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## **Economics and Institutional Aspects of Protected Cultivation of Carnation in Himachal Pradesh<sup>§</sup>**

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### **Abstract**

This paper examines the role of different institutions in promotion of protected cultivation and the benefits realized by the farmers in Solan district of Himachal Pradesh. The area under protected cultivation promoted by National Horticulture Mission, has been found nearly 1.5 lakh ha, of which 20 per cent is under greenhouse. The export-oriented carnation cultivation has been observed most profitable vis-a-vis domestic market oriented and diversified pattern of production. The study has shown that the cost of protected cultivation can be recovered in 3-5 years, depending upon the crops grown. The IRR varies from 31 per cent for carnation with capsicum to 73 per cent when only carnation is grown. The sensitivity analysis with respect to subsidy has shown that protected cultivation is sustainable even without subsidy for its cultivation. The protected cultivation has made a significant impact on the farm households in the hilly region. However, further expansion of protected cultivation will depend on the effectiveness of supporting institutions and market structure.

**Key words:** Protected cultivation, carnation cultivation, horticulture, National Horticulture Mission

**JEL Classification:** Q11, Q12, Q13, Q14

### **Introduction**

The Indian agriculture is entering a new phase where productivity, efficiency and quality are the major concerns. The sectors like horticulture and livestock are showing unprecedented growth. During the period 2007-08 to 2015-16, the horticultural production increased by about 34.30 per cent and reached 283.36 Mt in 2015-16 (NHB, 2017). Despite this impressive growth, the horticultural production is much less than the requirement. The demand target can be achieved by (i) bringing additional area under horticultural crops,

(ii) using hybrid seeds, (iii) adopting improved agrotechniques, and (iv) promoting protected cultivation (Singh and Vashist, 1999).

The protected cultivation, a technique of growing crops under controlled microclimate, is a capital-intensive activity, and the government provides subsidy for establishing greenhouses. From provision of knowledge about protected cultivation to marketing of the produce, numerous public and private institutions are performing different supportive functions. These institutions are quite active in the states of Himachal Pradesh, Maharashtra and Karnataka, and therefore, protected cultivation grew faster in these states. The hilly regions like Himachal Pradesh, Uttarakhand and Jammu & Kashmir are also called natural greenhouses. Since vegetables and flowers cultivation is a major practice in these areas, protected cultivation has emerged as the most important technology for ensuring

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higher farm productivity and income. Therefore, this paper analyses the economics of protected cultivation and discusses their implications for promotion of this technology. Specifically, the paper deals with the present status of protected cultivation in India, role of various institutions involved in its promotion, and economic feasibility of greenhouse cultivation.

### Area under Protected Cultivation

Several schemes of both central and state governments are being implemented for the promotion and development of protected cultivation. The major scheme is the National Horticultural Mission (NHM) and Horticultural Mission for North-East and Himalayan States. So, for the estimation of area under protected cultivation at the national level, the area achieved under the NHM have been taken into consideration. The area achieved under the NHM from 2005-06 to 2014-15 showed that area under protected cultivation was largest under plastic mulching, followed by naturally ventilated greenhouses. The total area bought under protected cultivation by NHM is estimated to be 1.5 lakh ha, of which 70 per cent is under plastic mulching and around 20 per cent is under greenhouses (both naturally ventilated and with fan and pad system).

### Institutional Support and Linkages

The majority of Indian farmers being small and marginal with limited resources, intervention from the

government is required for promotion and development of protected cultivation. In India, the protected cultivation technologies are still not readily adopted by farmers because of low resource base and lack of knowledge about them. A number of institutions play important roles in promotion of protected cultivation. The evidences are based on information collected from different agencies and farmers associated with protected cultivation in Solan, district of Himachal Pradesh, which has been developed as a major area for production of high-value flowers. This is due to suitable climatic conditions and support provided by various institutions and government schemes at both central and state levels.

### Data and Methodology

For this study, a sample of 40 farmers was drawn randomly from the beneficiaries under various schemes. These farmers were interviewed to collect the information on cost, production, linkages and other aspects of protected cultivation. It was found that most of the farmers practising protected cultivation were literate and the main source of information related to protected cultivation was the nearby agricultural university in Solan. Other sources of information were progressive Dochi farm, private dealers, internet and field officers. The study has shown that for 37.5 per cent of the farmers, agricultural university was the major source of information. This was followed by state department (20%) and fellow farmers (16%).

