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Economic Analysis and Profitability of Protected Flower Cultivation: A Case Study in the Mandi district of Himachal Pradesh

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ABSTRACT

This study provides a comprehensive analysis of the socio-economic dynamics and cost-and-returns assessment of five flowers i.e. Carnation, Gypsophila, Lilium, Limonium and Eustoma cultivated under protected conditions in Mandi district of Himachal Pradesh. A sample of 200 protected flower growers was selected using mixed method sampling technique. The socio-economic analysis revealed that most sampled households had nuclear family structures, with an average size of 5.53 persons. A noteworthy 94.95 per cent of family members were literate, reflecting an average education quality index of 2.08. Agriculture emerged as the primary occupation, engaging 91.52 per cent of the workforce in farming activities. The average area under protected cultivation was 665.74 m^2, out of which 630.64 m^2 to 885.91 m^2 area was under marginal and small farm categories, respectively in the study area. The total initial investment on polyhouses was ₹ 1,67,250. The cost analysis revealed that Limonium had the highest cultivation cost of ₹ 1552.80/m^2, followed by Gypsophila (₹ 1216.54/m^2), Lilium (₹ 1147.59/m^2), Eustoma (₹ 1140.51/m^2) and Carnation (₹ 291.81/m^2). Despite this, Lilium showed the highest gross returns at ₹ 2925.63/m^2, surpassing all other crops. It also yielded the greatest net returns at ₹ 1778.03/m^2. Carnation, though with lower returns, had the most efficient output-input ratio at ₹ 2.63, followed closely by Lilium (₹ 2.55), Eustoma (₹ 1.91), Gypsophila (₹ 1.84) and Limonium (₹ 1.62). These findings underscore the significant potential of protected cultivation in not only enhancing farm profitability but also in uplifting rural livelihoods in the region.

Keywords: Protected cultivation, net income, socio-economic dynamics, cost of production

Climate change has led to increased temperatures, prolonged droughts, excessive rainfall, and the emergence of new pests and diseases which affects agricultural production adversely. These challenges have made open field farming increasingly difficult to sustain. In response, protected cultivation emerges as a promising solution, offering a controlled environment to safeguard crops and mitigate the risks associated with climate change, ensuring more resilient and sustainable agricultural practices (Punera *et al*. 2017; Aryal *et al*. 2020; Prakash *et al*. 2021; Pachiyappan *et al*. 2022). Thus, the usage of protected cultivation can be very beneficial in overcoming fluctuations in weather variables and provides a controlled environment shielded from adverse weather conditions (Pattnaik and

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Mohanty 2021; Dixit *et al*. 2023). Using structures like polyhouses, nethouses, and tunnels, along with measures like windbreaks and irrigation, this method optimizes growing conditions for better crop yield and quality (Jensen, 2002; Chahal *et al*. 2020). Hence, commercial floriculture has developed into a hi-tech enterprise which takes place under controlled climatic conditions inside a greenhouse (Chawla *et al*. 2016). It's a fast-growing, profitable sector with huge potential to offer good self-employment and income for small farmers in Asian countries like India (Patil *et al*. 2022; Ninama *et al*. 2016). Floriculture is quickly becoming to be one of the most significant commercial agricultural operations in India due to the increasing demand for cut and loose flowers (Chawla *et al*. 2016). India is the second-largest flower-growing nation in the world after China and it ranks 14th in terms of floriculture exports (Anumala and Kumar, 2021). In Himachal Pradesh, polyhouse technology was popularized among the farmers with the introduction of protected farming programmes like the Horticultural Technology Mission, Pushp Kranti Yojna and Pandit Deen Dayal Kisan Bagwan Samridhi Yojna. These initiatives offered substantial subsidies, ranging from 50 to 80 percent, for greenhouse construction, encouraging many farmers to adopt this technology. The government also incentivized floriculture to boost farmers' incomes (Singh, 2017). In the study area, Carnation, Lilium, Limonium, Eustoma and Gypsophila were the main crops grown under protected conditions, with Carnations being the most prevalent. This study aimed to analyze the socio-economic status, costs and returns of cultivating these flowers, providing valuable insights into their economic viability and impact. The detailed profitability analysis serves as a guide for new farmers in commercial flower cultivation, helping them make informed investment decisions and navigate market complexities. With this knowledge in hand, aspiring farmers can confidently embark on their journey towards establishing successful flower cultivation enterprises.

