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Economics of Protected and Open Field Cucumber Cultivation in Jaipur District of Rajasthan

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ABSTRACT

Protective cultivation is a cropping technique in which the climate around the plant is modified in part or whole to meet the plant's requirement for the appearance of its output potential. For the study, an ultimate sample of 50 respondents was randomly selected from four villages in Jaipur district, which comprises 25 polyhouses and 25 open field cucumber cultivators. CACP cost concept was used in analyses of costs and returns pattern. Results showed that cucumber cost of cultivation in polyhouses and open fields was Rs 289815.10 and Rs 93726.24 per acre, respectively, while the gross return was Rs 543509.68 and Rs 137301.08 per acre. The net return of cultivation was Rs 253694.58 and Rs 43574.84 per acre under respective cultivation. In polyhouse cucumber cultivation, higher B-C ratio (1.88) was observed in comparison to open field cultivation (1.46) which showed that former was more profitable than latter. Family labor use in polyhouse was found relatively low in comparison to open field condition.

Keywords Costs, Returns, Polyhouse, Benefit- cost ratio, Family labor income.

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INTRODUCTION

For many people all across the world, agriculture is a crucial source of income and food. The industry has witnessed several modifications and improvements in various farming practices and technology during the last few years. Modern agriculture and agricultural operations operate substantially differently than they did decades ago, mostly as a result of technical developments in the form of sensors, machinery, equipment and information technology, of which protective cultivation technique is one. Protected cultivation is a cropping technique in which the climate around the plant is modified in part and whole to meet the plant's requirements for the appearance of its output potential. In protected farming, abiotic and biotic stress is minimized during crop development. Cucumbers are grown all year in polyhouses. Cucumber (*Cucumis sativus* L.) is a popular vegetable and one of the Cucurbitaceae family's most popular member (Lower and Edwards 1986, Thoa 1998). Cucumber is a significant vegetable crop in the cucurbitaceous vegetable group, produced widely across seasons and area. Cucumber fruits are edible and commonly used in salads, as well as aiding human digestion. Fruits are popular as a cooling snack in the summer. The fragile fruits are best for pickling, while the seeds' kernels are utilized in confectionery (Chakravarty 1990). Climate change has a significant impact on the farming community in modern agriculture. To increase crop productivity and production, farmers are turning to protected cultivation techniques like polyhouses, shade nets, and micro tunnels, among others, that can produce vegetables of superior quality

and without chemical residue (Harisha *et al.* 2019).

It offers a lot of potential in terms of yield, revenue, and job creation per unit of land and time. India is the world's top exporter of gherkins, with $114 million in shipments from April to October (2020-21). A pickled baby cucumber is known as a gherkin. In 2020–21, India exported 218 million US dollars' worth (223,515 metric tonnes) of cucumbers and gherkins. (Ministry of Commerce and Industry 2022). Cucumber area and production in India during 2020-21 were 0.12 million hectares and 1.67 million metric tonnes, respectively (Department of Agriculture Cooperation and Farmers Welfare 2020-21 3rd advance estimates).West Bengal ranks first in cucumber production of 326820 metric tonne output in India, accounting for 20.32% of total cucumber production, while Rajasthan ranks seventeen with 16570 metric tonnes production in 3710 ha area (Department of Agriculture Cooperation and Farmers Welfare 2021-2022, 1st Advance Estimates). In Rajasthan, Jaipur district led the state in both output and area, with 215 ha and 666 metric tonnes, respectively (Horticulture Department of Rajasthan 2020-21).

MATERIALS AND METHODS

Sampling technique

To select the ultimate sample, multi-stage purposive and random sampling was used. The Jaipur district was purposively selected because it has the most farmers growing horticulture crops in general and cucumber in particular under protected farming (under polyhouses) and open field conditions. From thirteen block in district, two blocks namely Sambhar and Jhotwara were selected purposively. Two villages from each block namely Kheri Aloopha and Kalakh from Sambhar block and other two villages namely Pachar and Baseri from Jhotwara block were selected randomly. In each randomly selected village 25-25 respondents of polyhouse and open field conditions were selected, creating a sample of 50 respondents for the purpose of study. The primary data related to costs and returns associated to cultivation of cucumber were collected from the selected farmers of the study area through pre-structured schedule for 2021-22.

