

A Study on Hydroponic Farming in Indian Agriculture

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Abstract

Hydroponics is a method of growing plants in water without soil. It is type of horticulture and subset of Hydroculture. The water must be enriched with nutrients and the plants need some type of inert medium to support the root system. The research gaps were identified after the detailed review of literature. Extant literatures show that Hydroponics farming is more efficient and high yielding. But very limited studies are made in comparison with the traditional farming. Few studies also examined that there is less awareness about Hydroponics farming to the people. Also, there was not detailed study about challenges regarding hydroponics farming and subsidies which help to setup it. Thus, we are trying to fill this gap through our study.

Keywords

Hydroponics, Vertical Farming, Agriculture, Farmers and Subsidy.

1. Introduction

Hydroponic farming is thriving in India. One of the major factors driving its growth is also the technology curve that diminishes costs and helps in scaling its operations. Further, integration of Artificial Intelligence and Data Analytics measure important indicators that help in food/crop planning and hence help connect in the food security ecosystem. Besides the technological factors, the need for creating a smarter and green market in highly populous nations also creates space for hydroponic farming (rooftop or vertical farming) to grow as a trend. Even though the growth of hydroponics in Indian agriculture is rising every year, it seems there is still a large population of farmers who are not much aware about hydroponic systems. In this research paper we try to study the awareness of Indian farmers about

hydroponic farming and the challenges faced by the farmers in implementing hydroponic systems in their farms.

Problem Statements-

Some of the main problems in implementing hydroponic farming in Indian agriculture are

- ◆ Lack of education and less awareness
The lack of education and awareness among farmers about all of these concerns and technical improvements is a major problem. Technical understanding, to the extent of micro-managing temperature and humidity, is required. A single blip in the ambient temperature might result in significant crop losses. Many farmers aren't even aware of hydroponics, let alone how to use it. When we consider that this technology is thriving mostly in the start-up sector of young, Urban Indians, the problem becomes much clearer.
- ◆ Heavy initial investment and maintenance costs
Setting up a hydroponic farm is much more expensive than traditional farming, especially in countries like India. To regulate the environment and cultivate the plants, one needs at least a building-like structure, as well as food-grade plastic trays and tubes. This infrastructure normally costs Rs. 50,000 and above per 1,000 sq. ft. Plumbing systems and automation, such as sensors, controllers, water pumps, and lighting, all have high expenses. Additional requirements include money given to consultants, costs associated with controlling ambient temperature, purifying water, and generating manufactured plant nutrition such as nitrogen, potassium, calcium nitrate, phosphorus, and other micronutrients such as manganese, zinc, and others.
- ◆ Lack of financial support from the Government
Hydroponics require huge investment costs to start so it is unrealistic for an average Indian farmer to cover up all the costs himself. In India, the central and state government have subsidized the capital costs for farmers willing to spend on hydroponics. Also, the exact subsidy appropriate is various for each state. Newly Maharashtra government has rendered a 50% subsidy to farmers to adopt hydroponics for growing animal fodder-Hydroponic Farming. Similarly, the subsidy has prepared for each state separately by the National Horticulture board. But most of these subsidies are credit based and requires the farmer to pay back the amount under a stipulated timeframe. Also, apart from the state Maharashtra the amount of subsidy given by other states are very low for starting hydroponics which discourages the farmers.

1.1 Objectives

The main aim of this research paper was to understand and create awareness about hydroponics and to analyze the challenges faced by hydroponic farmers in India. Following are the objectives which we developed to achieve this aim

- To study the awareness among the people regarding Hydroponics and its benefits.
- To identify the factors determining the shift towards organic produce post Covid.
- To analyze and understand challenges faced by the farmer, schemes and subsidies available to them.

