



Cost-Benefit Analysis Of Hydroponic Farming: Growing Lettuce Under Nutrient Film Technique In India.

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ABSTRACT

In the present days there is a scarcity for availability of food in that too availability of nutritious food. According to The Global Food and Nutrition Security Dashboard supported by Global Alliance for Food Security, In 2022 over 203.1 million in 45 countries faced food crisis, and it is projected to reach 669.1 million by 2030. According to UNO- In India nearly 195 million people undernourished which quarter and India ranks 68th among 113 major countries in terms of food security index which is published in Economic Intelligence Unit. This is because of use of pesticides and chemicals, lack of fertile soil, lack of water for farming and even some times scarcity of availability of land for cultivation. To overcome these issues, there is a need of upgrading farming techniques and methods and hydroponics is the best among them. It is not only solution for the above issues but also it of one of the most profit making industry. The initial investment required is high but it can yield great returns out of our investments. In this article we have analysed the Cost- Benefit of hydroponic farming. This study is conducted for the area of 5000 sqft. The analysis shows that there is a NPV is Rs.81,47,057 for the duration of 5years, Benefit-cost ratio is 5.317, PBP is less than 1 year i.e 9.43 months, Internal Rate of Return is 60.6% and profitability Index is 4.31. The study shows that the investment required for hydroponic farming is high but still it can be recovered within one year and sometimes it may take 1.5 years. Net present value is also high and Benefit cost ratio is greater than 1 hence the its also a good indication of adopting NFT in growing Lettuce. Internal rate return is ascertained considering 5% and 20% rates.

Key words: Hydroponic Farming, Nutrient film technique, Cost-Benefit Analysis, and SWOT analysis.

Introduction:

Hydroponics is a soilless cultivation technique which enables the farmers to grow the plants/crops without soil, but there is a media to support the growth of plant in hydroponic farming. Here the use of pesticides/ or chemicals can be avoided because crops grown hydroponically are free from pest attacks since they are cultivated in protected cultivation containers and houses where they are not exposed to air and soil. Here the water required is also less because it requires only 10-20 percent of water that is required for soil based cultivation. Space required is also less because plants can be grown closer and also because of vertical farming. The ratio may vary from farm to farm and approximately it requires 1/5th of space that is required for traditional farming to grown the same quantity output. Hence it the best solution when we have land scarcity. It can provide nutrients that are essential for growing plants or crops by providing nutrient rich solution to the plants roots. But there is a chance suffering from water borne diseases which may damage plants in the farm and also balancing nutrients also important for which professional labours are required and the labour cost will be expensive. Initial investment required is also very high but it can yield good returns for that because a return on investment is also high. There are different tools and techniques are used to analyze the financial/ economic feasibility of hydroponic farming among them cost-benefit analysis technique is one. In this study, the cost-benefit analysis is done for growing lettuce under Nutrient Film Technique. Nutrient film technique is one of the most commonly used method for growing lettuce. It is one of the technique used in hydroponics / aquaponics which is simple and effective design used to in some environment. Here PVC pipes are used in which nutrient solutions are passed and circulated. It can be flat bed system, frame or tower.

Review of literature:

Authors	Article	Methods and methodology	Results
Farida Nursahib, Nurdin Brasit, Idrus Taba and Suharyono	"Financial Feasibility Study of Hydroponic Vegetables Business (A Case Study on Serua Farm, Kota Depok)"	NPV, PBP, B/C ratio, R/C ratio, BEP and IRR	Total production cost per hector is Rp319,420,734 per hectare, Profit is Rp. 688,579,266, R/C is 3.16, B/C is 2.16, NPV is Rp552,162,558, IRR 107,5% and PBP value is 5months 6 days. This shows that it's financially viable, and also profitable.
Hisashi Urayama, Hidetoshi Takama and Sachio Maruyama.	"Economic Feasibility of Coconut Coir-Based Hydroponics as an Alternative System for Crop Management in Thailand"	B/C ratio and NPV	Cost-benefit ratio is 1.14. Considering lowest concessional discount rate of 9.75% in the northeastern Thailand which is cost effective.
Muthir Saleh Said A1 Rawahy & Msafiri Daudi Mbaga.	"Cost-Benefit Analysis of Growing Cucumbers in Greenhouse at different cooling of nutrient solution temperature in closed hydroponic system in Oman"	Returns above total cost	Here different cooling nutrient solution temperature are are experimented like 22°C, 25°C, and 28°C and among them 22°C yield more returns over the total cost.
Françoise Bafort, Stephan Kohnen, Etienne Maron, Ayoub Bouhadada, Nicolas Ancion, Nathalie Crutzen and M. Haïssam Jijakli.	"The Agro-Economic Feasibility of Growing the Medicinal Plant Euphorbia peplus in a Modified Vertical Hydroponic Shipping Container"	Profitability analysis	Best extraction yields and cheapest method can both be attributed to ethyl acetate at 120 °C, with a yield of 43.8 mg/kg at a cost of 38 per mg
Ganesh Thapa, Arun G C, Ashma Pandey.	"Economic viability of hydroponic system: a case from Kathmandu valley"	NPV, PBP, B/C ratio, R/C ratio, IRR, and SWOT analysis.	The above study revealed that, the average B/C is 2.32, NPV is positive, IRR is 27% and PBP is 3.81 which are good indications of adopting hydroponic farming especially in the urban area.
Azizul Kholis, Indra Maipita, Fitriawaty, Herkules, Gaffar Hafiz Sagala, Rangga Restu Prayogo	"Feasibility Study of Hydroponics as a Home Industry"	NPV, PBP, IRR, BEP and RoI	There are 3 crops in the analysis process they are Lettuce, Kala and Mustard. Average NPV of three crops is Rp.9,50,00,000, IRR is >295%, PBP±1 year, BEP is 1624, 3473, 2165 units for all three crops. RoI -362%, 476%, 477% for 5 years.