Analytical tools

In order to achieve the study's specific objectives, based on the nature and extent of availability of data, the following CACP (Commission for Agricultural Costs and Prices) cost concepts and formulae were employed for the analysis of the data. The cost concept involved the following head:

Cost A1 : Value of hired human labor + Value of owned bullock labor +Value of hired bullock labor + Value of owned machine labour + Value of hired machine + Value of owned seed + Value of purchased seed + Value of owned farmyard manure + Value of purchased farmyard manure + Value of fertilizers and insecticides + Irrigation charges + Land revenue + Interest on working capital + Depreciation on implements and farm building + Miscellaneous expenses

Cost A2 : Cost A1+Rent paid for leased in land

Cost B1 : Cost A1 +Interest on fixed capital (excluding land)

Cost B2 : Cost B1+Rent paid for leased in land + Rental value of owned land

Cost C1 : Cost B1+ Imputed value of family labor

Cost C2 : Cost B2+ Imputed value of family labor

Cost C3 : Cost C2 + Managerial cost (10% of Cost C2)

(a) Depreciation: Depreciation on farm machineries and equipment including polyhouse were estimated by using straight line method with the given formula:

$$\text{Depreciation} = \frac{\text{Purchase value–Junk value}}{\text{Expected life of the item}}$$

(b) Benefit- cost ratio : It is the ratio of gross return to total cost of cultivation.

$$\text{B : C ratio} = \frac{\text{Cross return}}{\text{Total cost (Cost C3)}}$$

(c) Gross return : Gross return for cucumber crop is

value of the main product at the selling price.

$$GR = Qm \times Pm$$

Where,

GR = Gross return

Qm = Quantity of main product

Pm = Price of main product

(d) Farm business income = Gross return – Cost A1

(e) Owned farm business income = Gross return – Cost A2

(f) Family labor income = Gross return – Cost B2

(g) Net return: Net return was estimated by deducting total cost from the gross return

Net return = Gross return – Cost C3 (Total cost)

RESULTS AND DISCUSSION

We can assess profitability more precisely if we compare the productivity and revenue from crop production to the different costs incurred during the cultivation of a certain crop. The cost of crop cultivation and production is the most important aspect of the agricultural economy, both from a micro and macroeconomic perspective. This cost serves as a benchmark for the government when setting prices for both inputs and final product.

The cost of the cucumber crop was evaluated and the findings are shown in Table 1. The costs and returns were calculated in Rs acre^{-1}. In a polyhouse, cucumber cost of cultivation was calculated to Rs 289815.09. Out of which costs A1, A2, B1, B2, C1, C2, and C3 totaled Rs 217643.57, Rs 217643.57, Rs 235575.22, Rs 259396.59, Rs 239646.89, Rs 263468.26 and Rs 289815.09. The study also leads to the conclusion that polyhouse farming requires a lot of cash. The cost of cultivating cucumbers in an open field was estimated at Rs 93726.23. In which, costs A1, A2, B1, B2, C1, C2, and C3 totaled to Rs 55863.75, Rs 55863.75, Rs 57577.88, Rs 72944.46, Rs 69839.09, Rs 85205.67 and Rs 93726.23.

Seed cost was found to be the most costly vari-

Table 1. Costs of polyhouse and open field cucumber cultivation (Rs/acre). (Source: Field survey 2021-22).

