

Resource use efficiency in carnation production under polyhouse conditions in Himachal Pradesh

Abstract: Flowers eloquently reflect the most sensitive, fragile, and caring feelings that our words fail to convey. Flower cultivation in polyhouses is a source of increasing revenue in the agricultural sector and it has emerged as a viable agricultural activity, especially in hilly states like Himachal Pradesh. Lower per capita cultivated land (0.12 hectares) and irrigated land (0.02 hectares) in the State necessitates a cropping pattern that would ensure highest income per unit area/labour/investment. Present study was conducted in Bilaspur district of Himachal Pradesh to assess the resource use efficiency in carnation cultivation under polyhouse conditions. A sample of 60 farmers who were using polyhouse was selected by proportional allocation method from two blocks of the district. In regard to resource use efficiency, the highest MVP to price ratio was found for manure (5.78) followed by pesticides (3.55) and labour (2.04) which were greater than unity. This implied that further increase in use of these resources would bring higher returns.

Keywords Cobb-Douglas production function, resource use efficiency, carnation, polyhouse

JEL codes C01, Q12

Introduction

Protected agriculture has emerged as the best option for efficiently utilizing land and other resources in the current era of declining land holdings and dramatic changes in weather and climate. It [offers the opportunity to](#) ~~has the potential to~~ increase the productivity of limited resources such as land, water, and electricity. It has been a blessing to marginal and small farmers, who can now make a decent living with their small plots of land and limited capital. Protected cultivation has the significant benefit of providing self-employment opportunities to the youth and rural population. Farmers can now grow exotic vegetables and flowers all year long thanks to this idea. India is the world's second-largest producer of flowers, after China. In 2017-18, flower production was

~~expected~~[projected](#) to be 1962 thousand tons of loose flowers and 823 thousand tons of cut flowers. India is [seeking](#)~~trying~~ to establish itself as a reliable floriculture supplier to the rest of the world. In the 2018-19 fiscal year, the country exported 19726.57 MT of floricultural products worth Rs.571.38 crores/81.94 million USD (APEDA, 2019). The government of Himachal Pradesh has devised a 150-crore plan to promote floriculture. Different incentives are being provided to dynamic and progressive farmers as part of the plan to enable them to engage in this worthwhile cash crop venture under the recently launched 'Himachal PushpKranti Yojna'. Therefore, an attempt [needed to be done](#) ~~to was made to~~ study resource productivity and resource use efficiency of carnation growers of Himachal Pradesh. It was found

that huge investment, lack of skilled labour, lack of cold storage facilities were the major problem for the greenhouse rose cultivation (Kumar and Ravichandran, 2017). Kumari et al. (2018) conducted a study in south Gujrat and found that attack of pest and diseases, high cost of construction of polyhouse were the major constraints faced by the Gerbera growers. In a study conducted in Solan district of Himachal Pradesh it was found that there is a need to impart regular trainings to the polyhouse farmers on the technical know-how of the growing crops under protective technology, since this technology is capital intensive (Chahal et.al., 2020).

Resource use efficiency calculations are an essential tool for modern agriculture. By helping farmers to optimize resource use, reduce costs, and improve sustainability, these calculations can help to ensure the long-term viability and profitability of farming operations. Its interpretations help farmers to use their resources, such as land, water, and fertilizers, in the most efficient way possible. This can lead to higher crop yields, increased profitability, and better environmental sustainability. The concept of resource use efficiency has been studied by [numerous many](#) researchers over time, and it continues to be an important area of Agricultural Production Economics. Bhandi and Kalirajan (2007) proposed that the strengthening of extension and educating the farmers may improve the efficiency of the farmers, which would lead to increased productivity and augment agricultural production. Patil et al. (2010) recommended that for increasing productivity, adequate technological information, efficient management practices and strong input support system should be made available for flower cultivation on large scale. In case of

marigold, it was revealed that the highest MVP to price ratio was of working capital followed by fertilizers, pesticides and manure which were greater than unity which means further increase use of resources would bring higher returns (Kolambkar et .al., 2014). The size of farm income depends on the efficiency with which farmers are able to utilize these resources. With higher efficiency in the use of scare resources, farmers can augment their income and savings. This study is aimed at exploring the profitability of carnation cultivation under polyhouse conditions in Bilaspur district of Himachal Pradesh through estimation of the extent of resource use allocation and efficiency as reflected by production function analysis.

