowns and ultimately created havoc in the economy. Although, the vertical farms which were established well in the country, even suffered from the implications of the pandemic.

The concept of Vertical Farming didn't appear overnight neither it's a new concept , step by step there was discoveries, invention and evolution and the result output was the vertical farming method.

As a proof ,During the World War II, the Allied forces stationed at South Pacific Islands and the food provided to them was produced by hydroponic system. But it was actually coined by an American geologist named Gilbert Ellis Bailey as "vertical farming" in 1915.

- Initially , people had less choice of food such as the leafy vegetables were available in spring , nuts in autumn etc. It was the introduction of agriculture that people started to cultivate and looking forward to produce the food they prefer themselves.
- Further , it was figured that there are certain criteria of growing plants like taste and preferences, if it's easy to harvest or not , production yields etc. Then people started exporting and importing food products.
- Then people took the road of innovation and in 20th century growers came up with toxic chemicals in order to boost their production and to safe them from insects , pests , rodents etc.
- On the road of innovation came the hindrances when climate started to interfere and started limiting the plant growth and the nutritional value of it.
- Greenhouses were introduced but the issue remained unsolved because even in greenhouses if there is bad weather outside then it is more likely to change the temperature within the greenhouse.
- Later on , the health of soil started deteriorating and the need for something more optimum risen. Then scientists and engineers came up with things like soil-less plantation , artificial illumination etc.
- Since there were already alterations were done with the plants like HYV, more alterations with plants in order to adjust in changing atmosphere was not easy so a whole new system of indoor farming was introduced.

Working with Replacements

Vertical farming can be done by any farmer no matter what he can afford or how much education they are having . Vertical farming is apparently about the setup and can be done even on a small piece of land. The objective of indoor farming comes back to the fulfillment of shortage of food across the plant.

1. Replacement of Natural Surroundings

Vertical Farming in a safe, excellently-monitored as well as controlled atmosphere provides confidence and contentment to farmers ensuring verifiable customisable process.

- After suppressing the involvement of natural forces, nothing with 'seasonal crop' exists and farmers therefore doesn't experience failures when they continue to expand the growing cycles of 'seasonal crop.'
- Vertical farming can also effectively decrease harvesting time of crops and increase quantity without sacrificing with quality or taste, that stays 100% constant.

In reality, when the indoor farming system is built and dealt with properly. flavour and nutritional value have reliably proved to demonstrate the enhanced qualities.

2. Replacement of Toxic Chemicals

Producing farm produce in a vertical farm, if properly handled, provides the ability to fully eradicate the compulsion for pesticides-because pests cannot penetrate a monitored and enclosed ecosystem to inflict harm to the crops as well as any disease-causing fungi would also be struggling in establishment of their base when moisture rates are handled.

In simple words, vertical farms are an indoor farm where there is lesser chance of pest / rodent / insect attacks. Chemicals like herbicides, weedicides, insecticides, pesticides etc are not required.

3. Replacement of Soil

In order to give nutrition to the plants , there is a special nutritional-fluid in which the roots of the plants are dipped. The plant absorbs the nutrition from the fluid and survive. This makes the nutritional value of the output from those plants even more.

4. Replacement of Sunlight

The plants carryout a process called “photosynthesis” by which they make their food and sent it to different parts of the plants. It is done in the presence of sunlight which clearly demonstrate the importance of the light from the sun.

In the place of sunlight , in vertical farms there are artificial lights generally called as “LED Lights” and they should have a specified color in order to help plant in flourishing. The colors are mainly blue or pink.

Since the very beginning , agriculture wasn't “natural” , it was something introduced a human brain. Similarly , Vertical farming is also not “natural” but is invented by a human brain. Although, it might seem very doubtful , new and risky but it does have the potential.

Given the land is limited and also the soil has been deteriorating at a very faster rate with an ever-changing climatic condition. The techniques of Vertical farming have gotten potential and if followed in the right way, then it will surely help in managing the burden on land.

II. OBJECTIVE

The objective of this dissertation is to bring out precise implications Of COVID 19 On Vertical Farming Start-ups In India.

There are three primary objective of the study -

- The first research question was to investigate what leads to the growth of vertical farming businesses during the pandemic
- The second research question was to evaluate the reason why farmers faced consequences even when the agricultural sector was excluded from lockdown restrictions
- The final research question was to find out how vertical farming businesses are flourishing when the entire agricultural sector is suffering from losses.