2.Literature Review

There have been many studies on the growing impact of hydroponics in agriculture. Various authors have focused on the hydroponics techniques namely, Drip, Ebb, NFT, their operations; benefits and limitations; performance of different crops (Nisha Sharma, Somen Acharya, Kaushal Kumar, Narendra Singh and O.P.Chaurasia,2018) in which their results revealed that to encourage Hydroponics Farming it is essential to expand less cost hydroponic technology that can reduce reliance on manpower and reduces the overall cost of startup. They came to the conclusion that to encourage Hydroponics Farming it is essential to expand less cost hydroponic technology that can reduce reliance on manpower and reduces the overall cost of startup .The potential of projects on hydroponics in rural areas and large metropolitan cities in scope of opportunities that arise throughout hydroponics was researched by the authors (Panayotis Kinanlis, George Malindretos, 2018) who found out that factors such as current transport infrastructure, production volume, current farming and local demand appear to be to be crucial for success of hydroponics farm. The authors (P.Srivani,Yamuna Devi C, S.H Manjula, 2019) reviewed various physical and environmental variables that influence the plant growth for the sustainable and efficient farming system and came to the conclusion that Soilless agriculture, hydroponics can be implemented efficiently with a Controlled Environment Agriculture System (CEA). The technological progress and improvements in smart farming have provided a platform for successful deployment of CEA. The value of hydroponics given by the consumers has been researched by authors (Gilmour, Daniel. Bazzani, Claudia, Nayga, Rodolfo M., Snell, Heather A., 2019). Their main research

focus was the inclusion of hydroponics in the U.S. Department of Agriculture (USDA) organic program which highlighted about marketing hydroponic crops. From their study they found out that the National Organic Program should consider ways to ensure the stability of organic premiums as perceptions about hydroponics evolve. They concluded that not to recommend that hydroponic farms be banned from organic certification. Huo, Shuhao, Liu, Junzhi studied the influence of microalgae on vegetable production and nutrient removal in greenhouse Hydroponics. The primary objective of their research was to study the effect of microalgae on plant growth and nutrient removal. This effect was assessed for three vegetables (arugula, purple kohlrabi and lettuce) grown entirely using nitrate-rich synthetic wastewater in greenhouse hydroponics. The research was done under the three conditions: Natural microalgae, Microalgae added, and Microalgae-free, the effects of microalgae on vegetable growth and nutrient removal were revealed in greenhouse hydroponics. Their results revealed that Microalgae had a negative effect on arugula growth, but in the purple kohlrabi and lettuce groups, there were no negative effects or even an increase in vegetable production. (Chen, Peng, Zhu, Gaotian, Kim, Hye-Ji) researched on comparative Life cycle assessment aquaponics and hydroponics in the Midwestern united states. Their primary focus was on high productivity and low land and water use, controlled-environment agriculture (CEA) like aquaponics and hydroponics. The research revealed that compared to the environmental performance, on an economic basis, of aquaponics and hydroponics with identical system design in India, US. For a one-month cultivation period, tilapia and six vegetables produced in the aquaponic system had almost twice the total value of the vegetables from the hydroponic system. (Mampholo, Bevly M. Maboko)

We conducted a literature review on researches done on Hydroponic Farming. Literature review of research on the advancements in hydroponic farming allowed us for a wider understanding about the research area and helped us to formulate the research objectives which helped us to achieve our aim. We have set a list of objectives while conducting this literature review. At first, we have identified the characteristics of the literature work. Next, we tried to incorporate the research done in this area of Hydroponics to understand Hydroponic Farming in Indian Agriculture. Finally, we discussed about the gaps existing in the literature for future research work.

3. Methods

Qualitative and quantitative methods were used for the collection of primary and secondary data through conducting field survey google form which was filled by 100 respondents in the Bangalore region. These methods were applied to understand about “Hydroponics in Indian Agriculture”. The questions explored the demographics of the respondents and their awareness on hydroponic farming.

A. Demographic Questions

- a. Name
- b. Age
- c. Occupation
- d. Where do you stay?

B. Questions related to find awareness of hydroponics

- a. Did u know hydroponics is soilless farming?
- b. Did u know that the water used in hydroponics can be reused and recycled?
- c. Do you know hydroponics are grown utilizing all the required nutrients and are safe as other plant productions?
- d. Do you prefer buying hydroponics produces?
- e. Would you be interested in learning about hydroponics?
- f. Do you know about any hydroponic farm near you?

C. Customer Perception towards Organic Produce

- a. Are u willing to pay a small premium for organic produce
- b. Do you prefer organic produce
- c. What is the most important factor when buying produce?
- d. Which purchase method do you prefer?
- e. Which of the following do you prefer?