Data and methodology

Bilaspur district of Himachal Pradesh was purposively selected for the study. Two-stage random sampling technique was used. Out of four community development blocks in district Bilaspur, two blocks namely Jhandutta and BilaspurSadar were selected randomly. The polyhouse owners who were cultivating carnation were selected from the list. Primary data from the producers on different aspects of commercial flower production were collected through the personal interview method in a structured schedule.

The following form and method of Cobb-Douglas production function was used as mentioned by Yewareet,al., (2009) in order to determine the resource productivity and resource use efficiency in carnation production.

$$Y = aX_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6}$$

Where,

Y = Number of carnation sticks
(number of sticks / ha)

X1= Labour (number of man-days/
ha)

X2= Expenditure on initial capital
(Rs. /ha)

X3= Expenditure on Planting
material (Rs. /ha)

X4= Expenditure on Manure (Rs.
/ha)

X5= Expenditure on Fertigation (Rs.
/ha)

X6= Expenditure on Pesticides (Rs.
/ha)

The efficiency of resource use in production of carnation was determined by the ratio of Marginal Value Product (MVP) to Marginal Factor Cost (MFC) of variable inputs based on the estimated regression coefficients. The coefficients from Cobb-Douglas production are used in the resource use efficiency measurement. So, efficiency of the resources was calculated by using formula:

$$r = \frac{MVP}{MFC}$$

Where,

r = Efficiency ratio

MVP = Marginal value product of a
variable input,

MFC = Marginal factor cost (Price
per unit of input)

The value of MVP was estimated using the regression coefficient of each input and the price of the output.

MVP= $MPP_{x_i} \times P_y$ (Unit price of output)

$$MPP_{x_i} = b_i \times \left(\frac{Y}{\bar{x}_i} \right)$$

Where; b_i = Estimated regression coefficient
of input X_i

Y= Geometric mean value of output

\bar{x}_i = Geometric mean value of input
being considered

The prevailing market price of input was
used as the Marginal Factor Cost (MFC).

MFC= P_{x_i}

Where,

P_{x_i} = Unit price of input x_i .

The decision rule for the efficiency analysis
was as:

r=1; Efficient use of a resource

r>1; Underutilization of a resource

r<1; Overutilization of a resource

Result and discussion

The results estimated by the Cobb-Douglas function are given in Table 1. The value of co-efficient of multiple determination (0.87) indicated that six resources together explained 87 per cent of variation in the output of the carnation production under polyhouse conditions. The elasticity co-efficient for labour (X_1), manure (X_4) and pesticides (X_6) were 0.929, 0.465 and 0.416 which indicated that one per cent increase in number of labour man-days (X_1), expenditure on manure (X_4) and expenditure on pesticides (X_6) would result in increasing the gross income by 0.929, 0.465 and 0.416 per cent, respectively. It was observed that regression co-efficient of labour, manure and working capital were positive and highly significant at 1 per cent level of probability. The elasticity co-efficient of initial cost (X_2) was 0.052 which was positive but ~~not~~ significant. The elasticity co-efficient of planting material (X_3) and fertigation (X_5) were -0.583 and -0.2, respectively suggesting that one per cent increase in number of planting material and expenditure on fertigation would result in

decrease of gross income by 0.583 and 0.2 per cent, respectively.

Table 1. Estimated coefficients of Cobb-Douglas production function for carnation production

Explanatory variables	Coefficient	Standard error	t-value
R ²	0.878		
Constant	5.6	4.86	1.15
Labour (X ₁)	0.929*	0.19	4.67
Initial Capital (X ₂)	0.052	0.06	0.75
Planting material (X ₃)	-0.583	0.26	-2.22
Manure (X ₄)	0.465*	0.11	3.96
Fertigation (X ₅)	-0.200	0.12	-1.55
Pesticides (X ₆)	0.416*	0.06	6.58

* indicate significance of value at P=0.