III. RESEARCH METHODOLOGY

Secondary data has been adopted to study the precise implications of COVID 19 on vertical farming start-ups.

The researches stating the implications of COVID 19 on businesses, start-ups, and agriculture sector as a whole were studied.

According to reputable news sources, the taken variable was the sales of the farm products.

Subjects

Indian agriculture sector

Start-ups and businesses of vertical farming in India

Materials

The study used Media Reports from Economic Times, ENTRAKR, CityFarmer, etc.

Relevant research reveals from different journals.

Procedure

The study has been divided into three phases.

The first phase was the negative effect of the pandemic on agricultural sector overall.

The second phase was when the agricultural sector was confronted with the repercussions.

The third phase was the blossoming of the vertical farming business.

The comprehensive investigation was performed through 10 research articles and 15 news stories.

After skimming through a number of reports, it was self - evident that this pandemic was a business opportunity for players involved in modern farming activities.

Relevant digits and records were indeed structured and streamlined.

Data analysis was conducted to plug the gap.

IV. LITERATURE REVIEW

Traditional agricultural practices are no longer efficient. It was found in the studies that by 2025,55% of Indians would be residing in urban areas. The continuously growing population has led to population explosion in the country. On the other hand, due to global warming drastically changes the weather has been seen.

With the continuous depletion in the health of the soil, the food supply could not be supported by traditional agrarian practices [5].

As a result, vertical farming is favored by researchers as an ultimate workaround approach.

As stated by D.Bower and A. Ramaswami in their paper, a Vertical farming approach with optimized techniques for food production could offer decent system-wide water (4 percent) as well as land decline (3 percent) . Moreover, an increase in 50% of the nutritional level of the population.

The agricultural sector is continually sculpting in India. New and improved innovations are gaining power against the pressures of overcrowding, resource extinction, climatological modification, labor shortages, and urban development, contributing to a decline in agricultural land. [6].

For this purpose, there is no information at what percentage vertical farming contributes to the overall food supply.

Coupled with profitability data of start-ups and companies in India like plenty, Infarms,BrightFarms,Surna, etc. , it can be concluded that vertical farming contributes to quite a good amount in food supply for the entire country.

The following info. Acknowledges the importance and contribution of vertical farming in a country like India.

The spread from individual to individual is observed; the infection is referred to as COVID-19 by the World Health Organization (WHO), which is gaining steam locally and globally. The pandemic of the latest coronavirus disease (COVID-19) in 2019 in Wuhan, China had already spread like wildfire all over China. [7]

For safety issues, government authorities ordered 4 national consecutive lockdowns which bought deep misery in the Indian economy. Almost every industry and sector faced a huge consequence because of this.

Whilst also being excluded out from lockout prohibitions, the agricultural sector was affected negatively. Dairy products, poultry, as well as various other associated sectors had also reported setbacks. [8]

It is interesting to note that while all sectors were struck with losses, the demand for vertical farming rises in the meantime. This paper bridges the gap between the crisis and breakdown of businesses and the growth of vertical farming.

V. FINDINGS OF THE STUDY

- **Research Question 1** - The first research question was to investigate what leads to the growth of vertical farming businesses during the pandemic.
- **Analysis** - News articles and appropriate research papers.
- **Results** - The vertical farming business is an innovative way of cultivating and producing agricultural produce.

Working with Replacements

Vertical farming can be done by any farmer no matter what he can afford or how much education they are having. Vertical farming is apparently about the setup and can be done even on a small piece of land. The objective of indoor farming comes back to the fulfillment of a shortage of food across the plant.

Replacement of Natural Surroundings - Vertical Farming in a safe, excellently-monitored, as well as controlled atmosphere, provides confidence and contentment to farmers ensuring the verifiable customizable process.

- After suppressing the involvement of natural forces, nothing with 'seasonal crop' exists and farmers, therefore, don't experience failures when they continue to expand the growing cycles of 'seasonal crop.'
- Vertical farming can also effectively decrease harvesting time of crops and increase quantity without sacrificing quality or taste, that stays 100% constant.

In reality, when the indoor farming system is built and dealt with properly, the flavor and nutritional value have reliably proved to demonstrate the enhanced qualities.