MATERIALS AND METHODS

The study employed a mixed-method approach within a survey research design for the selection of respondents during 2021-22. Firstly, Mandi district was purposefully chosen for this study due to the dominance of large flower growers in the area. After that, a sample of 200 protected flower growers was selected randomly which were further categorized into two groups based on their land holdings: marginal farms (< 1 ha) and small farms (1–2 ha). Protected flower growers in the study area were identified from a list obtained from Directorate of Horticulture, *Mandi*. Five crops namely carnation, gypsophila, Lilium, Limonium and Eustoma has been selected for the study. Primary data collection was done using structured questionnaire through personal interviews, capturing information on various factors including age, education, occupation, family size, landholding, etc. Additionally, secondary data from government offices and market functionaries were gathered, including information on flower prices and government policies. Simple statistical tools like averages and percentages were used to compare, contrast and interpret the results. The sex ratio, literacy index, dependency ratio and costs were calculated using the following formulas:

$$\text{Sex ratio} = \frac{\text{Number of females}}{\text{Number of males}} \times 100$$

$$\text{Literacy index} = \frac{\sum W_i X_i}{\sum X_i}$$

Dependency ratio w.r.t total workers =

$$\frac{\text{No.of dependents in the family}}{\text{Total workers}}$$

Dependency ratio w.r.t average size of family =

$$\frac{\text{No. of dependents in the family}}{\text{Average size of family}}$$

Cost analysis: Farm management cost concepts were used to estimate the cost and returns from flower cultivation with the following formulae:

(i) Cost A_1 includes:

1. Seed/Seedling cost
2. Value of manures, fertilizers and plant protection chemicals
3. Hired human labour
4. Bullock labour
5. Owned and hired machinery
6. Irrigation charges

7. Depreciation on implements, farm buildings and irrigation structures
8. Interest on working capital
9. Other miscellaneous charges.

(ii) Cost A_2: Cost A_1 + rent paid for leased in land

(iii) Cost B_1: Cost A_1+ interest on the fixed capital

(iv) Cost B_2: Cost B_1 + rental value of owned land

(v) Cost C_1: Cost B_1 + imputed value of family labour

(vi) Cost C_2: Cost B_2 + imputed value of family labour

(vii) Cost D: Cost C_2 + value of management input (10% of Cost C_2).

RESULTS AND DISCUSSION

For a comprehensive analysis, households were categorized as marginal or small based on landholding size for analysis. Factors like family size, workforce, and literacy significantly influenced protected flower cultivation, crucial for assessing its impact and sustainability in the region. Table 1 shows the size and structure of sampled households in the study area. On an average, each family comprised 5.53 individuals, with a nearly equal distribution of males (50.49%) and females (49.51%). The literacy rate across all categories was high (94.95%), with literacy indices ranging from 2.05 to 2.22 for marginal and small categories, indicating a generally high level of education quality. Agriculture emerged as the primary occupation, with 91.52 per cent of the workforce engaged in farming activities. The overall dependency ratio, calculated with respect to total workers, was 0.55, indicating that, on average, each worker supported less than one family member. The dependency ratio based on family size was 0.36 on average in the study area.

Table 1: Demographic profile of sampled households

Particulars	Farm size		
	Marginal	Small	Overall
Average size of the Family (number)	5.32	6.82	5.53
Number of males	50.41	50.98	50.49
Number of Females	49.59	49.02	49.51
Structure of Family			
Joint Families	34.27	63.77	38.36
Nuclear Families	65.73	36.23	61.64
Literacy rate	95.09	94.12	94.95
Literacy index	2.05	2.22	2.08
Non school going	5.72	9.33	6.22
Illiterate	4.63	5.33	4.73
Services	0.17 (5.03)	0.09 (2.12)	0.16 (4.63)
Business	0.13 (3.78)	0.18 (4.26)	0.14 (3.85)
Agriculture	3.15 (91.19)	4.00 (93.62)	3.26 (91.52)
Total	3.45 (100.00)	4.27 (100.00)	3.56 (100.00)
Average family size (no.)	5.32	6.82	5.53
Average no. of workers	3.45 (64.73)	4.27 (62.62)	3.56 (64.44)
Average no. of dependents	1.87 (35.27)	2.55 (37.38)	1.97 (35.56)
Dependency ratio w.r.t. total workers	0.54	0.60	0.55
Dependency ratio w.r.t. family size	0.35	0.37	0.36

