Mysore J. Agric. Sci., 58 (4) : 24-34 (2024)

Financial Viability of Hydroponic Firms in Bengaluru

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Received : July 2024
Accepted : September 2024

Abstract

Hydroponics is a cutting-edge agricultural method revolutionizing the way plants are grown in mineral nutrient solution without the use of soil. Hydroponic farming accommodates a wide spectrum of plants, including spinach, cauliflower, broccoli, mint, lettuce, parsley, rocket leaves, bok coy, celery, cherry tomatoes, cantaloupe melons, strawberries, bell peppers, cabbages, cucumbers and many more. Conducting a financial feasibility analysis for hydroponics is crucial to determine whether it is a viable and profitable venture and hence financial viability of hydroponic firms in Bengaluru was assessed in the study. A sample of 23 hydroponic firms (growing lettuce, spinach, celery, basil, amaranthus) in Bengaluru were selected through purposive and snowball sampling for analysing the financial viability of hydroponic firms in Bengaluru during 2022-23. Hydroponic firms were classified into 5 categories based on the land holding unit size (82,170 sq. ft., 43,560 sq. ft., 21,780 sq. ft., 10,700 sq. ft., 5,000 sq. ft.). Project appraisal techniques like NPV, B:C ratio and IRR were used to assess the financial viability of investment. The study revealed that, hydroponic firms' gross returns varied depending on its size, from Rs.11.00 lakhs to Rs.1.35 crores. The net returns were in the range of Rs.6.76 to Rs.68.16 lakhs. The NPV at 10.50 per cent of discount rate, demonstrated positively across all firm sizes, ranging from 5000 sq. ft acre to 2 acres (ranging from Rs.22 lakhs to Rs.230 lakhs). The highest B:C ratio was found in 43,560 sq. ft hydroponic firms (1.77) and lowest in 5000 sq. ft firm (1.21). However, it was more than one among all sample hydroponic firms. The hydroponic firms, with 43,560 sq. ft. of area had the highest Internal Rate of Return (30%), while the 5,000 square feet firms had the lowest Internal Rate of Return (17%). These findings clearly demonstrated that investment in any scale of hydroponic farming is a profitable business venture in Bengaluru.

Keywords : Financial viability and feasibility, Hydroponic firms, Cash flow analysis

Hydroponic farming can be defined as the science of growing plants in mineral nutrient solution without the use of soil. The word 'Hydroponics' has its derivation from combining the two Greek words 'Hydro' means water and 'Ponos' means labour (Sardare *et al.,* 2013). The primary advantage of hydroponics is its ability to minimize labour expenses due to controlled environments featuring automated irrigation and fertigation. According to growers, continuous production is possible only through hydroponic systems *i.e.,* production round the year and in a short growing period, requires less space and plants can be produced anywhere and even in a small space with a controlled growth environment. This approach can yield between 7 to 14 growth cycles compared to conventional methods. Growers often reply that hydroponics always allows them to have higher productivity

without any constrains of climate and weather conditions.

Hydroponics is a cutting-edge agricultural method revolutionizing the way we grow plants. The market need for hydroponic operations is being driven by the desire for fresh produce in the given area. Urban environments like metropolitan cities are fostering the markets expansion with rooftop hydroponic gardening. In India attempts were made during the late 1980's for propagating hydroponics technology for forage production and research works were undertaken by several workers (Santosh *et al.*, 2021). The development of hydroponic production systems that are cost-competitive with open-field agricultural methods will have a significant impact on the future expansion of the hydroponics industry in India. Moreover, with hydroponics, there is a better opportunity to place the fresh produce in the market as their average nutritional quality and consumers acceptance are higher (Mehra *et al.,* 2018). Hydroponic farming accommodates a wide spectrum of plants, including spinach, cauliflower, broccoli, mint, lettuce, parsley, rocket leaves, Bok coy, celery, cherry tomatoes, cantaloupe melons, strawberries, bell peppers, cabbages, cucumbers and many more.

The demand for exotic greens and vegetables has been consistently rising, driven by the enhanced buying capability of consumers. These distinctive products come at a premium cost, primarily because a majority of them are produced through hydroponic techniques. As a result, numerous research institutions and universities are dedicating their efforts to develop more uncomplicated hydroponic setups. The goal is to expedite the cultivation of these exceptional fruits and vegetables, aiming to fulfil the growing demand in the market. Furthermore, a growing consciousness among consumers regarding the consumption of freshly produced vegetables could also act as a catalyst for the market's future expansion. The expected boost in sales within the projected timeframe can be attributed to the rising consumer interest in distinct vegetables like red and yellow bell peppers, red lettuce, cilantro and cherry tomatoes. This demand is especially prominent in well-known food and retail chains such as Burger King and KFC etc.