Replacement of Toxic Chemicals

In simple words, vertical farms are an indoor farm where there is a lesser chance of pest/rodent/insect attacks. Chemicals like herbicides, weedicides, insecticides, pesticides, etc are not required.

Replacement of Soil

In order to give nutrition to the plants, there is a special nutritional-fluid in which the roots of the plants are dipped. The plant absorbs the nutrition from the fluid and survive. This makes the nutritional value of the output from those plants even more.

Replacement of Sunlight

In the place of sunlight, in vertical farms there are artificial lights generally called "LED Lights" and they should have a specified color in order to help plant is flourishing. The colors are mainly blue or pink.

Hence, vertical farming businesses were flourishing.

- **Research Question 2** - The second research question was to evaluate the reason why farmers faced consequences even when the agricultural sector was excluded from lockdown restrictions
- **Analysis** - Certain news articles and Professor Madhura Swaminathan's speech in a video on Youtube.
- **Results** - Before analyzing, the variable for agriculture was changed due to the absence of present year data.

From suicides of farmers to sales of agricultural products.

During 2020, the outbreak of COVID 19 was followed by a series of lockdowns.

India being a developing country has a majority of its rural population in the agricultural sector.

The Indian government estimated the impact of lockdown on poor farmers and the finance minister declared an INR 1.7 trillion package for vulnerable people like farmers.

Although, the agricultural sector was somewhat free from the restrictions of lockdown.

But since the agricultural things are fragile and small and marginal farmers did not have the storage facilities.

They were forced to sell their harvest at the lowest cost.

Furthermore, this situation was a growing opportunity for big or rich farmers.

They stored their produce in cold storage to sell when the prices get high.

Similarly, the entrepreneurs in the Agri-tech business saw this situation as a business opportunity and they expanded their business.

The India Agricultural sector was badly hit because it has the majority of poor and marginal farmers.

Moreover, it highly depends on the alliance sector.

On one hand, farmers were free to get the agricultural things to harvest and cultivate the crops.

And on the other hand, transportation was restricted from one state to another. In order to get the real prices of their harvest, they need to get to the 'mandis'.

Due to lockdown, they either could not get to the 'mandis' or their harvest got spoiled before they reach to the mandis.

- **Research Question 3** - The final research question was to find out how vertical farming businesses are flourishing when the entire agricultural sector is suffering from losses.

- **Analysis** - Significant digits and data were compared.

Comparison of factors that influences traditional agricultural practices and modern farming practices.

- **Results** - The vertical farming uses the techniques that do not involve the climatic conditions and nor it have big supply chains.

Some vertical farming startups directly engages with the customer.

Since these farms are majorly set up in urban areas, it is easy to offer takeaways and delivery at the doorstep.

The traditional agriculture faced the consequences of lockdown because there was havoc in the supply chain.

The vertical farms are generally owned by comparatively more educated people and they can make or adopt strategies according to themselves.

Whereas, the marginal or poor farmers have no sense of preparing strategies to cope up with changing environment.

During the pandemic, many climatic changes have been seen such as - rising temperatures, cyclones, thunderstorms, hailstorms, earthquakes, locust attacks, etc.

All these led to the failure of the crops and somehow impacted the agricultural sector.

In contrast to this, vertical farming practice saves their produce from the climatic conditions.

Being harvested in an enclosed environment under artificial devices provides the healthiest organic produce.

The attention in the pandemic was given to the health of the people. Hence, this led to high demand for organic food products. Also, during the lockdown, people tend to consume more which led to a higher demand for agricultural produce.

To sum up, vertical farming startups are flourishing because they protect their crops from changing atmospheric conditions.

Also, they interact with their customers and are willing to send the product at their doorstep whereas farmers doing traditional agricultural practices can't store their harvest to maintain its freshness and incapable of supplying the harvest to their buyers.

VI. DISCUSSION

Summary

- **Research Question 1** - The first research question was to investigate what leads to the growth of vertical farming businesses during the pandemic.

- **Study** - News articles and appropriate research papers.

- **Findings** - The willingness to supply organic food on the doorstep of buyers.

Harvest remains undisturbed by atmospheric conditions

It does not need to change prices since vertical farming produces in a comparatively shorter period.

- **Research Question 2** - The second research question was to evaluate the reason why farmers faced consequences even when the agricultural sector was excluded from lockdown restrictions

- **Study** - Certain news articles and Professor Madhura Swaminathan's speech in a video on Youtube.

