Indian Journal of Agricultural Sciences **92** (4): 460–3, April 2022/Article
https://doi.org/ 10.56093/ijas.v92i4.123966

Economic analysis of carnation (*Dianthus caryophyllus*) under protected cultivation in Maharashtra

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Received: 26 September 2020; Accepted: 25 November 2021

ABSTRACT

Protected cultivation of high-value crops offers higher productivity which in turn increases the profitability of the farm. There are a number of schemes and programs for the promotion and development of protected cultivation in India. Maharashtra is one of the states which have successfully adopted protected cultivation. Thus, the present study estimated the profitability of carnation (*Dianthus caryophyllus* L.) cultivation, its feasibility with and without government subsidy support and assessed price spread in marketing in Pune and Nasik districts of Maharashtra during 2018–19. Establishment cost of carnation under polyhouse was very high (₹12.99 lakh for 0.1 ha) but offered higher net income (₹2.22 lakh/year for 0.1 ha). Feasibility analysis in both cases: with and without subsidy for carnation cultivation is observed to be sustainable and viable. But with subsidy support, it is highly remunerative and profitable to farmers. Farmers have followed two types of marketing channels which consisted of aggregators but if we compare producer share in consumer rupee it is higher for channel I (64%) than channel II (60%). The result indicates that with subsidy support, the payback period of their investment in protected cultivation was reduced and return increased which could support higher adoption of protected cultivation among other farmers.

Keywords: Conjoint analysis, Economics, Feasibility, Marketing channel, Polyhouse cultivation, Price spread

Hi-tech horticulture is a technology that is modern, less environment dependent, capital intensive and can improve productivity and farmers' income manifold. Some of the technologies which form the basis of hi-tech horticulture are protected cultivation, genetic engineering, micro-irrigation, micro-propagation, fertigation, precision farming, high density planting, tissue culture, use of bio-inputs and use of remote sensing/GIS. Protected cultivation is a highly capital-intensive technology, which creates a favorable environment for the cultivated plants (Nordey *et al.* 2017, Harisha *et al.* 2019) and offers several advantages including higher productivity, better quality of produce, nursery raising and hardening of plants, better insect and disease management, reduced use of pesticides, off-season cultivation and efficient use of resources (Van Lenteren 2000, Kallo and Singh 2001, Sanwal *et al.* 2004, Gruda and Tanny 2014, Gruda and Tanny 2015, Yang *et al.* 2014). Advent of protected cultivation technology in India emerged during the early 1990s. Government of India is encouraging the protected cultivation by providing subsidies through many schemes and programmes. One such scheme, NHM (National Horticulture Mission) helped in bringing more area under horticultural crops in the country. Maharashtra is one of the states which have successfully adopted this scheme.

Carnation (*Dianthus caryophyllus* L.) is an important cut flower. It is the second choice of farmers after rose, mainly due to its excellent keeping quality, variety of colours and hassle-free transportation. It is grown under protected cultivation round the year and the economic bearing of the plant is 3 years. In Maharashtra, carnation is cultivated under polyhouse conditions. Government efforts in the promotion of carnation cultivation under polyhouse would mitigate climate mediated risks and increase farmers' income. Therefore, the study attempted to estimate the economics of the cultivation of carnation in order to evaluate the feasibility of polyhouse cultivation of carnation and assess the price spread in the marketing.

MATERIALS AND METHODS

The study is based on a farm survey of households that grew crops under protected and open field conditions in Pune and Nasik district of Maharashtra state. Both districts were purposively selected for the study, as these districts occupy the largest area under protected cultivation. Two blocks from each district were selected purposively which

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have the highest polyhouses and shade nets area. Further, from each block two clusters of villages were selected for the study. For sample selection in each selected cluster of the village, a random sampling procedure was followed for the primary survey of 15 farmers practicing protected cultivation from each village. Further, for the comparison, 10 farmers following the open method of cultivation were also selected randomly from the same cluster of villages. Thus, a total of 200 farmers were intensively surveyed comprising 120 farmers who practiced protected cultivation and 80 farmers who followed the open field cultivation. Information on socio-economic parameters, input use and its price, crop yield, price of farm produce, farm income, marketing cost and other related aspects was collected in 2018–19. Also, informal interviews were conducted for farm produce aggregators, wholesalers and retailers in both districts for value chain analysis. This paper specifically analyses the economic feasibility of protected cultivation of carnation under polyhouse. In our total farm household survey, 28 farmers have grown carnation in polyhouse. Further two aggregators, three wholesalers and five retailers were involved in the carnation supply chain.