4. Data Collection

Data collected via two methods:

On field interview with Hydroponic farmers in various cities of urban Bangalore. Survey Google form filled by such 100 respondents in Bangalore.

Questions being asked during in-depth interviews mentioned in 3. Methods.

While survey Google form included question based on total 25 variables; categorized into 3 major factors: -

- Demographic Factors
- Awareness Factors
- Type of Produce

5. Results and Discussion

The Data collected from primary sources indicates that only 42% of the overall population have the knowledge of hydroponics. Out of that 42% only 1/4th are the consumers of hydroponics produce. According to our study, we observed that Hydroponics is still not a widely-practiced technique in India, owing to the traditional nature of farming, high-initial set-up cost, lack of technical know-how, lack of awareness, and the complexity of the technology.

The main concern of any crop cultivation practice should include not only the profit point of view but also the environmental safety. The grower should consider that if he wants to increase the production and productivity, there would always be some consequences to compensate. Thus, he has to maintain the balance. Hydroponics is one of those underrated techniques where all these concerns can be maintained if the farmer is willing to take some initial risks and investment. So, it is clear that this is the time when our farming community should switch to modern terms and techniques from the conventional without thinking that the new is always unacceptable. It is time that the farmers should be encouraged to adopt Hydroponic system in every part of our country.

In the survey conducted, we realized that 56% of people had the knowledge about Hydroponics, and 70% of them were consumers of hydroponic produce, the majority of their demands were met by the E-business & a small portion of the demand was stratified by local producers.

We future surveyed the kind of produce which consumers purchased the most. Greens and leaves had the highest demands followed by Root vegetables and Cruciferous. Out of 4 hydroponics farm we visited only 2 out of 4 farms mainly focused mainly growing greens rest 2 farms had mixture of all the types of vegetables. Growing greens in a large scale had a huge quantity and price advantage.

5.1 Numerical Results

Based on the data we collected and analyzed we identified four factors that affect customer shift toward Hydroponics/ organics produce, namely;

1. Nutrient content
2. Freshness
3. Store Location
4. Health

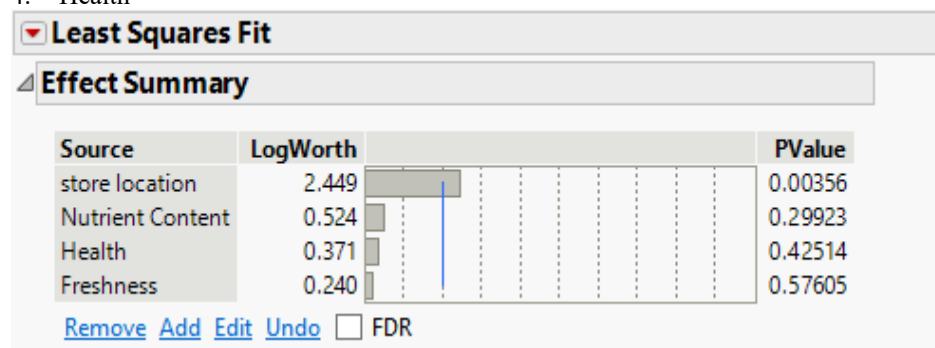


Figure 1: Factors Fit Analysis

The above Figure 1 shows the effects estimated by the model and gives a plot of log worth values for these factors. The p- value is the measure of probability used to find the hypothesis testing (Figure 2).

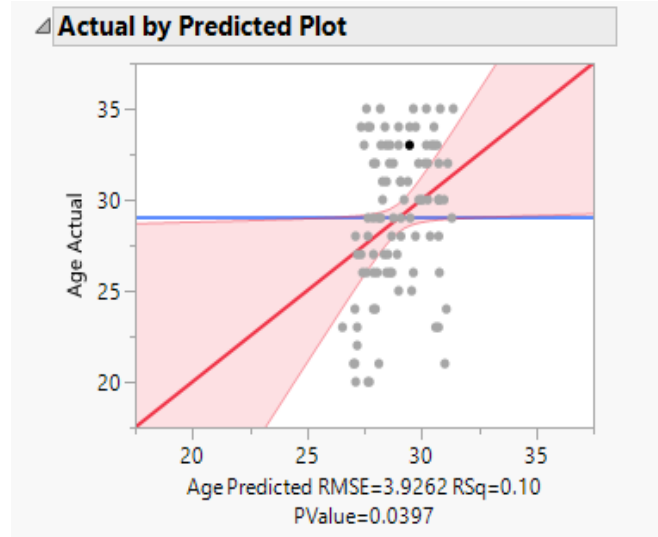


Figure 2: Actual Response vs Predicted Plot

The above graph shows the Plot of Actual response v/s predicted by our model. This graph helps to identify– Outliners, Unusual observant and pattern.