- **Findings** - Mainly farmers are poor and have small landholdings.

They are incapable of delivering agricultural produce at the doorstep of their buyers.

They are uneducated and have a lack of resources.

They can't save their produce from atmospheric conditions.

- **Research Question 3** - The final research question was to find out how vertical farming businesses are flourishing when the entire agricultural sector is suffering from losses.

- **Study** - Significant digits and data were compared.

Comparative analysis of factors that could affect traditional agricultural practices and modern farming practices.

- **Results** - The farmers involved in traditional agricultural practices suffered from great losses because of their long supply chain.

Their produce does not have storage facilities and they are unknowledgeable whereas vertical farming is completely opposite.

Interpretation

Explanation 1 - Vertical Farming is more far more innovative.

Explanation 2 - Farmers have a lack of knowledge and resources.

However, both the explanation justifies their question that why vertical farming is thriving and traditional agricultural practices are facing consequences.

Integration

Earlier the researches were done about the overall implication of COVID 19 on India Agricultural Sector and Benefits of Vertical Farming.

This is the first study that focuses on Vertical Farming Business and the implications of COVID 19.

Implications

It was believed that farmers should be given the basic knowledge of agricultural practices.

So far the farmers were taught about the soil, fertilizers, HYV Seeds, etc.

But this study provides a novel perspective: teaching farmers about the vertical farming approach.

This research paper gives rise to the idea of providing all the farmers, enough knowledge, and resources to set up their own vertical farms.

VII. FUTURE SCOPE AND LIMITATION

Future Scope

- Although indoor farming is a comparatively small portion of the sector, it is rising steadily & is expected to increase to exceed \$5.7 billion by 2025, including as the highest growth emerging in the Asia-Pacific region.

- Indoor farming technology is even actually pretty recent. Enterprises are still to generate produce on a level to render it financially affordability to satisfy the increasing demand for food.

- Since at this level when the demand for organic products are so high there is a possibility that a potential market is waiting across the globe. If you have huge capital then this type of business will be the most profitable whereas if you want invest less capital then you should go for simple indoor farming enterprise with some pretty good techniques.

- The most growing and productive type of vertical farming is the production of mushrooms. Temperatures as well as humidity levels regulated environments can only be produced feasibly in restricted areas.

1. **Gearing Up for The Hereafter** -Perhaps till 2049, approximately eighty percent of the population of Earth is anticipated to reside in metropolitan locations . Also, the escalating growth would contribute towards a spike in food demands.

The effective usage of indoor farming could have a major hand in planning and coping up with this task.

2. **Requires Considerably Smaller Supply of Water**- This has already been seen that regions that do not have any exposure to water eventually wind up just being an infertile piece of land, however these areas are very vulnerable to drought, which most often causes somewhat environmental destruction and degradation.

3. **Never Impacted by Extreme Weather Patterns** - Plantation in open fields may be negatively impacted from the natural hazards including heavy downpours, hurricanes, floods or prolonged droughts , occurrences which are much more frequent are a consequence of global warming.

Indoor farms are much least prone to encounter the impact of bad conditions, promising strong confidence of year-round crop production.

4. **Intensifies the Organic Production** - Harvests have always been raised in an excellently-controlled indoor atmosphere beyond the utilization of industrial chemicals, indoor farming enables the growth of insecticide-free and sustainable harvests.

5. **Approachable to Man as Well As The Planet** - Indoor farming will substantially reduce the environmental risks correlated with conventional farming. Growers are however not prone to risks linked to massive farming machinery and tools, infections such as measles, hazardous chemicals and so forth. Because it may neither harm wildlife nor plants of coastal habitats, this is ideal for environmental protection too.

3 Crops That Alone Can Bring Massive Profits

Lettuces- Lettuces provide relatively stable demand throughout much of the planet all across the year as well. perhaps they are pretty simple to grow and flourish in indoor farms is the reason.

Lettuces have always been hundreds of variations of lettuce, causing them convenient to cultivate and provide it to the marketers.

And that is why these are fast and convenient to harvest, unpredictable demand for most of the year. Also, accessible in plenty of various types such that producers can move their crops from every now and then.

Basil – Basil crops are said to be the ideal crops for indoor farming and the reasons are:

- Vulnerable towards cold environment
- Seasonal Crop

However, in indoor farming the temperatures are controllable and with hydroponically, basil can be grown anytime irrespective of the season. Furthermore, in latest studies it has been found that the nutritional value of basil grown in indoor farms are much higher than conventionally grown basil.