Particulars	Polyhouse	Open field	Expenditure difference between polyhouse and open field cultivation	% difference over open field cultivation
Cost A1				
Seed	64087.37	11686.21	52401.16	448.40
Fertilizer and manures	18288.94	10178.73	8110.21	79.68
Plant protection	11362.96	7564.81	3798.15	50.21
Irrigation charges	2651.72	1266.21	1385.51	109.42
Owned machine power charge	9321.51	4614.84	4706.67	101.99
Hired machinery charge	1347.35	3097.36	-1750.01	-56.50
Hired labor	28911.13	9476.39	19434.74	205.09
Interest on working capital	5651.71	2528.06	3123.65	123.56
Land revenue	0.00	0.00	0.00	0.00
Depreciation	74770.88	4801.14	69969.74	1457.36
Miscellaneous expenses	1250.00	650.00	600	92.31
Sub total	**217643.57**	**55863.75**	**161779.81**	**289.60**
Cost A2				
Cost A1	217643.57	55863.75	161779.81	289.60
Rent paid for leased in land	0.00	0.00	0.00	0.00
Sub total	**217643.57**	**55863.75**	**161779.81**	**289.60**
Cost B1				
Cost A1	217643.57	55863.75	161779.81	289.60
Interest on fixed capital	17931.65	1714.13	16217.52	946.11

Table 1. Continued.

Particulars	Polyhouse	Open field	Expenditure difference between polyhouse and open field cultivation	% difference over open field cultivation
Sub total	**235575.22**	**57577.88**	**177997.34**	**309.14**
Cost B2				
Cost B1	235575.22	57577.88	177997.34	309.14
Rent paid for leased in land	0.00	0.00	0.00	0.00
Rental value	23821.37	15366.58	8454.79	55.02
Sub total	**259396.59**	**72944.46**	**186452.13**	**255.61**
Cost C1				
Cost B1	235575.22	57577.88	177997.34	309.14
Impute value of family labor	4071.68	12261.21	-8189.53	-66.79
Sub total	**239646.89**	**69839.09**	**169807.81**	**243.14**
Cost C2				
Cost B2	259396.59	72944.46	186452.13	255.61
Impute value of family labor	4071.68	12261.21	-8189.53	-66.79
Sub total	**263468.26**	**85205.67**	**178262.60**	**209.21**
Cost C3				
Cost C2	263468.26	85205.67	178262.60	209.21
Managerial cost	26346.83	8520.57	17826.26	209.21
Sub total	**289815.09**	**93726.23**	**196088.86**	**209.21**

able input operation in a polyhouse, totaled to Rs 64087.37, followed by hired labor (Rs 28911.13), fertilizer and manures (Rs 18288.94), plant protection (Rs 11362.96), owned machinery power charge (Rs 9321.51), and interest on working capital (Rs 5651.71). In polyhouse, the least amount was spent on miscellaneous expenses (Rs 1250), followed by irrigation charges (Rs 2651.72), family labor (Rs 4071.68). Among total fixed cost, highest expenditure incurred on depreciation of Rs 74770.88, followed by rental value of land i.e. Rs 23821.37 and then on interest on fixed capital i.e. Rs 17931.65. In open field cucumber cultivation, rental value of land (Rs 15366.58) was major contributor to total cost, followed by family labor (Rs 12261.21), seed charges (Rs 64087.37), fertilizer and manures (Rs 10178.73), hired labor (Rs 9476.39) and plant protection (Rs 7564.81).

The cost of cucumber seeds under polyhouses and open fields differed substantially, with polyhouses having a 4 times higher seed cost. Similar trend were

Table 2. Returns of polyhouse and open field cucumber cultivation (Rs/acre). (Source : Field survey 2021-22).