Statement of the problem: The study is intended to analyze the cost-benefit analysis of hydroponic farming for growing lettuce under Nutrient Film Technique in India. In the study various elements involved in the total cost are identified and analyzed. With the help of econometrics the analysis has been done. The results are going to provide inputs for the new investors in hydroponic farming to make investment decisions.

Research objective:

- To ascertain various elements of costs in hydroponic farming.
- To analyze cost-benefit of hydroponic farming.
- To conduct SWOT analysis of hydroponic farming.

Data collection: For this study the data is collected through both primary and secondary data. Primary data is collected through questionnaires and interview method with hydroponic farmers. Secondary data is collected through referring journal, articles and other cost statements.

Methods and techniques: The methods and techniques used in hydroponic farming cost benefit analysis of growing lettuce in India are - Net Present Value (NPV) method, Benefit-cost ratio, Internal Rate of Return (IRR), Profitability Index and Payback period.

COST-BENEFIT ANALYSIS:

Cost-benefit analysis is technique used to know the viability of new project and it helps take decisions regarding accepting or rejecting the new project. Cost-benefit analysis is process of ascertaining the rewards or benefits obtained from the investments. It is the process of analyzing the excess of benefit from the decision made over the total cost incurred to convert the decision into an action. It also includes the intangible benefits and intangible cost from the decision taken like customer satisfaction and employee morale. This technique also considers the opportunity cost into account. There are basically two main methods of cost-benefit analysis they are-

1. Net Present Value model
2. Benefit-Cost Ratio

Net Present Value Model: The Net Present Value method is the difference between the PV of the benefit and the PV of the cost.

Net Present Value (NPV) = $\sum PV$ of total future benefit - $\sum PV$ of total future cost

Benefit-Cost Ratio: The Benefit-cost ration is percentage of present value of future benefits to the present value of future cost.

Benefit-Cost Ratio = $\sum PV$ of total future benefit / $\sum PV$ of total future cost

Here is the data which is relating to one-time set-up cost constructing hydroponic farming for 5000 sqft.

Other econometrics is used for the analysis feasibility study of hydroponic farming and they are- 1. Internal rate of return, 2. Payback period and 3. Profitability index

There is a need of various elements which are required to establish hydroponic farming system and they are as follows-

Nutrient Film Techniques (NFT) system setup-

Various elements required	Cost for the element
Poly house shelter	Rs. 600000
Pipes (4 inches)	Rs. 700000
Pipes (2 inches)	Rs. 12000
Pipe connectors	Rs. 120000
Stand platform (includes 40 Stands and 32 pipes for each)	Rs. 100000
20000 ltrs. Tank	Rs. 55000
1000 ltrs. Plastic tanks(2 no.)	Rs. 15000
5000 ltrs. Plastic tank	Rs. 22000
Water pumps (1 hp) and 4 no.	Rs. 30000
Water pumps (0.5 hp) and 2 no.	Rs. 10000
Net cups	Rs. 100000
Water cooler	Rs. 60000
Reverse Osmosis system	Rs. 50000
PH meter	Rs. 1200
TDS (Total Dissolved Solids) meter	Rs. 2000
Labour cost	Rs. 10000
Total cost	Rs. 18,87,200.