Nearly 80 per cent of the farmers had attended training programmes. Of these, 65 per cent had attended trainings organized by the state line department, 42.5 per cent had attended training in the agricultural university and around 30 per cent had attended training organized by the private dealers. This showed that farmers attend training programmes frequently and had attended trainings organized by more than one agency.

The infrastructure includes construction of polyhouse with drip irrigation system and other devices to control the environment. The government provides subsidy on infrastructure only. The farmers availing subsidy from the government get polyhouse constructed on contract basis, while some farmers construct polyhouses without subsidy also. Under the private contract, the total cost of erection was ₹ 10 lakh/1000 sqm, of which 80 per cent was paid by the

**Table 1. Area achieved under protected cultivation by NHM**

Protected cultivation	Total area (ha)
Green house structure (fan & pad system)	479
Naturally ventilated	26,423
Shade net house/ shade net	7,145
Plastic tunnel	2,607
Anti-bird / anti-hail nets	6,466
Planting material of high-value vegetables grown in poly house	947
Planting material for flowers for poly house/ shade net	903
Plastic mulching	105,047
<b>Total</b>	<b>150,017</b>

Source: National Horticulture Mission (2005-06 to 2014-15)

state government as subsidy. The farmers who constructed polyhouses without subsidy, were experienced farmers and their average cost of construction was comparatively low (₹ 6.5 lakh/1000 sq.m). The quality and life of polyhouses constructed by the farmers without subsidy was found better and longer because under the contract system, the quality of material was determined by the private contractor. The Solan market was the major source of infrastructure development. The other markets for infrastructure were Ludhiana, Bilaspur and Chandigarh. Around 87.5 per cent of the farmers opined that infrastructure constructing firm provided technical support also. After construction of polyhouses, the follow-up information provision by the state department was rather limited.

The subsidy was provided at different rates under different schemes. About 73 per cent of the farmers availed the subsidy provided by the government, whereas 27 per cent of the farmers constructed polyhouses without subsidy. The commercial banks were the major source of credit to farmers. All the loanee farmers (35%) had taken loan from the commercial banks only. Out of 73 per cent of the farmers who had availed subsidy, only 30 per cent had taken loan, and 45 per cent of the farmers who did not avail subsidy, had taken loan.

The major source of planting material was private dealers in case of both carnation and colour capsicum. About 87 per cent of the farmers purchase planting material from the private dealers and the rest 13 per cent buy from the university. For marketing of carnation, the major dealers were 'Florence Flora' (Bengaluru) and 'K.F. Bioplants' (Pune). Some of the export-oriented farmers import the planting material directly from the Netherlands. All the private dealers sell planting material of exotic varieties, and the cost includes expenditure on raising the planting material and royalty. The planting material of carnation from Pune or Bengaluru was transported by air to Delhi and then by road to Solan. The planting material is protected by the issuing authority.

One of the major reasons for development of Solan as a floriculture hub is the availability of market for its produce. The national capital Delhi is around 350 km from Solan, and the Ghazipur flower market in NCR is among the major flower markets in India. Most of the growers (80%) sell their produce in the Delhi

market. The other markets were Chandigarh and Mohali. For capsicum and other vegetables, the Azadpur (Delhi) market is among the biggest vegetable markets in Asia, and 62.5 per cent of the farmers sell their produce in this market, the other markets being Solan and Chandigarh. Around 85 per cent of the farmers sell through commission agents. Another channel was direct sale to consumers, which was followed by a few progressive farmers, who produce flowers in bulk.

### **Economics of Protected Cultivation**

A sample of 40 farmers, practising crop cultivation under protected structures in Solan district were selected randomly from the list of beneficiaries. The main characteristics of these farmers are given in Table 2. The data revealed that educational level of the majority of the respondents was senior secondary and about one-fifth of them were graduates.