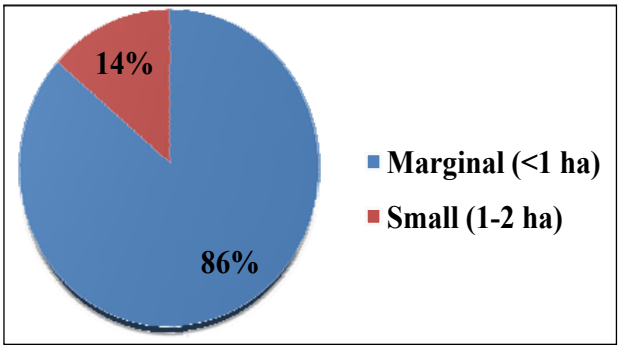

Fig. 1: Distribution of sampled households according to their land holdings

Land use pattern

The land use pattern directly influences the adoption of protected cultivation methods in an area. By strategically allocating land for greenhouse construction or other protected cultivation structures, farmers can mitigate the risks associated with adverse weather conditions. The average landholding size in the overall category was 0.61 hectares, with 11 per cent dedicated to protected flower cultivation as

shown in Fig. 2. Orchards and vegetable cultivation occupied the largest area, ranging from 64.74 per cent to 78.71 per cent of total land holdings among marginal and small farm units, respectively. Other land uses in the study area included pastures/ ghasnies (9%) and barren land (4%), with 7 per cent of total land used for non-agricultural purposes overall.

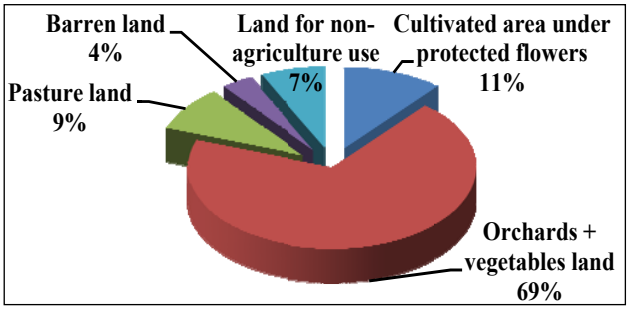

Fig. 2: Land use pattern of sampled households in overall

Average area under protected cultivation

The analysis of protected cultivation revealed that, on an average, 665.74 m^2 of land was utilized for this purpose, with variation observed across marginal and small categories, ranging from 630.64 m^2 to 885.91 m^2 as shown in Table 2. Among the five flowers grown under protected cultivation, Carnation dominated, occupying 540.38 m^2, followed by Eustoma (36 m^2), Lilium (33.74 m^2), Limonium (27.75 m^2), and Gypsophila (27.87 m^2). Carnations accounted for the largest share (81.17%) due to their extended cultivation cycle, lasting three to four years, which allows for continuous flower production. This emphasizes the profitability of cultivating flowers in the study area.

Table 2: Area of different flowers under protected cultivation in study area (Square metre)

Area under flowers	Farm size		
	Marginal	Small	Overall
Carnation	521.59	658.18	540.38
	(82.71)	(74.29)	(81.17)
Lilium	28.91	64.09	33.74
	(4.58)	(7.23)	(5.06)
Limonium	22.75	59.09	27.75
	(3.61)	(6.67)	(4.17)
Gypsophila	26.52	36.37	27.87
	(4.21)	(4.11)	(4.19)
Eustoma	30.87	68.18	36.00
	(4.89)	(7.70)	(5.41)
Total	630.64	885.91	665.74
	(100.00)	(100.00)	(100.00)

Figures in the parentheses are percentage to total.

Initial capital investment

The estimated initial capital expenditure for the construction of various sized polyhouses under various categories was estimated and results have been shown in Table 3 which shows that the total initial expenditure on polyhouses was ₹ 1,67,250, of which the total initial expenditure on polyhouses for marginal and small farm units was ₹ 1,60,289 and ₹ 2,10,909, respectively. The results showed that polyhouse cultivation is capital intensive and requires higher investment.