Farm business analysis was done to evaluate the costs and returns of carnation cultivation under polyhouse. Costs were classified into fixed and variable costs. Rental value of owned land was charged as per the prevalent rate. Interest rate on fixed and working capital were 12% and 7% per annum, respectively. Straight line method was employed for calculation of assets based on their expected lifespan. Cost of planting material, fertilizers, plant protection chemicals, hired machine labour, hired labour, packaging and transportation are based on the actual cost incurred by the sample farmers. Cost of own planting materials, farm yard manures, machines and family labour were imputed based on prevailing rates. Irrigation charges were estimated based on the cost incurred for electricity and diesel consumption. Gross returns were calculated by multiplying the total quantity of flowers produced with the price received. Net returns were calculated by subtracting the gross returns from annual total costs.

Project evaluation methods, viz. net present value (NPV), benefit:cost ratio (BCR) and internal rate of return (IRR) was employed to evaluate the feasibility of the protected cultivation of carnation under polyhouse. Project life of the polyhouse was assumed to be 12 years. One crop of carnation remains for three years in the polyhouse, so four cycles of carnation cultivation in one polyhouse were taken for analysis.

Net present value is the difference between the present worth of benefit stream and present worth of cost stream determined following Gittinger 1982. Decision criteria was that if the present value of benefits is more than the present value of costs, then the investment made on the polyhouse would be treated as economically viable. Benefit:cost ratio is the ratio of the present worth of the benefit to the present worth of cost determined following Gittinger (1982). If BCR is more than one, then the investment made on the polyhouse can be considered economically viable. Internal rate of return is the discount rate at which net present value is equal to zero determined following Panwar *et al.* (2014). Decision criterion was that the projects with IRR more than the cost of capital should be selected. Payback period is the length of time it takes to recover the cost of an investment determined following Panwar *et al.* (2014), Nirmal *et al.* (2019).

Choice based conjoint analysis was employed to value farmers' preference for carnation. Colour, variety, yield and price were considered. Software SPSS V. 22 was employed to produce product profiles. Hypothetical good generated were shown to the respondents for ranking based on their preference. After ranking, utility or part-worth scores of each attribute were calculated.

RESULTS AND DISCUSSION

Socio-economic characteristics of sampled farmers practicing protected cultivation of carnation showed that about 86% of the farmers belong to the younger age group between 30–45 years which indicates that younger farmers are early adopters who have the intuition to adopt newer technology at a faster pace. The majority of the farmers practicing polyhouse cultivation had attended higher School (56%) followed by intermediate (30%) and graduate and above (15%). About 59% of the farmers had experience in protected farming of about 5 to 10 years, followed by 2 to 5 years (22%), less than 2 years (11%), and very few farmers (7%) had the farming experience of more than 10 years. Based on landholding, about 63% of the farmers were marginal and 37% were small. While in the case of area under polyhouse all the farmers had 0.1 ha area.

Establishment cost of carnation under polyhouse condition was worked out to be ₹12.99 lakh for the size of 0.1 h area. Government support in the form of subsidy (₹5.97 lakh) for adopter farmers was 46% of the total establishment cost. Major proportion of this cost was incurred on the polyhouse structure which accounted for 66% (₹8.6 lakh), while crop establishment constituted about 24% (₹3.13 lakh), irrigation system and equipments constituted 10% (₹1.25 lakh) of the total establishment cost. Among the polyhouse structure, the proportion of the amount spent on the structural frame was the highest which was about 42% (₹5.42 lakh) of the total establishment cost.

Variable costs form the major component in the cost of cultivation of carnation under polyhouse condition constituting 50% (₹2.30 lakh). Among the variable costs, human labour was the major item in the variable costs which constituted 33% of the total annual cost of cultivation followed by packaging and transportation (8.45%), interest on working capital (3.27%) and fertilizers (2.73%). Fixed costs were worked out to be ₹2.30 lakh (49.96%). Among the fixed costs, the interest on fixed capital was the highest (18.27%) followed by the amortized cost of crop establishment (16.51%) and depreciation on structure and equipments (13%). Average annual cost of cultivation of carnation under polyhouse was estimated to be ₹4.60 lakh for

Table 1 Feasibility analysis of protected cultivation of carnation under polyhouse for 0.1 ha area

Nature of subsidy	Benefit:cost ratio			NPV (Lakh ₹)			IRR (%)	PBP (years)
	7%	10%	12%	7%	10%	12%		
On polyhouse	1.67	1.62	1.59	21.95	17.92	15.75	90	1.65
On polyhouse and planting material	1.74	1.69	1.66	23.17	19.11	16.91	126	1.48
None	1.47	1.41	1.37	17.58	13.67	11.58	41	2.51

NPV, Net Present Value; IRR, Integrated Rate of Return; PBP, Pay Back Period.

a 0.1 ha area. Yield of carnation in a year under polyhouse cultivation was 2.07 lakh spikes for 0.1 ha area. Average price realized per flower in the market was ₹3.3. Gross and net returns of ₹4.60 lakh and ₹2.23 lakh, respectively, were realized from carnation cultivation for 0.1 ha area.

