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Enhancing agripreneurship through comparative farming models: Insights from polyhouse and open field practices

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Abstract
This research paper investigates the environmental and economic feasibility of protected (polyhouse) versus unprotected (open field) farming in India, emphasizing their influence on agripreneurship. The study reveals that polyhouse cultivation significantly enhances agricultural productivity, with net yields more than double those of outdoor farming across various crops. Despite higher average variable costs in both systems, fixed costs are notably lower for polyhouse operations. The results demonstrate that polyhouses not only improve crop outputs but also contribute to economic growth and better living standards by fostering entrepreneurial activities in the agribusiness sector post-economic liberalization. Comparative analyses of soil properties, production parameters, and climatic conditions underscore the advantages of polyhouse farming, including higher CO2 levels, greater yield per rupee for crops like summer squash and tomatoes, and a favorable Benefit-Cost ratio for sustainable cropping models. In contrast, outdoor farming often results in lower profitability and less efficient resource use. Returns per rupee were higher for the marigold & bottle guard grown under polyhouse conditions with values 1.03 & 1.20 respectively, than in open field conditions amounting to -0.69 & -0.10 correspondingly. Overall, this study advocates for the adoption of polyhouse technology to enhance agronomic practices and boost agripreneurial endeavors in India.

Keywords: Economic feasibility, polyhouse cultivation. open field cultivation, environmental conditions

Introduction

In India, about 70% of the population earns their livelihood from agriculture. It continues to provide a livelihood to people in our country. It satisfies the basic needs of humans and animals. It is an important source of raw material for many agro-based industries. India's geographical location is unique for agriculture as it offers many favorable conditions. There are flat areas, fertile soils, a long growing season and wide climatic variations etc. Apart from the unique geographical conditions, India has always made innovative efforts to increase production through the use of science and technology. India has witnessed a steady annual increase in the average kilograms of various agricultural products produced per hectare across the country over the last 60 years. These increases are mainly due to India's polyhouse farming, improvement in road and power generation infrastructure, knowledge of profits and reforms. (Bhagat, 2017) [3].
Indian polyhouse agriculture is characterized by the need for a strong linkage between production and marketing strategies and an inadequate marketing infrastructure. Indian agriculture has evolved from an era of frequent droughts and vulnerability to food shortages to a major exporter of agricultural commodities. This has been made possible by persistent efforts to harness the potential of land and water resources for agricultural purposes (Anonymous, 2011) [1]. Indian agriculture, which grew at a rate of about 1 percent per annum in the fifty years before independence, has grown at a rate of about 3percent per annum in the post-independence period. The diversity of physiographic, climatic and soil conditions enables India to grow a wide variety of horticultural crops- – fruits, vegetables, flowers, spices, aromatic and medicinal plants, plantation crops, etc. (Abhiviyakti, 2015) [2].

Agripreneurship plays a crucial role in increasing agricultural productivity, promoting rural development, ensuring food security and promoting economic growth. In the 21st century, agriculture around the world faces many challenges. The biggest challenge is to increase food production per area and to cope with climate change. Climate change is adversely affecting food production and water resources. India is home to 17 percent of the world's population but has only 4 percent of its water resources. The per capita availability of land and the size of farms are continuously decreasing with increasing population, urbanization and industrialization. Due to population growth, decrease in arable land and scarcity of water for irrigation, efforts are required to conserve every drop of water and increase production while conserving land and water. Polyhouse farming is an alternative new technique in agriculture that is gaining ground in rural India.It reduces dependence on rainfall and ensures optimal use of land and water resources. A polyhouse is a structure made of translucent material that creates a controlled environment for plant growth. It extends the growing season, protects plants from bad weather and optimizes growing conditions. By regulating the climate, it promotes higher yields and quality produce and reduces the need for chemical pesticides. Greenhouses are widely used in commercial agriculture for year-round cultivation of various crops to ensure productivity and quality. The challenges posed by surplus production and especially the liberalization of world trade can only be met by a sound agricultural marketing system in our country. It has been recognized that the development of agriculture in multi-family houses must be market-oriented and responsive to the changing world trade environment. The challenges posed by surplus production and, above all, the liberalization of world trade can only be overcome by a solid agricultural marketing system in our country.