Table 3: Initial capital investment on polyhouses by the sampled households (₹ /Farm)

Particulars	Farm size		
	Marginal	Small	Overall
Polyhouse cost	144637.00	160909.00	146875.00
	(90.24)	(76.29)	(87.82)
Shade net	15652.00	50000.00	20375.01
	(9.76)	(23.71)	(12.18)
Total	160289.00	210909.00	167250.00
	(100.00)	(100.00)	(100.00)

Cost and returns of Carnation from protected cultivation

Carnation is a crop that may be grown for a long time, only one Carnation crop was grown for three to fourth years in each of the selected polyhouses and the plants immediately began to produce flowers and continued to do so, upto the third or fourth year after cultivation. Therefore, growing cut flowers is profitable in farming business in the study area. The price per seedling of Carnation was ranging between ₹ 10 to ₹ 12. Average cost compositions of growing Carnation under protected cultivation were studied and the results have been depicted in Table 4. At overall the total cost for cultivation of Carnation was ₹ 291.81 per square metre. The cost of planting

material per square metre was found to be higher in small farm unit ₹ 238.95 than in marginal farm unit ₹ 186.64. Overall, it was calculated that the gross income from crop was ₹ 768.02 per square metre and the estimated net returns were ₹ 476.21 per square metre. Similar research findings were reported by Gamanagatti and Patil, 2018; Balamurugan *et al*. 2023. The input output ratio for Carnation in marginal and small categories varied between 2.61 and 2.70, respectively. On the other hand, it was anticipated to be 2.63 at the overall level, which means that an investment of Rs.1 on Carnation cultivation is getting ₹ 2.63 as returns.

Table 4: Average cost and returns of Carnation cultivation in the study area (₹/m^2)

Particulars	Marginal	Small	Overall
Cost A_1	243.70	304.35	253.86
Cost B_2	249.37	312.35	259.92
Cost D	280.32	348.95	291.81
Gross Income	732.71	943.65	768.02
Net Income	452.39	594.69	476.21
Output input ratio	2.61	2.70	2.63

Cost and returns of Gypsophila from protected cultivation

Gypsophila, also known as baby's breath, is a versatile plant often utilized in floral arrangements to adorn bouquets. In its initial year, Gypsophila typically yields at least two flushes of growth. The cost per seedling of Gypsophila ranges from ₹ 30 to ₹ 35. Total cost of cultivating Gypsophila under protected cultivation was ₹ 1216.54 per square meter, as shown in Table 5.

Table 5: Average cost and returns of Gypsophila cultivation in the study area (₹/m^2)

Particulars	Marginal	Small	Overall
Cost A_1	961.30	1059.25	979.03
Cost B_2	1072.73	1204.08	1096.46
Cost D	1190.00	1336.86	1216.54
Gross Income	2177.19	2530.81	2240.98
Net Income	987.19	1193.95	1024.44
Output input ratio	1.83	1.89	1.84

At the overall level, the gross income and net income was estimated to be ₹ 2240.98 and ₹ 1024.44 per square metre, respectively. The input output ratio for Gypsophila in marginal and small categories varied between 1.83 and 1.89, respectively. However, it was estimated to be 1.84 in the study area, which indicates that a ₹ 1 investment in Gypsophila cultivation therein returns ₹ 1.84 in total. Similar results were obtained in a study conducted by Sharma *et al*. in 2014.

Cost and returns of Lilium from protected cultivation

Table 6 outlines the costs of cultivating Lilium across different farm categories. Overall, costs per square meter for A1, B2, and D were ₹ 936.26, ₹ 1033.26, and ₹ 1147.59 respectively. Small farms incurred higher total costs (₹ 1171.93/m^2) compared to marginal farms (₹ 1138.65/m^2), possibly due to more efficient resource utilization by small farmers and higher labor expenses. Lilium, due to its high investment needs, is selected by few growers, with bulb prices ranging from ₹ 30 to ₹ 35. Gajanana *et al*. (2008) also noted Lilium as a capital-intensive crop in their study in the Nilgiris district of Tamil Nadu. At overall, gross income was estimated to be ₹ 2925.63 per square metre whereas, it was recorded higher in case of small growers (₹ 3475.58/m^2) compared to marginal growers (₹ 2730.41/m^2). The overall output-input ratio for Lilium cultivation was estimated at 2.55, indicating that an investment of ₹ 1 in Lilium cultivation yields ₹ 2.55 in returns.