Mints and Chives – In initial periods of indoor farming, mints and chives can be grown since these two crops get dense during the time of their harvest as well as they are very convenient to grow. There is a good market for them throughout the planet and their various flavours make their demand consistent.

Although indoor farming is a comparatively small portion of the sector, it is rising steadily & is expected to increase to exceed \$5.7 billion by 2025, including as the highest growth emerging in the Asia-Pacific region.

Indoor farming technology is even actually pretty recent. Enterprises are still to generate produce on a level to render it financially affordable to satisfy the increasing demand for food.

Since at this level when the demand for organic products are so high there is a possibility that a potential market is waiting across the globe. If you have huge capital then this type of business will be the most profitable whereas if you want to invest less capital then you should go for simple indoor farming enterprise with some pretty good techniques.

The following stands to the benefits of Vertical Farming

a. Agricultural Production Throughout the Year

- The foremost advantage of vertical farming is to produce agricultural produce throughout the year. As we know, in conventional farming there are four seasons wherein different parts of the cultivation take place and even if one season ends early or late it can spoil the crop.
- The pollution led to the global warming which causes the sudden change in the weather and depletion of soil quality, hence for the coming years, we could not be depended on conventional farming only.
- All-year round crops can be cultivated in an enclosed and controlled environment by replacing all the necessary things from the artificial things. For example – LED Lights instead of sunlight, nutritional-fluid in the place of soil etc.
- This way, even if any natural calamity occurs there would be much lesser risk than the risk involving in the conventional farms. Many people come up with the “scarcity of arable land” or less “fertile land”, however vertical farming solves this problem too.

b. Abolish Farm Runoff

- In conventional farming, the fertility of land is the top most priority for some farmers and in order to increase that farmers use chemical fertilizers blindly which result in the depletion of the level of fertility of soil in the long run.

So the question arises that if farmers do not enrich their soil with chemicals then how come they produce to fulfil all the demands of people?, is it like that we have to choose one between the health of the soil or human need? , is there any way to take consideration of both the things?

- The vertical farms solve this issue by using no-soil or a very little quantity of soil used by a plant. Hypothetically, if you have indoor farms scattered in few acres of land, all around the globe, then they would be no use of toxins on soil, availability of more land to grow any plant with taking into account the fertility etc. due to which the soil gets time to restore its health.

c. Limits the Usage of Fossil Energy Enormously

Fossil Fuels are in limited quantity in all the nation or in the sense that they are the non-renewable resource gifted by the planet, that has to be taken care of. And agriculture being a repeated process tends to demand more and more for the fuel.

- This might not be possible in developing countries or less developed countries because they still use non-renewable resources for power and renewable source of huge amounts of energy might not be very convenient for them.
- Whereas for developed countries, this advantage fits perfectly. In conventional farming, there are tractors and certain more machinery which are necessary to employ and that consumes huge amount of fossil energy.

d. Utilizes Neglected or Abandoned Lands

- All land masses on earth are not arable land, there are limited amount of lands on which crops can be grown and rest have their special demographic features.
- Since the conventional agriculture approach has been seen since ages and its been decades after agricultural revolution, there are land masses that could not produce now, they have lost their fertility and producing capacity or are barren.
- So, with vertical farming, non-agricultural land can be used to establish the indoor farms and the remaining arable land can be used to make its soil better or vice versa.

e. Offers Sustainability

Sustainability includes usage of resources but also taking future generation into consideration. The vertical farming approach considers the future, maintain soils health, uses less fossil fuels etc. This is the post authentic approach in agricultural sector so far.

f. Purifies Water

Water purification not in literal terms but it does keep the water clean. If there will be no harmful toxins on soils then they neither slow into the sea nor goes down in groundwater.

Now just humans rely on water, even living creature does and vertical farming, makes the environment healthy by keeping the water clean.

g. Provides Employment Opportunities

When a farmer buys a farm then all he has to do is either hire labour and do the cultivation or he himself carry out the whole process of cultivation, generally speaking. But the setup of indoor farm creates huge employment in the economy, there is the need for labours to construct the building, engineers to set up technology, workers at different posts, drivers for commuting services for workers, interior designers to layout the things in best possible way etc.

h. Lowers the Risk of Infection

Infections happen when some harmful bacterial or thing goes into the system of a human body. Sometimes air transmitted diseases occur if you do not wash the food properly before consumption as in conventional farming, the crops are left in open areas and farmers are least bothered about disinfecting the crops in their farms.