**Table 2. Distribution of respondents according to their personal attributes**

(N=40)

Attributes	Category	Percentage of sample farmers
Age	Young (< 35-45 years)	55.0
	Middle (45-60 years)	35.0
	Senior (> 60 years)	10.0
Educational level	Primary	12.5
	High School	30.0
	Intermediate	37.5
	College	20.0
Farming experience	1 year	15.0
	1-5 years	22.5
	5-10 years	47.5
	More than 10 years	15.0

The majority of farmers practising protected cultivation had experience of a few years only as greenhouse technology in India is not very old. Most of the farmers have been practising farming for 5-10 years and only 15 per cent had farming experience of more than 10 years. The pioneering work in this field was done by 'Dochi Farm' situated in Chail and some farmers adopted this technology from there. Doch Farm introduced various exotic flowers and methods of their

**Table 3. Distribution of respondent-farmers according to their landholding size and area under protected cultivation (N=40)**

Type of holding/cropping	Category	Percentage of farmers
Landholding size	Marginal farmers (<1 ha)	12.5
	Small farmers (1-2 ha)	20.0
	Medium farmers (2-10 ha)	60.0
	Large (more than 10 ha)	7.5
Area under protected cultivation	Less than 1000 m <sup>2</sup>	20.0
	1000-5000 m <sup>2</sup>	40.0
	5000-10000 m <sup>2</sup>	37.5
	More than 10000 m <sup>2</sup>	2.5
Single cropping	Carnation	35.0
	Capsicum	5.0
	Other flowers (rose, gerbera)	10.0
	Carnation + Capsicum	20.0
Multiple cropping	Carnation + Other flowers	15.0
Proportion of export-oriented carnation growers		15.0

cultivation under protected structures. It served as a demonstration farm to fellow farmers, which led to faster adoption of technology.

### Land Area and Crops Grown

As shown in Table 3, the majority of farmers had medium-size landholdings with area of nearly 2 ha, of which most of the area was under pastures. The area under protected cultivation varied from 250 to 10,000 sq. m. The farmers with initial startup had less area under protected cultivation, whereas farmers with more years of experience had a larger area and diversified crops under cultivation.

The majority of the farmers grow carnation in the study area, as climate of Solan valley is suitable for its cultivation. Most of the farmers (35%) grew only carnation in greenhouses, followed by carnation and capsicum (20%). The other important crops taken by few farmers were rose and gerbera.

### Economic Feasibility of Protected Cultivation

To assess the economic feasibility of protected cultivation, various financial ratios were used. Since these ratios are influenced by the subsidy given by government, sensitivity analysis with and without subsidy was also done. One crop of carnation remains for three years in the polyhouse, so three cycles of

carnation cultivation in one polyhouse were taken for analysis. The fixed costs invested during previous years were compounded to present the period at 8 per cent rate of interest and future costs and revenues were discounted at 8 per cent to calculate feasibility at a common reference point, i.e. 2015. The economic feasibility of carnation cultivation for export-oriented flower growers was also calculated. The export-oriented growers pay more attention to the quality and size of flower stick, so they use more spacing, i.e. less plants per unit area and fetch higher prices. The economic feasibility of farmers growing diversified crops, mainly carnation, capsicum and other flowers, was also calculated.

### Carnation Cultivation

The costs and benefits of carnation cultivation in Solan district are presented in Tables 4 and 5. Table 4 shows that of the total cost, variable cost constituted 82 per cent for farmers producing for domestic market, and 84 per cent for export-oriented farmers. The fixed costs for domestic and export-oriented farmers were calculated to be 18 per cent and 16 per cent, respectively. In variable cost, the cost of labour was found to be the major cost, followed by cost of planting material. In fixed cost, interest on fixed capital and cost of infrastructure were the major costs.