Table 6: Average cost and returns of Lilium cultivation in the study area (₹/Square metre)

Particulars	Farm size		
	Marginal	Small	Overall
Cost A_1	922.25	975.12	936.26
Cost B_2	1024.46	1057.31	1033.26
Cost D	1138.65	1171.93	1147.59
Gross Income	2730.41	3475.58	2925.63
Net Income	1591.76	2303.65	1778.03
Output input ratio	2.40	2.97	2.55

Cost and returns of Limonium from protected cultivation

The study analyzed the cost components of cultivating Limonium across different farm categories, summarized in Table 7. Overall, costs per square meter for A1, B2, and D were ₹ 1277.48, ₹ 1395.42, and ₹ 1552.80 respectively. Total cultivation costs were higher for small farmers (₹ 1563.37/m^2) followed by marginal farmers (₹ 1548.68/m^2), mainly due to a larger share of cost A1 (including planting material, hired labor, fertilizer, and crop protection) in small farms. Gross income averaged ₹ 2519.14/m^2 overall, with small growers earning more (₹ 2665.43/m^2) than marginal ones (₹ 2458.99/m^2). Net income ranged from ₹ 910.31/m^2 (marginal growers) to ₹ 1102.05/m^2 (small growers), with an overall estimate of ₹ 966.34/m^2. The output-input ratio for Limonium varied between 1.59 and 1.70 for marginal and small categories respectively, while it was 1.62 overall, indicating a favorable return on investment in Limonium cultivation in the study area.

Table 7: Average cost and returns of Limonium cultivation in the study area (₹/Square metre)

Particulars	Marginal	Small	Overall
Cost A_1	1264.62	1309.03	1277.48
Cost B_2	1394.51	1398.17	1395.42
Cost D	1548.68	1563.37	1552.80
Gross Income	2458.99	2665.43	2519.14
Net Income	910.31	1102.05	966.34
Output input ratio	1.59	1.70	1.62

Cost and returns of Eustoma from protected cultivation

Eustoma is grown as an annual or biennial cut flower with broadly bell- shaped, blue- purple flowers, either single or in clusters. The price per seedling of this crop ranges from ₹ 30 to ₹ 35, making it capital intensive. Overall costs per square meter of A1, B2, and D were ₹ 940.06, ₹ 1030.97 and ₹ 1140.51 respectively as shown in Table 8. Total cultivation costs (Cost D) were higher for small farmers (₹ 1247.71/m^2) compared to marginal ones (₹ 1102.77/m^2), likely due to better management practices by small farmers. Gross income is higher for small growers (₹ 2533.40/m^2) followed by marginal ones (₹ 2059.83/m^2). Net income per square meter is ₹ 957.06 for marginal and ₹ 1285.69 for small farmers, with an overall estimate of ₹ 1042.64. The output-input ratio ranges from 1.87 to 2.03 for marginal and small categories, with an overall ratio of 1.91, indicating favorable returns on investment in Eustoma cultivation.

Table 8: Average cost and returns of Eustoma cultivation in the study area (₹/Square metre)

Particulars	Marginal	Small	Overall
Cost A_1	901.68	1049.04	940.06
Cost B_2	997.40	1126.28	1030.97
Cost D	1102.77	1247.71	1140.51
Gross Income	2059.83	2533.40	2183.16
Net Income	957.06	1285.69	1042.64
Output input ratio	1.87	2.03	1.91

CONCLUSION

In conclusion, the study underscores the diverse economic potential of protected flower cultivation in Himachal Pradesh, with Limonium, Gypsophila, Lilium, Eustoma and Carnation showcasing varying levels of profitability. Limonium exhibits the highest cultivation cost at ₹ 1552.80/m^2; while Lilium emerges as the most profitable crop, with the highest gross returns at ₹ 2925.63/m^2 and the greatest net returns at ₹ 1778.03/m^2. Notably, Carnation demonstrates the most efficient output-input ratio at ₹ 2.63, indicating its viability despite lower returns. To optimize protected cultivation's success, strategies such as subsidizing polyhouse construction, providing comprehensive training in crop management and greenhouse technologies, establishing marketing cooperatives, investing in research, financial support for initial capital to farmers and promoting sustainable farming practices are crucial. Through these concerted efforts, stakeholders can nurture a favorable ecosystem for flower growers, stimulating sectoral growth and fostering broader economic development in the region.

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