Following is the table that represents various elements and cost incurred for each element:

Sl. No.	Variables	Lettuce
01.	Initial investment / one time setup cost	Rs.18,87,200
02.	Total number of harvests p.a	5 times
03.	Net production capacity per harvest	2200 kg
04.	Total production per annum	11,000kg
05.	Price per kg	Rs.350
06.	Total revenue per annum	Rs.38,50,000
07.	Operating expenses per cycle	Rs.1,92,000
08.	Total operating expenses per annum	Rs.9,60,000
09.	Estimated life of the growing system	5 years
10.	Discount rate	10%
11.	Depreciation	Rs.3,77,440

Note: Depreciation is provided under straight line method.

Results: Following is the data relating to cost- benefit analysis of hydroponic farming in India.

Various cost –benefits analysis techniques	values
Net Present Value(NPV)	Rs.81,47,057
Benefit – cost ratio	5.317
Other econometrics are:	
Payback period	9.43 months
Internal rate of return	60.6%
Profitability index	4.31

This study is conducted for the area of 5000 sqft. The analysis shows that there is a NPV is Rs.81,47,057 for the duration of 5years, Benefit-cost ratio is 5.317, PBP is less than 1 year i.e 9.43 months, Internal Rate of Return is 60.6% and profitability Index is 4.31. The study shows that the investment required for hydroponic farming is high but still it can be recovered within one year and sometimes it may take 1.5 years. Net present

value is also high and Benefit cost ratio is greater than 1 hence it's also a good indication of adopting NFT in growing Lettuce. Internal rate return is ascertained considering 5% and 20% discount rate.

SWOT analysis of hydroponic farming firm in India- Strengths:

- Need of less land in hydroponics because, of vertical farming.
- Water required is very less. Nearly we can save 80-90% of water that is required for traditional farming.
- There is no need of using pesticides as there will be no issue relating to pests because the crops grown hydroponically are grown under protected cultivation and since it is not attached to the soil, the soil borne diseases cannot be identified.
- Crops grown hydroponically are organically grown since they use fish manure for supplying the nutrients to the plants.
- There is an artificial intelligence involved; less man power is required.
- Return on investment is very high.
- It is best suitable urban farming. Where fresh food produces are supplied to the consumers.
- Crops can be grown in any season.
- Harvesting duration is less.

Weakness:

- Initial investment required is high. In the study we recognized that nearly Rs. 20,00,000 is required for one time set-up of hydroponic farming. Where small investors cannot afford.
- If the water borne diseases start infecting the plants, with in short time the plants will get affected and that will be big loss for the farmers.
- There is a need of highly skilled labour, which is bit expensive to the farmers.
- Nearly 31.25% of the crops produced are considered as scrap.
- There is a need expertise tactics and knowledge for marketing the hydroponic produce.
- When the land used for hydroponic farming is on rental basis/lease basis, it is bit expensive.

Opportunities:

- Increase in the demand for food produce in the global market because of increased population, non-availability land for farming.
- Opportunity of getting high returns by growing unseasonal crops which can be sold for high price.
- It can get certified as organic produce which can be easily accepted by many consumers for the consumption.
- It is opportunity for the urban growers without harming the ecology. Transportation cost less and marketing will become easier since there is high demand for organically grown crops.
- There is a financial support from both central and state government in the form of subsidies and low interest rates borrowings. This helps to reduce the cost of borrowing capital.
- There is an opportunity to get back the initial investment within one year or within 1.5 year.
- There are training programs conducted and provide by the Government of India for women and differently abled people to encourage self-dependence and to develop the attitude of entrepreneurs.

Threats:

- Traditional farmers may restrict to adopt the hydroponic technology.
- Most of the time there will be unavailability of components that are essential for hydroponic farming.
- Lack of quality marketing intelligence.
- Much more research is to be conducted regarding this area.

CONCLUSION:

In India hydroponic farming firms are playing an important role in development of the country because it one of the industry which is contributing for the development of the economy. Due scarcity of nutrient rich food produce in the world and crops grown hydroponically are rich in nutrients, pesticides free produce enables to overcome that issues. There is a great demand for the food produce grown hydroponically because in most of the cases they are grown organically. The increase in demand, less consumption of water, land and other resources create an opportunity to grow more crops in less time. The results of the above analysis also shows that its beneficial for the farmers who are willing to enter into hydroponic because they can able earn huge profits when they have sufficient capital and importantly skilled and highly qualified human resource who is going to operate and monitor the hydroponic farm. Both are expensive, still they can yield high returns. Maintain proper PH level, temperature and nutrients level is very important. In India, the central and state government is providing 25%-50% subsidies the range varies from state to state; training programs are given from central and state government for empowering women and differently abled. Since the Cost-

Benefit analysis is showing the positive indications of implementing hydroponics it suggested adopting hydroponic farming as a traditional method of farming.

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