**Table 4. Cost of carnation cultivation under polyhouse in Solan district**

Cost components	Domestic market	Share, %	Export-market	Share, %
<b>Fixed costs</b>				
Infrastructure	658,625	11	552,796	8
Rental value of land	19,800	1	19,800	1
Interest on fixed capital	417,335	7	344,998	8
Total fixed cost	1,095,760	18	917,594	16
<b>Variable cost components</b>				
Planting material	829,400	14	1,140,000	16
Plant protection	287,400	5	435,000	6
Fertilizer	495,800	8	795,000	11
FYM	55,200	1	94,500	1
Labour	2,213,800	37	2,485,500	35
Packaging and transportation	452,070	8	362,400	5
Interest on working capital	520,040	9	633,708	9
Total variable costs	4,853,710	82	5,914,608	84
Total cost	5,949,470	100	6,832,202	100

**Table 5. Economic benefits of carnation cultivation under polyhouse**

Returns components	Domestic Market	Export-oriented
Plants per 1000 sq. m (No.)	186,600	153,000
Flowers per plant (No.)	9.64	10.22
Price per flower (₹)	5.00	7.3
Total flowers produced (No.)*	1,794,800	1,563,660
Total revenue (₹/1000 sq.m)	8,998,267	11,469,333
Net returns (₹/1000 sq.m)	3,048,796	4,637,131
Benefit-cost ratio	1.43	1.60
Net present worth (₹)	2,002,285	3,167,946
Pay-back period (years)	3 <sup>rd</sup> year	2 <sup>nd</sup> year
Internal rate of return (%)	73	117

Note: \*Total number of flowers produced/1000 sq. m is the average of all the respondents

The flower carnation possesses high export potential and farmers having orientation towards it were more experienced and used quality planting material. The cost of their cultivation was also higher as more nutrients and labour were required. For export, the flower stick needs to be of high quality, for which farmers had to cultivate less plants per unit area. It was found that export-oriented growers could earn more revenue (150%) than farmers producing for the local market. The average price received per carnation

flower, B-C ratio, NPW and IRR were found higher for export-oriented farmers (Table 5).

#### Diversified Cultivations

The farmers were found practising diversified cropping pattern in Solan district. The major crops were carnation and colour capsicum. The colour capsicum was cultivated under polyhouse and required less investment than carnation. The cost and returns were also found to be lower in the case of diversified

**Table 6. Diversified cropping pattern of carnation**

Cost head	Carnation only	Carnation and capsicum	Carnation and other flowers	(₹/1000 sq. m)
Total fixed cost	1,095,760	1,205,356	1,258,361	
Total variable cost	4,853,710	4,794,132	5,124,118	
Total costs	5,949,470	5,999,488	6,382,479	
Gross returns	8,998,267	7,391,500	8,281,600	
Net returns	3,048,796	1,392,011	1,899,120	
Total discounted cost	4,665,320	4,522,856	5,033,824	
Total discounted returns	6,667,605	5,491,636	6,413,451	
Benefit-cost ratio	1.43	1.21	1.27	
Net present worth	2,002,285	968,780	1,379,627	
Pay-back period	3 <sup>rd</sup> year	5 <sup>th</sup> year	4 <sup>th</sup> year	
Internal rate of return (%)	73	31	38	

cropping than single carnation cropping. Table 6 shows that under diversified cropping of carnation and colour capsicum, the net present worth for carnation and diversified pattern is positive and therefore, the planting is beneficial in both the cases. The net present worth, benefit-cost ratio and internal rate of return were found to be lower as compared to the export-oriented and single carnation growing farmers. The cultivation of flowers is more profitable than cultivation of colour capsicum. So, growing flowers under polyhouse is a profitable venture for farmers in the study area.

#### Sensitivity Analysis of Economic Benefits

The economic feasibility of carnation cultivation was calculated with and without government subsidy. The sensitivity analysis for export-oriented famers revealed that cultivation without subsidy was also profitable as the farmers can have a positive net income

which is around 75 per cent of the income obtained with subsidy and IRR is as high as 58 per cent. Thus, improved farming practices and better prices in export market can make this technology financially viable for the growers. The sensitivity analysis has shown that practising protected cultivation of high-value flowers is profitable even if no subsidy were provided. This was also supported by the fact that some of the farmers had constructed their own polyhouses without availing any subsidy from the government.

Hence, the farmers can obtain nearly 55 per cent more income if subsidy is provided. However, cultivation of capsicum with carnation provides lower returns if subsidy is withdrawn (IRR 13%). Therefore, sustainability of this technology requires financial incentives from the government if low-value crops are cultivated.