Measure of how far a point is vertically from the regression line. E between Predicted v/s Actual values RMSE (Root Mean Square Error) (Figure 3, 4, 5, 6, 7, 8, 9 and 10).

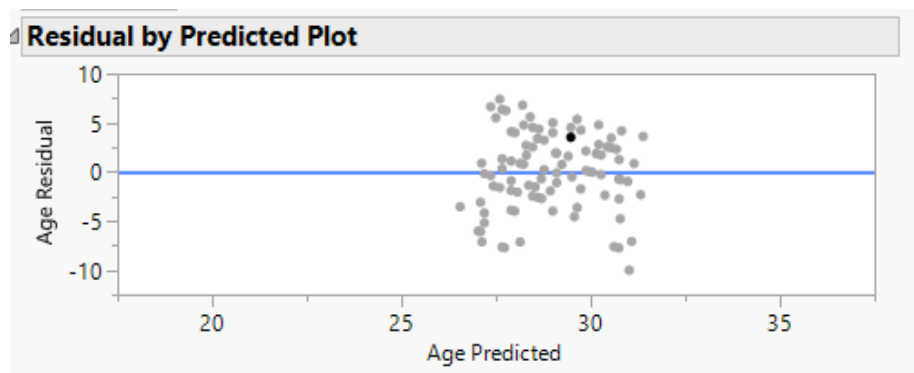


Figure 3: Prediction Plot

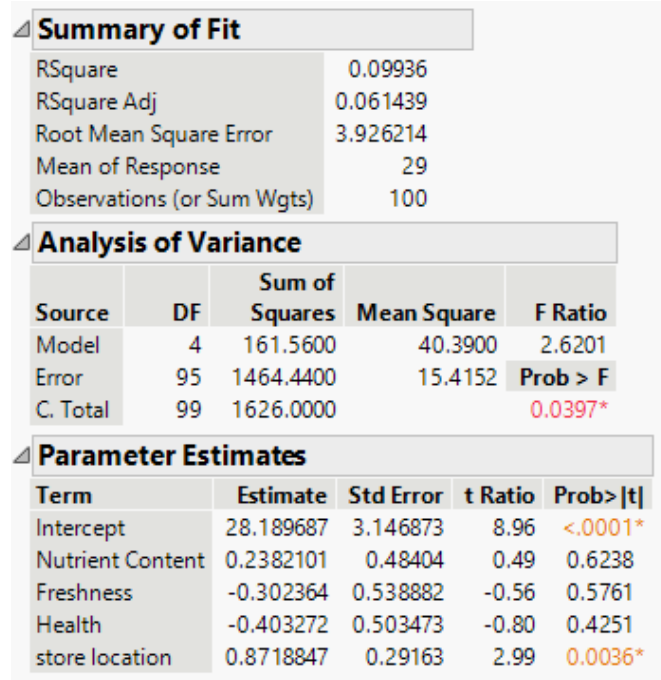


Figure 4: Summary of overall Analysis in JMP Tool

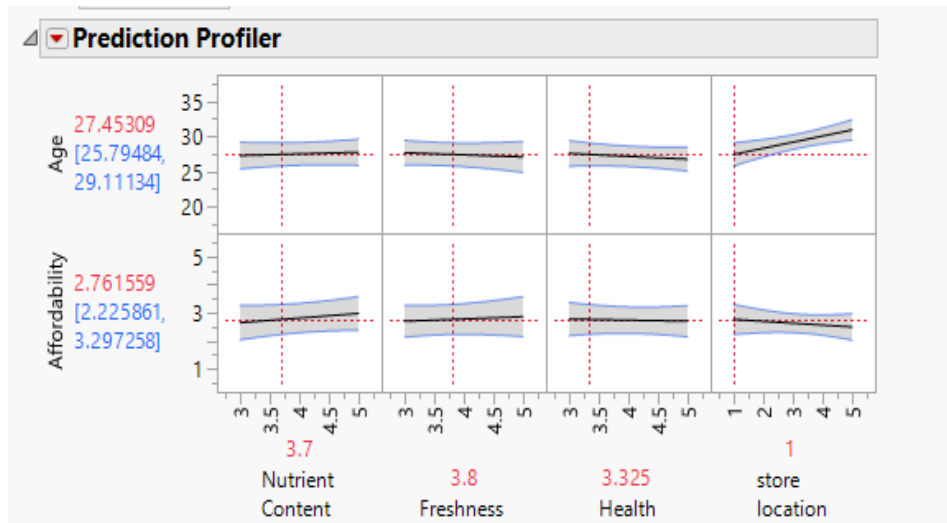


Figure 5: Prediction Profiler

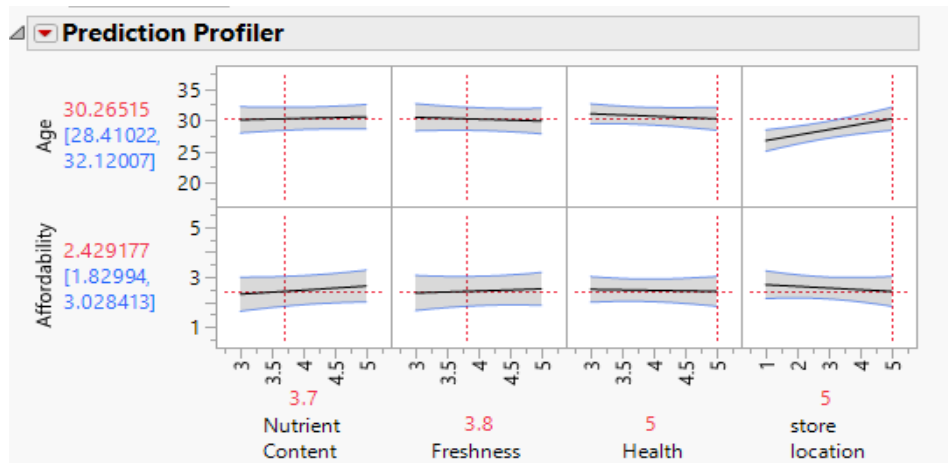


Figure 6. Prediction Profiler

5.2 Graphical Results

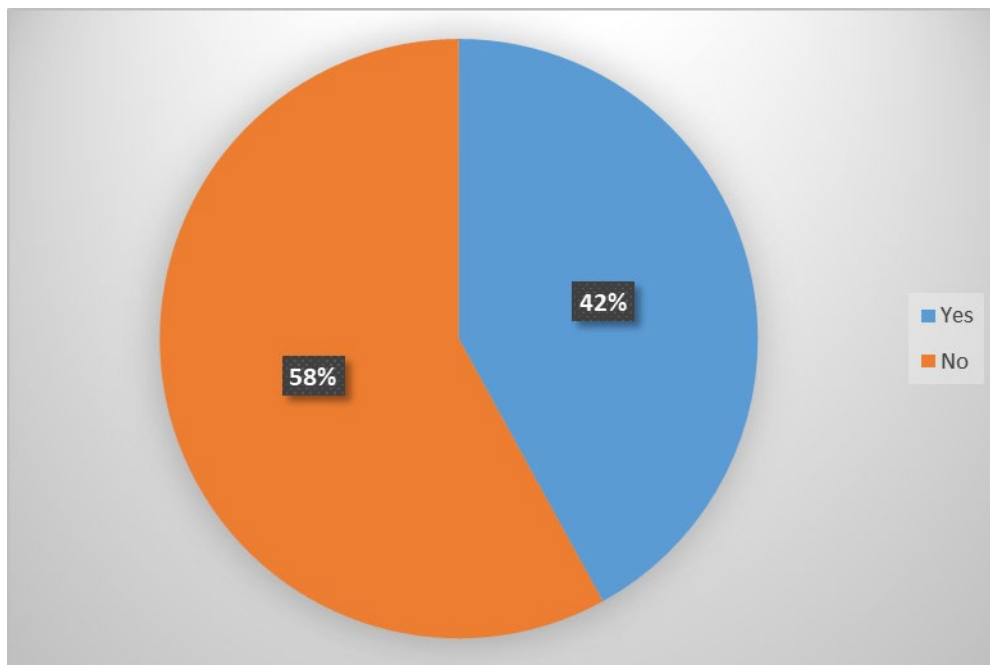


Figure 7.: Study on Awareness

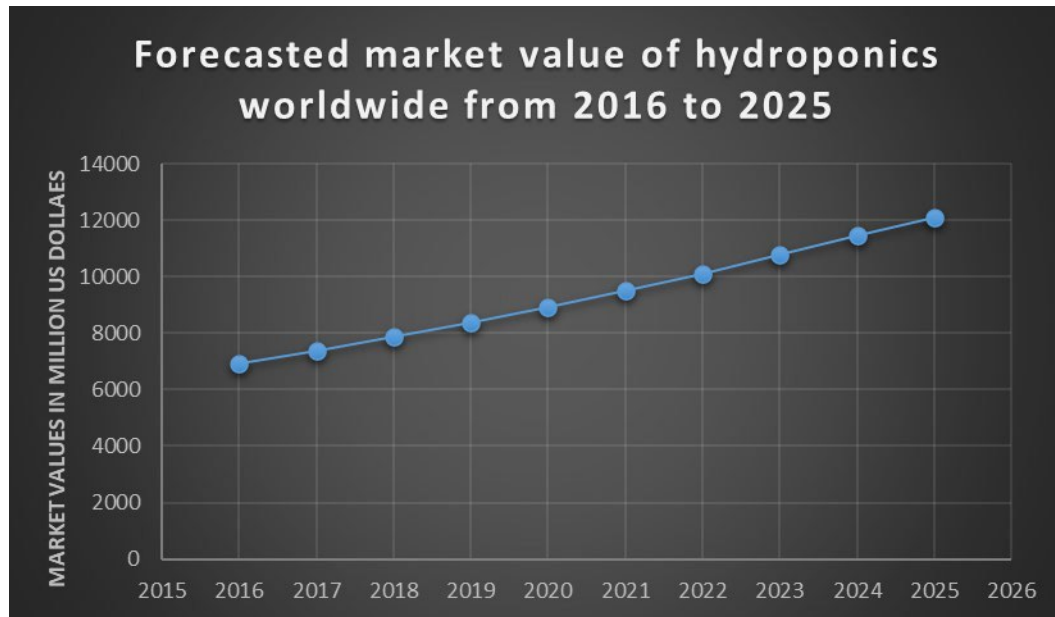


Figure 8. Forecasted market value of hydroponics

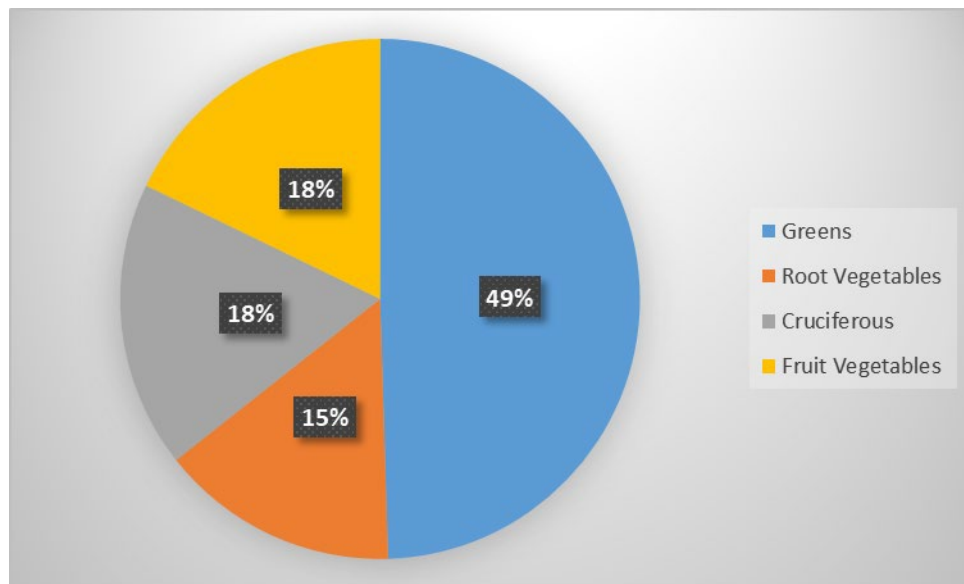


Figure 9. Customer's Buying Preference

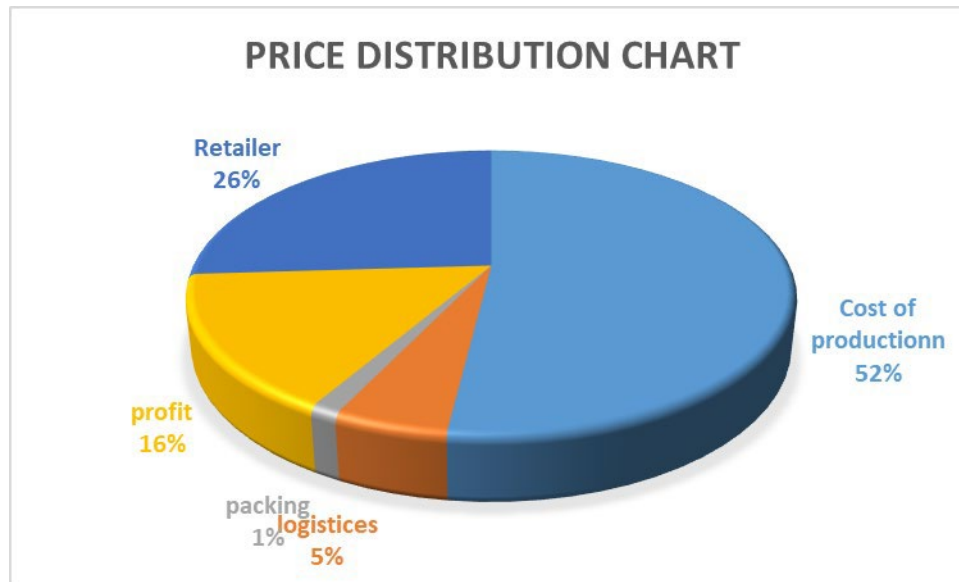


Figure 10. Price distribution Chart

5.3 Recommendations for future research