And undoubtedly it is not practical.

- So far, the reports have shown that the toxins used on plants and soil in conventional farming are dangerous for the health. It can lead from teeny tiny infection to disease like cancer. But vertical farming uses no chemical and there is very little risk of infection.

i. Restoration of Earth's Assets

- The earth had no pollution before humans existed but as greedy the humans get for their comforts, the earth started losing its health. Mainly the soil gets deteriorated, certain species got extinct etc.

- Vertical farming gives a way to reimburse the resources of the Earth especially the soil. Soil is very important on earth and its deterioration can even kill millions of people with hunger.

j. No Pesticides

In open fields or in conventional farming, the crops are prone to the insects, pests, rodents etc which can also be a reason of failure of crops. Till date, pesticides are used, which is also a toxic chemical used to kill the pests and this can also be the reason for infections.

Vertical farming prohibits the use of pesticides and even practically, in enclosed farm their would be no chance of having pests.

The vertical farming is the only approach in agricultural that is fruitful for both the plants and living organisms. "Desperate times call for desperate measures" and this is time and this is the measure. Moreover, above it has been fully justified by considering the tremendous benefits into account.

VIII. LIMITATIONS

The only limitation of this study is the common problems faced by vertical farming businesses and startups.

1- Challenges Concerning Economic Viability Due to Expenses Are Formed

There would be less workers because citizens wouldn't need to transport vegetables, making more people homeless and growers lose employment.

- Some other downside is the shortage of pollinators in plants which will have to be performed physically.

- Since the pollination needs to be performed by hand, the money paid tend to be pretty huge.

- Setting up of vertical farms in metropolitan cities would raise overall expenditure plus operational costs.

In this regards, acceptance of the development of these farms can increase the value of employment due to extra requirements.

2- Potential Effects on The Ecosystem and Power

Considerations over emissions and sustainability emerge since domestic plants rely on artificial illumination. While the usage of fluorescent lamp or Lighting systems in solar photovoltaic panels decreases the price of power used, it does have its repercussions.

- Such that the consumption of LED growing lighting has improved. there seem to be several vertical farms that use 1000-watt LED growing light lamps.

- In order to respond to such artificial lights, the vertical farms have sophisticated equipment as well as automatic structures. Vertical farming thus needs greater power consumption than open field cultivation.

- Because vertical farming relies over the usage of fossil energy, such activity has much more drastic consequences. Renewable and sustainable power solutions have to be built to assure the environment protection as well as technology performance of vertical farming.

3- Possible Risk to Society and Even Its Peoples

The next risk and drawback seem to be that vertical farming has the ability to sabotage populations that depend on cultivation. Vertical farming may render conventional farm work outdated. Family groups residing beneath poverty threshold as well as the median wage that depends on farming, in terms of direction, would probably fall.

The successful shift to vertical farming involves the production and execution of plans or initiatives targeted at informing policy leaders, the adoption of applicable regulations and laws as well as the incorporation of new trends in agricultural practices.

4- Requirement for Modern Technologies and Dynamic Processes

Creating and running a vertical farm involves the need for different technology associated with large kick-up costs and also the construction of complicated structures. It becomes more costly to establish or even sustain vertical farms versus conventional agricultural farms.

Information technology-related technological innovations may enable for monitoring crops, maintain plants, track yields as well as analyses demand. However, building and running the vertical farms for those with no professional background or experience, resemblance and funding may be daunting.

5- Artificial World Can Malfunction at Any Point of Time.

In the end of the day, depending on technologies may be a big drawback for vertical farms. Since a vertical farm can lose electricity every day, there would be a significant drop of output. It already ensures that vertical farming relies onto a fully-controlled and well as enclosed environment which holds a temperature around 41 ° C and steady moisture content, and therefore that crops cultivated within these vertical farms do die through shortage of power.

5.1- Managing Temperature

The very first problem is towards climate control which vertical farmers should resolve is to decide what more ventilation, intercooling or even heat is needed to maintain the temperature of the growing place. Well into the vertical farming, lights refer to the main form of energy, accompanied by appliances required to control fans, automation and so forth.