Commercial vegetable growers are paying close attention to hydroponic production due to its efficiency in input control and facility management, especially for effective reduction in disease and pest outbreaks. Moreover, accelerated urbanization has led to a surge in the demand for hydroponically cultivated vegetables and crops from diverse sectors including hospitality, dining establishments, quick-service franchises, non-governmental organizations and defence. This trend is motivating farmers to adopt hydroponic cultivation methods. This growing adoption of hydroponics as a viable cultivation technique is projected to be a key driver for market expansion. As of 2020, the Hydroponics market in India was valued at 1.56 Billion USD and is projected to reach 3.04 Billion USD by 2028, growing at a CAGR of 7.5 per cent between 2020 and 2028. There is a huge market for organic crops and hydroponics in metros and tier one cities. This market in India consists of consumers who are health conscious and will readily willing to pay a premium price for organically or hydroponically grown produce that is fresh, safe and healthy (https://datamintelligence.com/). Hence, conducting a financial feasibility analysis for hydroponics is crucial to determine whether it is a viable and profitable venture. It will assist in risk assessment, resource planning, revenue projections and overall decision-making, helping entrepreneurs to make informed choices about entering or expanding in the hydroponics market. In this regard, present study has been undertaken to analyse financial viability of hydroponic firms in Bengaluru.

METHODOLOGY

Study Area

Bengaluru (Urban and Rural districts) was purposively chosen for the study because it is a metropolis with one of the fastest increasing populations and has residents from a variety of cultures, economic background, languages, castes, jobs and food habits. Apart from this, study area offers a strategic advantage due to its unique blend of factors and also more than 70 hydroponic units are located in this

region. Bengaluru's urban challenges and dynamic ecosystem, position it as a prime location to establish hydroponics firms that can contribute to sustainable and efficient agricultural practices and making it an ideal location to pioneer and scale such ventures profitably.

Sampling Framework

Purposive and snow ball sampling was used for the selection of the hydroponic firms. A sample of 23 hydroponic firms (growing lettuce, spinach, celery, basil, amaranthus) were selected for analysing the financial viability/feasibility of hydroponic firms in Bengaluru. Hydroponic firms were classified into 5 categories based on the land holding (82,170 sq. ft., 43,560 sq. ft., 21,780 sq. ft., 10,700 sq. ft., 5,000 sq. ft.) with different firm sizes as given in Table 1. The year of the study was 2022-2023 and the data collection was carried out during the month of July and August 2023.

Table 1

Categorization of sample hydroponic firms

Area (sq. ft)	Number of Hydroponic firms	Classification	Per cent
82,170 sq. ft	2	A	9
43,560 sq. ft	11	B	48
21,780 sq. ft	5	C	21
10,700 sq. ft	3	D	13
5,000 sq. ft	2	E	9
Total	23		100

Analytical Tools and Techniques

Financial Feasibility Analysis

Financial feasibility analysis was carried out to evaluate feasibility of investment on hydroponic farming. The discounted cash flow techniques which have an advantage of reducing cash flow to a single point of time were used to facilitate the test of feasibility. Project appraisal techniques like NPV, B:C Ratio and IRR were used in the study.

NPV (Net Present Value)

This is the discounted measure of cash flow analysis. It is simply the difference between the present worth of all the future benefit streams and the present worth of all the future costs. The project with positive NPV is the criterion for the selection of the project (Omar and Abdullah, 2016).

$$\text{NPV} = \sum_{t=0}^{n} \frac{Bt - Ct}{(1+r)t}$$

Where,

t = 1……. n years

n = Total number of years of the project

Bt = Present value of all the discounted benefits in the year t

Ct = Present value of all the discounted costs in the year t

r : discount rate

Positive NPV implies the viable investment and whereas if NPV is equal to zero then the investment breaks even.

Benefit Cost Ratio (BCR)

The Benefit Cost Ratio (BCR) was worked out by using the following formula discounted net cash flows the ratio must be more ≥ 1 for an enterprise to be considered worthwhile. This technique also ranks the project investment for selection.