Our study was done only in the north and south urban regions of the Bangalore. The results may be different for different states. Future research can be done on other states which can help in a more accurate analysis.

The sample survey was done on hydroponic farmers and their customers from our visit of 4 hydroponic farms. Opinions on others like Distributors, E-Commerce suppliers were not taken so further research including information from these sources would help to provide another alternative perspective on this subject.

The farms we visited were not large-scale commercial farms. So further study can be conducted on larger commercial farms to see how the results differ from this study.

6. Conclusion

The research paper focuses on the role of hydroponics in the Indian agriculture. Hydroponics is a highly effective approach utilized in a variety of agricultural domains and also during the natural disasters. However, hydroponics requires less manpower, but it is still costly and complex, with high productivity. The awareness about hydroponics among the people was less; many people did not have a clear picture about Hydroponics. From this research we found out that many people do not prefer Hydroponics farming as the initial investment cost is very high and the financial support provided by the subsidies in the Government for Hydroponics farming are very less compared to traditional farming. Even though there is huge demand for Hydroponics produce as it is organic, medium and small-scale farmers faced the majority of difficulty in distribution and marketing. Among all the hydroponics produce greens have a huge demand.

The main purpose of this paper was to create awareness among farmers in India about the benefits of hydroponic farming when compared to traditional farming and to understand the various challenges faced by them in India in setting up a hydroponic farm.

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Acknowledgements

We would like to express our special thanks of gratitude to our mentor Mr. Ajay R for providing us his invaluable Guidance, comments and suggestions throughout the course of the project. We would also like to thank extend our gratitude to our Head-FMC Dr K M Sharath Kumar and Ramaiah University of Applied Sciences for giving us this wonderful opportunity for exploring and learning a new deal of things which would help us greatly for our Future aspirations and providing us with all the amenities for successfully completing our project on time.

And finally, a big thanks to all the people who spent their valuable timings in providing us a detailed insight regarding the Hydroponics Farming in Indian Agriculture.

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