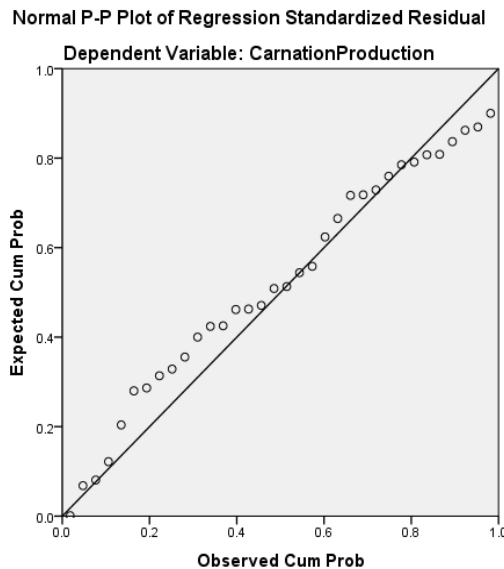


Fig .1
The resource use efficiency was estimated using the individual input elasticities obtained from Cobb-Douglas production function analysis. For each resource used in carnation production under

polyhouseconditions, Table 2 shows the marginal value product, marginal factor cost, and ratio between marginal value product and marginal factor cost. It was revealed that use of manure in carnation production showed the highest MVP to price ratio for manure (5.78) followed by pesticides (3.55) and labour (2.04) which were greater than unity. This implied that further increase in use of these resources would bring higher returns. The scope for enhancing profit by increased use of resources was evident from the analysis. On the other hand, the MVP to price ratio for initial capital was less than unity, and the MVP to price ratio for planting material and fertigation was negative, meaning that farmers could increase their benefit by using less planting material and spending less on initial costs and fertigation.

Table 2. Estimated results on resource use efficiency of carnation production

Independent variable	Geometric mean of inputs	Coefficient	MVP (Rs.)	MFC	r	Level of resource use
Labour (X ₁) (Man days)	7172.350	0.929	2.046	1.000	2.046	Under utilization
Initial Capital (X ₂) (Rs.)	1981760.000	0.052	0.145	1.000	0.145	Excess utilization
Planting material (X ₃) (number)	2177787.000	-0.583	-0.148	1.000	-0.148	Excess utilization
Manure (X ₄) (Rs.)	444333.000	0.465	5.786	1.000	5.786	Under utilization
Fertigation (X ₅) (Rs.)	704658.000	-0.200	-1.569	1.000	-1.569	Excess utilization
Pesticides (X ₆) (Rs.)	647158.000	0.416	3.554	1.000	3.554	Under utilization

Conclusion and policy implications

Carnation cultivation under polyhouse conditions is becoming increasingly popular due to the numerous advantages it offers. Polyhouses protect plants from adverse weather conditions and pests while allowing the necessary sunlight and air circulation for plant growth. The temperature inside the polyhouse must be maintained between 18°C to 24°C during the day and 12°C to 16°C at night which makes Himachal Pradesh an ideal place for carnation ~~cultivation~~ ~~cultivation~~. The humidity level inside the polyhouse must be maintained between 80% to 85%. Carnations require regular fertilization and irrigation. A balanced NPK (Nitrogen, Phosphorus, and Potassium) fertilizer must be applied every 15 days. Drip irrigation is the preferred method for irrigation, as it provides the necessary water and nutrients directly to the roots of the plants. It was found that carnation cultivation under polyhouse conditions in Himachal Pradesh requires proper planning, monitoring, and management. With the ~~proper~~ ~~right~~ techniques and practices, carnation growers can achieve high yields of quality blooms. The co-efficient of multiple ~~determination~~ ~~determinations~~ R^2 was 0.87, suggesting that the explanatory variables used in the model clarified 87 percent of the variance in carnation output. It was revealed that use of manures in carnation production indicated the highest MVP to price ratio followed by pesticides and labour which were greater than unity. This implied that further increase in use of these resources would bring higher returns.

Himachal Pradesh has immense potential for flower cultivation under polyhouse conditions, as it can help to increase farm incomes, create employment opportunities, and promote exports. However, there are several policy implications that need to be considered to boost flower cultivation under polyhouse conditions in Himachal Pradesh. Providing financial support such as subsidies, loans, and grants can help to encourage farmers to adopt polyhouse cultivation for flower production. The government can also offer tax incentives for investment in polyhouse infrastructure. Technology transfer is essential for improving productivity and efficiency in flower cultivation under polyhouse conditions. The government can establish technology transfer centers and provide training to farmers on the latest cultivation techniques, irrigation methods, pest control measures, and post-harvest management. Promoting flower cultivation under polyhouse conditions can help to increase demand for Indian flowers in domestic and international markets. The government can create marketing campaigns to promote domestic flowers, establish flower auctions, and provide support to exporters. Developing infrastructure such as roads, electricity, and water supply is essential for the successful cultivation of flowers under polyhouse conditions. The government can ~~provide~~ ~~allocate~~ funds for infrastructure development in flower cultivation regions.