B : C ratio = Discounted net cash flow/Initial investment

Internal Rate of Return (IRR)

The rate of discount at which the net present value of the project is equal to zero is Internal Rate of Return (IRR) to the project. The net cash inflows were discounted to determine the present worth following the interpolation technique. (Bheemagouda and Rajendra, 2016).

$$\text{IRR} = \text{LDR} + \left(\text{Diff.}\frac{\text{b}}{\text{w}}\text{2 discount rates}\right) \frac{\textit{Present worth of cash flows at LDR}}{\textit{Absolute diff. b/w present worth of cash flow stream at two discount rates}}$$

LDR : Lower Discount Rate

If the project being analyzed has Internal Rate of Returns which is more than the ruling rate of interest (opportunity cost), then the investment in the project could be feasible.

Results and Discussion

Cost and Returns from Hydroponic Firms of Different Scale

The total initial investment/installation cost includes costs for land development, building poly-houses-low cost or low tech poly-house, medium cost or medium-tech poly-house, expensive or Hi-tech poly-house (cold storage rooms, drip and sprinkler system, polyethylene material, natural vents, drip and fogger, materials, sliding doors, shade nets and gutters), implementation of technologies (Nutrient Film Technique (NFT), Deep Water Culture (DWC), Ebb and Flow system, Wick system, Drip irrigation system) and equipment purchasing cost. This equipment cost consists of cooling fans, pipes, a motor pump or pumping station, the motor pump assembly, as well as other elements made to last longer than the project itself.

The initial establishment costs, calculated on an annual basis, were considered over a project cycle duration of 10 years. Table 2 presents about the initial establishment costs for the selected hydroponic firms. It could be seen from the table that, the total initial establishment cost ranged from Rs.18 lakhs to Rs.179 lakhs. Table 3 and Table 4 presents the total annual costs comprising fixed and variable costs. The overall

Table 2

Initial establishment cost of hydroponic firms

(n=23) (Rs.)

Particulars	A	B	C	D	E
Land development cost	3,19,000 (1.7)	1,52,000 (1.7)	80,000 (1.5)	38,000 (1.1)	20,000 (1.0)
Installation of poly-house structures	73,30,000 (40.7)	36,15,000 (41.4)	23,05,500 (45.8)	16,85,750 (52.3)	10,50,075 (56.9)
Drip irrigation system cost	10,61,680 (5.8)	4,03,840 (4.6)	2,00,920 (3.9)	1,10,560 (3.4)	60,000 (3.2)
Implementation of Technology (NFT/DWC etc.) cost	67,31,600 (37.4)	32,85,800 (37.7)	18,92,900 (37.6)	10,56,450 (32.7)	5,90,200 (32.0)
Equipment setup and installation cost	25,53,600 (14.1)	12,56,800 (14.4)	5,53,400 (10.9)	3,31,700 (10.2)	1,54,985 (8.4)
Total initial establishment Cost	1,79,95,880	87,13,440	50,32,720	32,22,460	18,42,270
Initial establishment Cost/ sq. ft	216.50	200.03	231.92	301.16	368.45

Note : Values in parentheses indicate per cent of total initial establishment cost respectively. Hydroponic firms are classified into Five categories : (A - 83,120 sq. ft, B - 43,560 sq. ft, C - 21,700 sq. ft, D - 10, 700 sq. ft, E - 5,000 sq. ft).

Table 3

Total Annual fixed cost of sample hydroponic firms

(n=23) (Rs.)

Particulars	A	B	C	D	E
Depreciation on irrigation equipments	69,149 (3.8)	26,302 (2.8)	13,086 (2.1)	7,201 (1.5)	3,907 (1.3)
Depreciation on poly-house structure	4,77,418 (26.3)	2,35,452 (25.3)	1,50,162 (24.6)	1,09,797 (23.0)	68,393 (24.2)
Depreciation on equipment and machineryvii.	1,66,321 (9.1)	75,344 (8.1)	36,044 (5.9)	21,604 (4.5)	10,094 (3.5)

Continued....

TABLE 3 Continued....