Sl. No.	Particular	Polyhouse	Open field	Difference between polyhouse and open field	% difference over open field
1	**Productivity (qt/acre)**	**451.42**	**169.09**	**282.33**	**166.97**
2	**Market price (Rs/qt)**	**1204.00**	**812.00**	**392.00**	**48.28**
3	**Gross return**	**543509.68**	**137301.08**	**406208.60**	**295.85**
4	Return over Cost A1 (Farm business income)	325866.11	81437.33	244428.79	300.14
5	Return over Cost A2 (Owned farm business income)	325866.11	81437.33	244428.79	300.14
6	Return over Cost B1	307934.46	79723.20	228211.26	286.25
7	Return over Cost B2 (Family labor income)	284113.09	64356.62	219756.47	341.47
8	Return over Cost C1	303862.79	67461.99	236400.79	350.42
9	Return over Cost C2	280041.42	52095.41	227946.00	437.55
10	Return over Cost C3	253694.58	43574.84	210119.74	482.20
11	**B:C ratio**	**1.88**	**1.46**	**0.42**	**28.02**

seen in fertilizer and manure, plant protection and hired labor. Parallel finding was reported by Kumar *et al.* (2017) who concluded that maximum difference was observed for seed which was more than twelve times as compared to open field condition. In cost composition under polyhouse, depreciation make larger share of it which was fourteen time more to depreciation in open field cucumber cultivation. The result was in consonance with the result reported by Jain *et al.* (2021).

Table 2 reveals the return structure of polyhouse and natural condition cucumber cultivation, which shows that the average production of polyhouse cucumber cultivation was 451.42 qtl per acre. The computed gross return per acre using the source data were Rs 543509.68. The farm business income, farm labor income, and owned farm business income of Rs 325866.11, Rs 284113.09 and Rs 325866.11 per acre, were also calculated, respectively in polyhouse cucumber cultivation. The return over Cost C3 which was also called net return calculated to be Rs 253694.58. In case of open field cucumber cultivation, the average productivity of cucumber was observed to be 169.09 qtl acre^{-1} with gross return and net return of Rs 137301.08 and Rs 43574.84, respectively. The calculation of returns on open field cucumber cultivation showed that farm business income, farm labor income and owned farm business income were Rs 81437.33, Rs 64356.62 and Rs 81437.33, respectively.

Comparative economics of polyhouse and open field cucumber cultivation

The comparison of costs and returns of polyhouse and open field cucumber cultivation shows that difference in total cost of cultivation was observed to be Rs 196088.86 per acre (209.21%). Similar result was also observed in various costs of both farming technique. Expense on the seed was found to be more than four times than that in open field cucumber cultivation. In case of other items of cultivation, expenditure was higher in polyhouse cultivation except expenditure incurred on family labor (-66.79%) and hired machinery charge (-56.50%). Although overall cost was higher in polyhouse, but it gain in terms of increase in productivity i.e. 282.33 qtl acre^{-1} (166.97%). Increment in productivity of polyhouse cucumber made gross return (295.85%) and net return (482.20%) higher than open field cucumber production. Benefit-cost ratio of cucumber cultivation in polyhouse and natural condition were 1.88 and 1.46, respectively that former was 28.02% more than later. Finding shows that yield of cucumber was higher in polyhouse as compare to open field which was nearly two times more. Net return obtained from the cucumber grown under polyhouse was higher by ₹210119.74 than under open-field production which was supported by Singh *et al.* (2005).

CONCLUSION

Above study concluded that that average total cost, total variable cost and total fixed cost of cucumber cultivation in polyhouse observed higher than open field production system.Also similar trend was found in gross and net return. The higher returns in polyhouse cucumber cultivation compared to open field were due to high productivity (451.42 qtl acre^{-1}) and high market price of produce (Rs 204.00 qtl^{-1}). High productivity was due to better cultural and management practices, high use of fertilizer and plant protection, low infestation of pest and disease and controlled environment in the polyhouse. Investment on polyhouse cucumber cultivation was more financial feasible (28.02%) than in open field condition. So, the cultivation of cucumber under polyhouse was highly profitable enterprises for them either as new cultivars or as experienced one because of good market for the produce. The high profitability of polyhouse cucumber cultivation makes it a better career option for young enterpreneurs. But high investment in polyhouse establishments and high cost of cucumber seed create obstacles to its adoption among marginal and small farmers.

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