Since vertical farms are mostly well-isolated as well as configured to work long and hard during the year and, low temperature is typically needed 24/7 and around the year just to eliminate the heat produced within the room.

Dehumidification is however actively needed to extract the humidity introduced to the atmosphere from either the crops or the irrigation system through evapotranspiration.

The volume and amount of Evapotranspiration entirely depends on a variety of factors, particularly light frequency, humidity and air temperature (or moisture stress insufficiency), movement of air and irrigation. While evapotranspiration is the greatest thing when crops reaches maturity as well as the lighting is on, evapotranspiration doesn't end even when there is no light.

The scale as well as function of dehumidification device would thus consider the potential between the max amount and the minimal level evapotranspiration levels required within the vertical farming.

Structures of heat in the vertical farming are typically required owing to all heat production by lights within the space.

Nevertheless, the air-conditioning system is required for cooling as well as to dehumidify the atmosphere, such device must generate extremely cold air which extract (or compress) moisture from the environment. Most often, farmers don't have to bring the cooler air back to the crops, so they reheat it until air is send it back into the farm. This is perhaps the most burgeoning usage of heating in vertical farming.

5.2- Circulation of Air

The second major problem is to find out what to do about air conditioning in the vertical farm and build a (ideally) consistent growing atmosphere. If shelves are closely packed next to each other — alike horizontally and vertically — it will be impossible to establish consistent standards anywhere.

In the downward direction, crops and light fixtures block the passage of airflow from location to location, frequently tends to result in variations of temperature of atmosphere, moisture and velocity

of air from one side of the tray to another. Whenever the height is vertically low, the airflow restriction is compounded.

On upper edge of it anyway, that air flowing over the shelves grabs warm air including moisture, making it warmer and also stickier through its way. Shorter heights intensify the phenomenon by reducing the quantity of air which could be pushed between rack stages, thus cutting the amount of moisture in the hot air that could be sucked and allows the air to humidify and also moisten much faster.

The consequence:

- a) Significant variations in temperatures and humidity ratios across location 1 to location 2.
- b) The higher the rack, the higher the route for the air and also the stronger the disparity.

Many techniques may be used to promote the air flow well into the vertical farming.

Air flow could also be improved through remembering when air con is inserted into room and also when it is withdrawn until loading with moisture and heat. The form of diffusers of air may also serve to disperse or move air to appropriate positions, and assist to balance cool air below the ground with hot air up to the ceiling to minimize the impact of pile.

5.3- Situation of HVAC Gears

Space issues are not restricted to transferring air conditioning into the stack structure; they also require where or how to position the HVAC appliances. Lot depends on the configuration, the HVAC devices can contain ACs, dehumidifiers, ventilation machines and so forth. Lowering of temperature and removal of moisture from the gas are done through equipment which are ideally installed outside the property, so moisture as well as heat could be released into the outside atmosphere.

The certain machinery is preferably placed on either the top of the building or over the place outside just next to the area this takes up, that tends to minimize duct work. Many machineries have a dedicated location far from the structure to handle bigger machinery. Within the framework and also the vertical farming on its own, greater air circulation may be accomplished if sufficient room is given for duct work, ventilation & circulation of air.

IX. CONCLUSION

In this study, it was investigated what leads to the growth of vertical farming businesses during the pandemic

It was also evaluated why farmers faced consequences even when the agricultural sector was excluded from lockdown restrictions

Furthermore, the study shows how vertical farming businesses are flourishing when the entire agricultural sector is suffering from losses.

The findings that are confirmed are: vertical farming startups are flourishing because they protect their crops from changing atmospheric conditions.

In contrast to traditional farming practices, vertical farming does not have a long supply chain.

Moreover, people engaged in vertical farming are comparatively much educated and are capable of planning strategies to cope up in a dynamic environment.

X. SUGGESTION

Astute Perspective given in the study is: To educate the growers regarding vertical farming and grant them the resources.

More research is required for the allocation of resources, evaluation of vertical farming devices for the farmers, etc.

The government spends crores on farmers but that does not seem very effective. Each year farmer suicides or dies in debt. By exposing the farmers to new Agriculture Technology, will raise the standard of the farmers.

The country would have more organic farm produce that could be used to generate more imports of agricultural commodities. In addition to all of this, India does indeed have a population of young, and most of them are from an engineering background. So, unemployed engineers would get employed.

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