Particulars	A	B	C	D	E
Other costs (license fee, insurance)x.	7,90,500 (43.6)	3,48,230 (37.4)	2,12,190 (34.8)	1,55,280 (32.5)	87,780 (31.0)
Rental value of land	1,21,462 (6.7)	1,38,461 (14.8)	1,20,560 (19.8)	1,12,000 (23.4)	82,220 (29.1)
Interest on fixed cost @ 12 per cent/ annum	1,80,406 (9.9)	83,021 (8.9)	49,377 (8.1)	35,265 (7.3)	20,420 (7.2)
Total Fixed Cost (TFC)	18,12,595 (100)	9,29,940 (100)	6,08,346 (100)	4,76,987 (100)	2,82,435 (100)

Note : Values in parentheses indicate Per cent of total fixed cost respectively. Hydroponic firms are classified into Five categories : (A – 83,120 sq. ft, B – 43,560 sq. ft, C- 21,700 sq. ft, D- 10, 700 sq. ft, E – 5,000 sq. ft)

TABLE 4

Total Annual variable cost of sample hydroponic firms

(n=23) (Rs.)

Particulars	A	B	C	D	E
Labour Charges	14,01,160 (25.4)	6,98,080 (26.3)	3,89,040 (26.9)	1,25,520 (20.2)	88,550 (22.5)
Repairing charges	2,65,150 (4.8)	1,15,450 (4.3)	87,560 (6.0)	40,050 (6.4)	22,240 (5.6)
Electricity cost	2,05,150 (3.7)	1,08,100 (4.0)	73,890 (5.1)	30,500 (4.9)	16,750 (4.2)
Transportation cost	3,25,352 (5.9)	1,55,176 (5.8)	94,088 (6.5)	42,044 (6.7)	25,552 (6.4)
Marketing and distribution cost	1,50,720 (2.7)	91,360 (3.4)	50,680 (3.5)	20,340 (3.2)	10,560 (2.6)
Plant Protection Chemicals cost	9,00,789 (16.3)	4,00,160 (15.0)	1,89,730 (13.1)	1,00,065 (16.1)	98,980 (25.1)
Nutritional Solution cost	9,80,789 (17.8)	4,50,940 (17.0)	2,15,420 (14.9)	1,00,010 (16.1)	52,555 (13.3)
Maintenance cost	1,60,890 (2.9)	90,240 (3.4)	44,340 (3.0)	30,000 (4.8)	14,580 (3.7)
Planting Material cost	6,06,880 (11.0)	3,15,670 (11.9)	1,60,220 (11.0)	74,610 (12.0)	18,980 (4.8)
Harvesting and Packaging cost	1,50,560 (2.7)	91,760 (3.4)	54,340 (3.7)	21,450 (3.4)	20,540 (5.2)
Miscellaneous cost	1,00,150 (1.8)	54,000 (2.0)	26,500 (1.8)	10,050 (1.6)	7,100 (1.8)
Interest on working capital @ 10.5 per cent per annum	2,61,381 (4.7)	84,392 (3.1)	48,246 (3.3)	28,841 (4.6)	17,904 (4.5)
Total Variable cost (TVC)	55,08,971 (100)	26,55,328 (100)	14,34,054 (100)	6,18,481 (100)	3,93,341 (100)
Total Annual Cost (Total Fixed Cost + Total Variable Cost)	73,21,566	35,85,268	20,42,401	10,95,468	6,76,726
Total Annual Cost/ sq. ft	88.08	82.30	94.11	102.38	135.34

Note : Values in parentheses indicate Per cent of total variable cost respectively.

TABLE 5

Cost and returns of sample hydroponic firms

(n=23)

Yield and income	A	B	C	D	E
Average Yield / year (Kg)	30,080	19,000	11,000	6,900	4,100
Average Price (Rs.)	470	400	360	330	330
Gross returns (Rs.)	1,41,37,600	76,00,000	39,60,000	22,77,000	13,53,000
Total Annual cost (TVC + TFC)	73,21,566	35,85,268	20,42,401	10,95,468	6,76,726
Net returns (Rs.)	68,16,033	40,14,731	19,17,598	11,81,531	6,76,273
Net returns (Rs.)/ sq. ft	82.00	92.16	88.36	110.42	135.25

Note : (A - 83,120 sq. ft, B - 43,560 sq. ft, C - 21,700 sq. ft, D - 10, 700 sq. ft, E - 5,000 sq. ft)

project total annual cost varied from Rs.6.76 lakhs to Rs.73.21 lakhs, wherein the total fixed cost ranged from Rs.2.82 lakhs to Rs.18.12 lakhs, while the total variable cost ranged from Rs.3.93 lakhs to Rs.55.04 lakhs.