Polyhouse is the most important innovation supported by the state governments by providing subsidies for the construction of the structure. Polyhouse cultivation requires less water and good planning and management skills to make profits. The area under polyhouse cultivation is increasing day by day. Polyhouse cultivation has become a great agricultural enterprise that creates employment opportunities with low capital cost and increases the real income of the people. Greenhouse cultivation is attracting a lot of interest and is now being practiced on a larger scale. Polyhouse cultivation is the cultivation of plants under fully controlled environmental conditions such as temperature, humidity, fertilizers, etc. with an automated system. It was found that in Haryana, 1,77,121 square meter area was under polyhouse cultivation with the participation of 1956 farmers (Horticulture Department, Govt. of Haryana). It has been calculated that the cost of constructing a polyhouse under 100 m2 is 62,740/- including irrigation and labor out of which 43,416/- is paid by the government as subsidy(Dhaiya and singh,2018) [4]

Results

This paper mainly deals with the results obtained through the analysis of the data; and results obtained were classified, as follows:

Table 1: Physiochemical properties of soil

Sr. No.	Testing Parameters	Polyhouse	Open field
1.	Type of soil	Loamy soil	Loamy soil
2.	pH of soil (1:2)	8.2	7.5
3.	Salt (1:2) decisimen/m	.37	.26
4.	Organic carbon (%)	.15	.52
5.	Phosphorus (per kg)	10	20
6.	Potash (per kg)	120	580

Physiochemical properties of soil: This table provides the physiochemical properties of soil in polyhouse and open field. The soil in both environments was loamy. The pH of the soil in the polyhouse measured 8.2, indicating a more alkaline condition compared to the open field soil,

Table 2: Sustainable cropping model solutions based on physiochemical properties of soil and water:

Sr. no.	Model number	Crops
1.	$Crop_1$+$crop_2$+………$crop_n$	Bottle guard + Marigold

Sustainable cropping model solutions based on physiochemical properties of soil:

Sustainable cropping model solutions were developed on the basis physiochemical properties of soil. This model included bottle gourd and marigold. Production parameters were field preparation, sowing, irrigation, manure/fertilizer, pesticides/insecticides, weeding, harvesting and storages and microclimatic parameters were temperature, humidity, and carbon dioxide.

Table 3: Assessment of production parameters of sustainable cropping model II

Sr. No.	Production Parameters	**Polyhouse** (Area-60m^2)		**Open field** (Area-60m^2)	
		Bottle guard	**Marigold**	**Bottle guard**	**Marigold**
1.	**Field Preparation**				
	Ploughing	By hoe & racks	By hoe & racks	Tractor	Tractor
	Harrowing	By hoe & racks	By hoe & racks	Tractor	Tractor
	Levelling	Hoe	Hoe	Hoe	Hoe
	Addition of manure/fertilizer	Nil	Nil	Nil	Nil
2.	Sowing	52 plants	52 plants	52 plants	52 plants
	Method of sowing	Transplantation	Transplantation	Transplantation	Transplantation
	Time of sowing	April	April	April	April
	Height of seedlings	3 inches	3 inches	3 inches	3 inches
	Space between plant to plant	60 cm	60 cm	60 cm	60 cm
	Space between row to row	90 cm	90 cm	90 cm	90 cm
	Depth of sowing seedling	3 inches	3 inches	3 inches	3 inches
3.	Pesticides/ insecticides	Not used	Not used	Not used	Not used
4.	Weeding	One time in 20 days	One time in 20 days	One time in 10 days	One time in 10 days
5.	Harvesting	July	June and July	July	June and July

Assessment of production parameters of sustainable cropping model: Table 3 describes the production parameters for sustainable cropping model (Bottle Gourd and Marigold), comparing the conditions in polyhouse and open field environments, each with an area of 60 square meters.

This table provides a comprehensive view of the production parameters, highlighting the consistency in certain practices such as sowing methods and plant spacing.

Table 4: Temperature of the polyhouse and open filed during sustainable cropping model:

Months	Polyhouse		Open field	
	Minimum (ºC)	Maximum (ºC)	Minimum (ºC)	Maximum (ºC)
April	23.67	28.00	16.67	35.00
May	23.00	34.67	27.67	45.33
June	27.67	34.00	29.00	43.33
July	23.00	32.00	29.00	36.33
Average	24.33	32.17	25.59	40.00

Temperature of the polyhouse and open filed during sustainable cropping model: The table 4 presents a comparative analysis of temperature levels in polyhouse and open field during the months of April to July, as part of Sustainable Cropping Model. The data reveals that the polyhouse and open field environments exhibit varying temperature levels throughout the four-month period.