**Table 7. Economic feasibility without government subsidy**

Benefits without subsidy	Carnation—domestic market	Export-oriented carnation	Diversified (carnation and colour capsicum)	(₹/1000 sq.m)
Benefit-cost ratio	1.20 (1.43)	1.39 (1.60)	1.04 (1.21)	
Net present worth	1,112,853	2,401,152	214,668	
Pay-back period	5 <sup>th</sup> year	3 <sup>rd</sup> year	7 <sup>th</sup> year	
Internal rate of return (%)	28 (73)	58 (117)	13 (31)	

*Note:* The figures within parentheses are B-C ratio and IRR with subsidy

**Table 8. Determinants of size of polyhouse for protected cultivation in Solan district**

(N=40)

Determinants		Coefficient	Standard error
Years of schooling		-77.46	98.32
Years of farming experience		176.08**	79.40
Total landholdings		22.57***	8.35
Linkages	-Public institutions	1238.80	1177.59
	-Private institutions	2068.35**	973.42
	-Fellow farmers	1055.05	1273.61
	-Financial institutions	1368.80**	634.58
	Training attended	-28.38	717.90

*Note:* \*\*\* significant at 1 per cent, and \*\* significant at 5 per cent levels

### Determinants of Size of Polyhouse

The size of polyhouse depends on several factors. The variables taken for the study were years of schooling, years of farm experience, total landholdings, institutional linkages (with public institutions, private institutions and fellow farmers), financial linkages, and trainings attended. It was hypothesized that farmers with more experience, literacy and financial linkages will have higher area under protected cultivation. The results presented in Table 8 support this hypothesis. The total landholdings, years of farm experience, linkages with private and financial institutions were the factors that significantly affected the size of polyhouse. The non-significant variables were years of schooling and linkages with public institutions. This was perhaps because all the farmers had linkages with the university and state line department for training and subsidy.

### Impact on Household Economy

The high quality and off-season produce under protected cultivation can fetch a better price in the market and can give higher income to the farmers. Diversification of agriculture towards horticultural crops has considerable potential to accelerate agricultural growth and provides an opportunity to the farmers to raise their income level (Birthal *et al.*, 2008). Most of the farmers (78%) indicated that they invested more in farm business. Nearly 72 per cent of the respondents said that higher income increased their consumption expenditure and the consumption pattern shifted towards nutritious foods like fruits and

vegetables. Only 44 per cent of the respondents stated that protected cultivation had increased value of their assets and their social expenditure had also increased. The large farmers were found spending a lower proportion of their increased income on consumption as compared to small farmers mainly because consumption expenditure of the former was already higher than of the latter. The large farmers were reported spending more on education of their children. Increase in the expenditure on social customs was nearly same for both the categories. As regards investment, a part of the increased income was invested in on-farm and off-farm activities. The small farmers mostly invested on farm and they shifted towards floriculture which is capital-intensive in nature. The large farmers invested comparatively more on non-farm activities to diversify their income portfolio. Thus, protected cultivation has a positive impact on farm households.

### Conclusions

The study has shown substantial increase in the area and production of crops grown under protected structures. The floriculture in India is identified as a sunrise industry and the Government has accorded it export-oriented status. The area covered under protected cultivation by the NHM has shown that of the total protected cultivation area, 20 per cent is under greenhouses and only 2 per cent is under fan and pad operated greenhouses.

The benefit-cost ratio, internal rate of return and pay-back period for export-oriented carnation farmers

have been found to be 1.60, 117 per cent and two years, and for domestic market-oriented cultivators, these were 1.43, 73 per cent and three years, respectively. The diversified pattern of carnation cultivation with other flowers and colour capsicum has resulted in a lower profit as compared to cultivation of carnation alone. The IRR for carnation with other flowers was 38 per cent, whereas for carnation with colour capsicum was 31 per cent. The sensitivity analysis with respect to subsidy has shown that protected cultivation is sustainable even without subsidy for carnation, but IRR reduced to 28 per cent and 58 per cent for producers of domestic and export markets, respectively. The protected cultivation has increased income of the farmers by 65 per cent. Small farmers spend most of their increased income on consumption while large farmers make non-farm investments. Thus, protected cultivation has made a significant impact on farm households in the hilly region. However, further expansion of protected cultivation will depend on the effectiveness of supporting institutions and market structure.

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