Table 5 presents the total costs and returns. The drastic changes in the yield and returns can be attributed to difference in land holding of the hydroponic firms. The hydroponic firms gross returns varied depending on its size, from Rs.13.53 lakhs to Rs.141 lakhs. The sales prices of the crops had a direct impact on this income. Depending on the size of the farm, which can be anywhere between 5000 square feet to 2 acres, the total annual expenses ranged from Rs.6.76 to Rs.73.21 lakhs. The net returns were in the range of Rs.6.76 to Rs.68.16 lakhs. In the given region, most farmers/firms utilized hydroponic systems to cultivate exotic crops in response to consumer preferences. Hydroponically grown produce, such as basil, commanded a price of Rs.110 per kilogram, while lettuce ranged from Rs.110 to Rs.130 per kilogram. Celery and spinach were priced between 90 to 120 rupees per kilogram and Amaranthus and Kale prices ranged from 130 to 160 rupees per kilogram, depending on the specific location. The findings of the present study are in line to the study conducted by Kaveri (2021), wherein it was reported that hydroponic farming required high initial investment.

Financial Feasibility of Selected Hydroponic Firms

Financial feasibility analysis was carried out to evaluate feasibility of investment on hydroponic firms. For the hydroponics firms, cash flow estimates were generated over a 10-year time period. An initial cash investment was made to purchase capital items for the facility's construction. Operating expenses were incurred and sales revenues were generated after the gestation period. The project lifespan of 10 years is considered for the hydroponic units. In this present objective, a discount factor of 10.5 per cent was used to discount the net cash inflows representing the opportunity cost of capital. Crops selected were Lettuce, Spinach, Celery, Basil, Amaranthus as they were the major crops cultivated in majority of the firms.

Discounted Cash Flow Analysis of the Selected Hydroponic Firms

Table 6 presents the initial investment (Rs.1,79,95,880) made for hydroponic firms with 2 acres of land and the average annual working cost was Rs.73,21,566. Further, it can be seen that annual working cost of hydroponic system remained constant from first year to tenth year. The returns from hydroponics system started flowing from first year (Rs.1,41,37,600) and assumed as constant up to tenth year. Table 7 presents the initial investment made (Rs.87,13,440) for hydroponic firms with 43,560 sq. ft. of land and the average

TABLE 6

Discounted cash flow analysis for sample hydroponic units (A*)

(n=2)

Years	Outflows (Rs.)	Inflows (Rs.)	Net cash flows (Rs.)	Discount factor (r) at 10.50%	Net present value (Rs.)
0	1,79,95,880	0	-1,79,95,880	1	-1,79,95,880
1	73,21,566	1,41,37,600	68,16,033	0.9049	61,68,356
2	73,21,566	1,41,37,600	68,16,033	0.8189	55,82,223
3	73,21,566	1,41,37,600	68,16,033	0.7411	50,51,785
4	73,21,566	1,41,37,600	68,16,033	0.6707	45,71,751
5	73,21,566	1,41,37,600	68,16,033	0.6069	41,37,331
6	73,21,566	1,41,37,600	68,16,033	0.5493	37,44,191
7	73,21,566	1,41,37,600	68,16,033	0.4971	33,88,408
8	73,21,566	1,41,37,600	68,16,033	0.4498	30,66,433
9	73,21,566	1,41,37,600	68,16,033	0.4071	27,75,052
10	73,21,566	1,41,37,600	68,16,033	0.3684	25,11,359
Total				2,30,01,014	

Note : *A-87,120 sq. ft.

TABLE 7

Discounted cash flow analysis for sample hydroponic units (B*)

(n=11)

Years	Outflows (Rs.)	Inflows (Rs.)	Net cash flows (Rs.)	Discount factor (r) at 10.50%	Net present value (Rs.)
0	87,13,440	0	-87,13,440	1	-87,13,440
1	35,85,269	76,00,000	40,14,731	0.9049	36,33,241
2	35,85,269	76,00,000	40,14,731	0.8189	32,88,001
3	35,85,269	76,00,000	40,14,731	0.7411	29,75,566
4	35,85,269	76,00,000	40,14,731	0.6707	26,92,820
5	35,85,269	76,00,000	40,14,731	0.6069	24,36,941
6	35,85,269	76,00,000	40,14,731	0.5493	21,05,376
7	35,85,269	76,00,000	40,14,731	0.4971	19,95,816
8	35,85,269	76,00,000	40,14,731	0.4498	18,06,168
9	35,85,269	76,00,000	40,14,731	0.4071	16,34,541
10	35,85,269	76,00,000	40,14,731	0.3684	14,79,223
Total					1,54,34,257

Note : *B - 43,560 sq. ft.

annual working cost was Rs.35,85,269. Further, it can be seen that annual working cost of hydroponic system assumed as constant from first year to tenth year. The returns from hydroponics system started flowing from first year (Rs.76,00,000) and assumed as constant up to tenth year.