Table 5: Humidity of the polyhouse and open filed during sustainable cropping model:

Months	Polyhouse		Open field	
	Minimum (%)	Maximum (%)	Minimum (%)	Maximum (%)
April	27.67	70.33	25.6	68.07
May	22.67	51.67	19.47	48.60
June	58.33	63.33	53.80	63.93
July	61.67	83.00	65.67	79.00
Average	42.59	67.08	41.14	64.90

The data in table 5 presents a comparative analysis of humidity levels in polyhouse and open field during the months of April to July during Sustainable Cropping Model. The data reveal that the polyhouse and open field environments exhibit varying humidity levels throughout the four-months.

Table 6: CO_2 level in the polyhouse and open filed during sustainable cropping model:

Months	Polyhouse		Open field	
	Minimum (ppm)	Maximum (ppm)	Minimum (ppm)	Maximum (ppm)
April	750.33	977.33	410.00	481.67
May	746.67	953.67	458.00	602.00
June	779.67	891.00	476.00	556.33
July	757.00	828.00	477.00	599.67
Average	758.42	912.50	455.25	559.92

CO_2 level in the polyhouse and open filed during sustainable cropping model

The data reveals that the polyhouse consistently maintains higher CO_2 levels than the open field throughout the four-month period

Table 7: BC ratio of sustainable cropping model (Bottle guard + Marigold) in polyhouse:

Sr. no.	Parameters	Bottle guard	Marigold
1.	Total plants	52	52
2.	Per sapling/plant cost (Rs.)	3	2
3.	Total cost of plants (Rs.)	156	104
4.	Manpower cost (Rs.)	700	700
5.	Electricity bill (Rs.)	850	850
6	Water bill (Rs)	35	35
	Total cost (Rs.) (3+4+5+6)	1741	1689
6.	Total production (kg)	20	6
7.	Sale per kg (Rs.)	105	290
8.	Gross return (Rs.)	2100	1740
	Profit (Rs.)/ Net Return	359	51
	BC Ratio	1.20	1.03

BC ratio of sustainable cropping model (Bottle guard + Marigold) in polyhouse: Table 7 presents a detailed economic analysis of sustainable cropping model (Bottle Gourd and Marigold) in polyhouse. This resulted in a net profit in Bottle Guard & Marigold as Rs 359 & Rs. 51 respectively and BC & Marigold ratio as 1.20 & 1.03 returns per rupee, there by achieved a marginal profit.

Table 8: BC ratio of sustainable cropping model II (Bottle guard + Marigold) in open field

Sr. no.	Parameters	Bottle guard	Marigold
1.	Total plants	52	52
2.	Per sapling/plant cost (Rs.)	3	2
3.	Total cost of plants (Rs.)	156	104
4.	Manpower cost (Rs.)	500	500
5.	Electricity bill (Rs.)	550	550
6	Water bill (Rs)	120	120
7	Tractor (diesel bill)	180	180
	Total cost (Rs.) (3+4+5+6+7)	1506	1454
6.	Total production (kg)	2	4
7.	Sale per kg (Rs.)	70	250
8.	Gross return (Rs.)	140	1000
	Profit (Rs.)/ Net Return	-1366	-454
	BC Ratio	-0.10	-0.69

BC ratio of sustainable cropping model (Bottle guard + Marigold) in open field: Table 8 presents the Benefit-Cost (BC) ratio for sustainable cropping model (Bottle gourd and Marigold) in an open field. Bottle Gourd incurred a total expense of Rs. 1506, whereas Marigold's total cost was slightly lower at Rs. 1454. Marigold's net return was still a loss of Rs. 454, its BC ratio of 0.69 was better than that of Bottle Gourd. This ratio suggests that Marigold recovered Rs. 0.69 for every Rs. 1 spent, reflecting a more favorable but still negative financial outcome.

Conclusion

In conclusion, the body of literature examined underscores the significant potential of protected cultivation techniques in enhancing the productivity and economic viability of various crops, particularly in varied climate regions of India with limited resources. From the economic analyses of crops like bottle guard and marigold to the management of environmental factors in polyhouse systems, it is evident that adopting advanced agricultural practices can not only boost crop yields but also support sustainable agricultural development. As remote agricultural stakeholders and policymakers look towards future advancements, fostering access to such innovative technologies will be crucial in addressing food security and improving the livelihoods of farmers. Embracing these insights will pave the way for optimized agricultural practices and greater resilience against climatic challenges in modern farming.

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