Investing in research and development is crucial for improving flower cultivation techniques, developing new varieties of flowers, and increasing yields. The government can establish research and development centers to support flower cultivation under polyhouse conditions as we ~~import~~ ~~planting~~ ~~import~~ ~~planting~~ material import from other states.

Overall, boosting flower cultivation under polyhouse conditions in Himachal Pradesh requires a multi-faceted approach that involves financial support, technology transfer, marketing and promotion, infrastructure development, and research and development. By adopting these policy implications, the government can create a favorable environment for farmers to adopt flower cultivation under polyhouse conditions and increase the competitiveness of Himachal flowers in global markets.

References

- APEDA, 2019. http://apeda.gov.in/apedawebsite/SubHead_Products/Floriculture.htm. Accessed in January, 2019.
- Bhendi, M.J., Kalirajan, K. P., 2007. Technical efficiency of major food and cash crops in Karnataka (India). *Indian Journal of Agricultural Economics* 62(2), 176-192.
- Chahal, A.S., Sharma, R., Dev, K., 2020. Economic analysis of carnation under protective cultivation: A study of Mid Hills Zone of Himachal Pradesh. *Indian Journal of Ecology* 47(2), 369-377.
- Karthick, V., Alagumani T., Amarnath J.S., 2013. Resource–use efficiency and technical efficiency of turmeric production in Tamil Nadu — A stochastic frontier approach. *Agricultural Economics Research Review* 26(1), 109-114.
- Kolambkar, R.A., Suryawanshi, R.R., Shinde, H.R., Deshmukh, K.V., 2014. Resource productivity and resource use efficiency in marigold production. *International Journal of Commerce & Business Management* 7(1), 96-99.
- Kumar, M.N., Ravichandran, S., 2017. Economic of green houserose production in Krishnagiri district, India. *Journal of Floriculture and Landscaping* 3, 11-15.
- Kumari, S., Singh, N., Chaudhari, D.J., Thumar, V.M., 2018. Economic analysis of Gerbera cultivation in the protected condition in South Gujarat. *Indian Journal of Economics and Development* 14(2), 383-386.
- Naqvi, S., Ashfaq, M., 2013. Technical efficiency analysis of hybrid maize production using translog model case study in district Chiniot, Punjab (Pakistan). *Agricultural Sciences* 4, 536-540.
- Patil, E.R., Jadhav, J.D., Patil, J.B., 2010. Resource use efficiency and constraints faced by the cultivators in flower production of coastal areas. *International Journal of Commerce and Business Management* 3(1), 1-5.
- Subedi, M., Pandey, M., Ojha, R.K., Acharya, B., 2020. Production economics and resource use efficiency of tomato under open field condition in Kapilvastu, Nepal. *Journal of Agriculture and Natural Resources* 3(1), 282-289.
- Semerci, A., 2013. Determining the resource use efficiency in wheat (*Triticumaestivum* L.) production: A case study of Edirne Province – Turkey. *Bulgarian Journal of Agricultural Science* 19, 314-324.
- Tambo, J.A., Gbemu, T., 2010. Resource-use efficiency in tomato production in the Dangme west district, Ghana. Conference on International Research on Food Security, Natural Resource Management and Rural Development, ETH Zurich, September 14-16, 2010.

Tijani, B. A., Abubakar¹, M., Benisheik, K. M., and Mustapha A. B., 2010. Resource Use Efficiency in Rice Production in Jere Local Government Area of Borno State, Nigeria. Nigerian Journal of Basic and Applied Science 18(1), 27-34.

Verma, A.K., Ahirwar, R.F., Thakur, U.S., 2016. Cost of cultivation and resource use efficiency of major rabi crops in vidisha district of Madhya Pradesh. Economic Affairs 61(2), 231-237.

Yeware, P.P., Pawar, B.R., Landge V.V., Deshmukh, D.S., 2009. Resource productivity and resource use efficiency inmrugbahar sweet orange production. Asian Science 4(1-2), 32-34

UNDER PEER REVIEW