TABLE 8

Discounted cash flow analysis for sample hydroponic units (C*)

(n=5)

Years	Outflows (Rs.)	Inflows (Rs.)	Net cash flows (Rs.)	Discount factor (r) at 10.50%	Net present value (Rs.)
0	50,32,720	0	-50,32,720	1	-50,32,720
1	20,42,401	39,60,000	19,17,598	0.9049	17,43,271
2	20,42,401	39,60,000	19,17,598	0.8189	15,84,792
3	20,42,401	39,60,000	19,17,598	0.7411	14,40,720
4	20,42,401	39,60,000	19,17,598	0.6707	13,09,745
5	20,42,401	39,60,000	19,17,598	0.6069	11,90,678
6	20,42,401	39,60,000	19,17,598	0.5493	10,82,434
7	20,42,401	39,60,000	19,17,598	0.4971	9,84,031
8	20,42,401	39,60,000	19,17,598	0.4498	8,94,574
9	20,42,401	39,60,000	19,17,598	0.4071	8,13,249
10	20,42,401	39,60,000	19,17,598	0.3684	7,39,317
Total					67,50,095

Note : *C - 21,780 sq. ft.

TABLE 9

Discounted cash flow analysis for sample hydroponic units (D*)

(n=3)

Years	Outflows (Rs.)	Inflows (Rs.)	Net cash flows (Rs.)	Discount factor (r) at 10.50%	Net present value (Rs.)
0	32,22,460	0	-32,22,460	1	-32,22,460
1	10,95,468	22,77,000	11,81,531	0.9049	10,74,119
2	10,95,468	22,77,000	11,81,531	0.8189	9,76,472
3	10,95,468	22,77,000	11,81,531	0.7411	8,87,701
4	10,95,468	22,77,000	11,81,531	0.6707	8,07,001
5	10,95,468	22,77,000	11,81,531	0.6069	7,33,637
6	10,95,468	22,77,000	11,81,531	0.5493	6,66,943
7	10,95,468	22,77,000	11,81,531	0.4971	6,06,312
8	10,95,468	22,77,000	11,81,531	0.4498	5,51,193
9	10,95,468	22,77,000	11,81,531	0.4071	5,01,084
10	10,95,468	22,77,000	11,81,531	0.3684	4,55,531
Total					40,37,537

Note : *D - 10, 700 sq. ft.

Table 8 presents the initial investment made (Rs.50,32,720) for hydroponic firms with 21,780 sq. ft. of land and the average annual working cost was Rs.20,42,401. Further, it can be seen that annual working cost of hydroponic system assumed as constant from first year to tenth year. The returns from

hydroponics system started flowing from first year (Rs.39,60,000) and assumed as constant up to tenth year. Table 9 presents the initial investment made (Rs.32,22,460) for hydroponic firms with 10,700 sq. ft. of land and the average annual working cost was Rs.10,95,468. Further, it can be seen that annual working cost of hydroponic system assumed as constant from first year to tenth year. The returns from hydroponics system started flowing from first year (Rs.22,77,000) and assumed as constant up to tenth year.

Table 10 presents the initial investment made (Rs.18,84,270) for hydroponic firms with 5,000 sq. ft. of land and the average annual working cost was Rs.6,76,726. Further, it can be seen that annual working cost of hydroponic system assumed as constant from first year to tenth year. The returns from hydroponics system started flowing from first year (Rs.13,53,000) and assumed as constant up to tenth year. In the present paper, outflows and inflows from year 1 to year 10 are assumed constant for the sake of computation.