Payback period for production of carnation under polyhouse with and without subsidy support on polyhouse was estimated to be 1.65 and 2.51 years, respectively, for 0.1 ha area (Table 1). It is observed that without subsidy at a 12% discount rate, benefit:cost ratio was 1.37 for the cultivation of carnation while it improved significantly to 1.65 with the provision of subsidy on polyhouse. Similarly, the NPV increased from ₹11.58 lakh to ₹15.75 lakh. IRR was observed to be 41% without subsidy for the cultivation of carnation under polyhouse while it improved significantly to 90% with the provision of subsidy on polyhouse. Punera *et al.* (2017) reported that the investment made for cultivation of export-oriented carnation under a polyhouse with subsidy support can be recovered in <3 years and benefit:cost ratio was 1.60 and internal rate of return was 117%. Therefore, the production of carnation in a polyhouse is highly feasible and profitable with and without subsidy.

Among the attributes, colour was found to be the chief attribute with a relative importance score of 33.30%, followed by yield (29.72%), price (27.43%) and variety (9.52%). Dark pink was the most preferred colour by the farmers with a relative utility of 1.525, followed by red (0.925), and yellow and white had a negative utility value of -2.100 and -0.350, respectively. Hybrid variety was given a higher utility value of 0.313 over the local variety. High priced carnation yielded the highest relative utility value of 1.083, whereas medium price and low priced ones had relative utility value of 0.983 and -1.067, respectively. Carnation yield of >2.5 lakh flower per 0.1 ha area had highest utility value of 0.692, whereas 2 to 2.5 lakh flower and <2 lakh flower per 0.1 ha area had a relative utility value of 0.242 and -0.933, respectively. Pearson's R for the entire producers' group was 0.818 indicating a strong relation between producers' ranking and judgments of attributes.

For the marketing of carnation which is grown under protected cultivation, farmers follow two types of marketing channels. Both the channels involve aggregators through which farmers transact their produce. Majority of the farmers followed marketing channel II rather than marketing channel I. Marketing channel II was followed by 56% of the total farmers, while marketing channel I was followed by 44% of the total farmers (Table 2). In channel II, farmers have received nearly 3% higher prices in comparison to channel I but marketing cost was 12% higher for the farmers who followed channel II rather than channel I. Producer share in consumer rupee was nearly 4% higher in channel I compared to channel II. Aggregators and wholesellers are involved in the transaction of carnation in both channels. The price for the consumer in channel II was nearly 10% higher than channel I. Total marketing cost and marketing margin was also higher for channel II than channel I.

Agriculture has transformed into a commercial enterprise from being a mere livelihood. In a country like India, with nearly 80% of the farmers being small and marginal land holders (own <2 ha of land), growing high value crops which increase farmers' competitiveness in the market is important. Establishment cost of carnation under polyhouse was high, but offered higher gross and net returns. Feasibility analysis showed that without subsidy support, carnation cultivation under polyhouse is sustainable and feasible, but payback period was more

Table 2 Marketing channel followed by the polyhouse farmers for cultivation and sale of carnations

	Marketing channels									Per cent share	PSCR (%)
I	Farmers (PR=320 MC=22.16)	→	Aggregators (MC=11 MM=44)	→	Wholesaler at Pune (MC=8.5 MM=36.5)	→	Retailers (MC=17 MM=63)	→	Consumers (PP=500)	44	64
II	Farmers (PR=330 MC=22.16)	→	Aggregators (MC=15 MM=55)	→	Wholesaler at Mumbai (MC=10 MM=40)	→	Retailers (MC=18 MM=82)	→	Consumers (PP=550)	56	60

Note: PR=Price received (₹/100 flowers, PP=Price paid (₹/100 flowers); MC=Marketing cost (₹/100 flowers); MM=Marketing margin (₹/100 flowers); PSCR=Producer's share in consumer's, rupee (%).

compared to that with subsidy support. Price spread in marketing of carnation showed that the producer share in consumer rupee is highest for channel I than channel II. The result indicates that with subsidy support, the payback period of their investment in protected cultivation was reduced and returns increased.

ACKNOWLEDGEMENT

Authors are thankful to ICAR-Indian Agricultural Research Institute, New Delhi for providing financial assistance to carry out the research work.

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