Financial Feasibility Analysis for Sample Hydroponic Units

Table 11 presents the financial feasibility analysis for sample hydroponic units measuring 83,120 sq. ft,

Table 10

Discounted cash flow analysis for sample hydroponic units (E*)

(n=2)

Years	Outflows (Rs.)	Inflows (Rs.)	Net cash flows (Rs.)	Discount factor (r) at 10.50%	Net present value (Rs.)
0	18,84,270	0	-18,84,270	1	-18,84,270
1	6,76,726	13,53,000	6,76,273	0.9049	6,14,793
2	6,76,726	13,53,000	6,76,273	0.8189	5,58,903
3	6,76,726	13,53,000	6,76,273	0.7411	5,08,093
4	6,76,726	13,53,000	6,76,273	0.6707	4,61,903
5	6,76,726	13,53,000	6,76,273	0.6069	4,19,912
6	6,76,726	13,53,000	6,76,273	0.5493	3,81,738
7	6,76,726	13,53,000	6,76,273	0.4971	3,47,035
8	6,76,726	13,53,000	6,76,273	0.4498	3,15,486
9	6,76,726	13,53,000	6,76,273	0.4071	2,86,805
10	6,76,726	13,53,000	6,76,273	0.3684	2,60,732
Total					22,71,135

Note : *E - 5,000 sq. ft.

Table 11

Financial feasibility indicators for sample hydroponic firms

(n=23)

Particulars	A	B	C	D	E
Net present value (Rs.)	230 lakhs	154 lakhs	67 lakhs	40 lakhs	22 lakhs
Benefit-cost ratio	1.28	1.77	1.34	1.25	1.21
Internal rate of return (%)	19	30	19	17	16

Note : Discount rate @ 10.50 per cent
(A - 83,120 sq. ft, B - 43,560 sq. ft, C - 21,700 sq. ft, D - 10, 700 sq. ft, E - 5,000 sq. ft)

43,560 sq. ft, 21,700 sq. ft, 10, 700 sq. ft and 5,000 sq. ft. The NPV criterion helps to evaluate the benefits accrued and costs incurred during the project life. The present value of the net cash flows at 10.50 per cent discount rate was worked out to Rs.2.30 crores (83,120 sq. ft), Rs.1.54 crores (43,560 sq. ft), Rs.67 lakhs (21,700 sq. ft), Rs.40 lakhs (10, 700 sq. ft) and Rs.22 lakhs (5,000 sq. ft). This positive net present value of hydroponic firms for all firm sizes, had clearly indicated that investment on hydroponics was financially feasible. Benefit-Cost ratio is another tool for appraising the worthiness of investments. The BCR indicated expected returns for each rupee of investment. The BCR ranged between 1.21 to 1.77 among sample hydroponic firms at 10.50 per cent discount rate. It may be recalled that even though the investment on hydroponic firms was high, the rewards were commensurate with investment requirement. The formal selection criterion of IRR is to accept the projects with IRR more than the opportunity cost of capital. The IRR was found to be 19 per cent (83,120 sq. ft), 30 per cent (43,560 sq. ft), 19 per cent (21,700 sq. ft), 17 per cent (10, 700 sq. ft) and 16 per cent (5,000 sq. ft)., which was higher than the discount rate (10.50%) considered as an opportunity cost in the analysis. The IRR represents the average earning power of money invested on hydroponics during its life span. Since IRR was more than the discount rate, investment on hydroponic firms in Bengaluru was financially viable.

The formal selection criterion of IRR is to accept the projects with IRR more than the opportunity cost of capital. The IRR represents the average earning power of money invested on hydroponic farming during its life span. Since, IRR was more than the discount rate, investment on hydroponic farming in Bengaluru was financially viable. The hydroponic firms with 43,560 sq. ft. of area had the highest Internal Rate of Return (30%), while the 5,000 square feet firms had the lowest Internal Rate of Return (16%). These findings clearly demonstrated that investment in any scale of hydroponic farming is a profitable business venture in Bengaluru.

The study findings affirm the viability of the project within the examined region. The project would become more appealing/enhanced through the cultivation of crops like olives, strawberries, english cucumber, oregano, bok choy, rocket leaves etc. particularly those of exotic in nature. The above findings are in line with Ganesh Thapa *et al.* (2021), who analyzed the financial feasibility of hydroponic farms inside Kathmandu valley and it was reported in the study that investment on hydroponics was financially viable. Similar results were also obtained by Likin Bopanna *et al.* (2016) who analysed the financial viability of Coorg mandarin cultivation.

Conclusion and Policy Implications

These findings clearly demonstrated that investment in any scale of hydroponic farming is a profitable business venture in Bengaluru. As this technology is capital intensive and requires technical knowledge, there is a need to provide financial assistance under a separate credit line for the hydroponic farms with low interest rate. This can enhance the rate of adoption of in the state and country.

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