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# Economic Analysis of Input Use Efficiency of Garlic in Himachal Pradesh: A Case Study of Sirmaur District

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**Abstract**

*Garlic is the one of the most important spice crop of sub-tropical areas of the Himachal Pradesh. A sample of 60 farmers cultivating garlic was selected using multistage simple random sampling. Results of the study revealed that literacy rate in the study area were worked out to 86.10 per cent with literacy index of 2.54 indicating low quality of education. Average operational area was found 2.60 ha, out of which cultivated area was 1.13 ha and garlic accounts for 0.77 ha. It has been also observed that fertilizer, seed and human labour were significantly affecting the production but bullock labour and FYM was found to be non- significant. It has been observed that fertilizer, seed and human labour were found to be significantly under-utilized resources and increase the use of these inputs will increase production. The findings of the study strongly recommend the optimum use of the resources in order to attain desired growth in garlic cultivation and ultimately the productivity*.

**Keywords**: *Literacy status, Cropping pattern, Resource use efficiency, Garlic*

**JEL Classification:** *Q10, Q12*

## Introduction

Vegetable production in the state has increased from 25000 MT during 1951-52 to 5,30,000 MT during 1966-67 and in 2014-15 production was 14,00,000 MT (Anonymous 2015). Himachal Pradesh is having an advantage of growing vegetables as off season crop, when these cannot be produced in the plains and garlic is one of that crop. Vegetables and other cash crops play a special role in hill agriculture both at micro-level and macro-level. In general they are of high value and generate higher income. A study on economic aspects of these crops would be very useful to formulate policy measures for boosting their production. The history and destiny of our country, perhaps the whole world were influenced unbelievably by the fragrance of garlic. It is the taste of the garlic which attracted not only the Indian but the Arabs and Europeans to this country and ultimately led to the foreign domain.

Garlic (*Allium sativum* L.) belonging to the family Alliaceae is one of the most important crop among spices grown throughout the country. It is cultivated as a bulb crop and is the second most important crop after onion in India (Sankar et al., 1997). The primary centre

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of origin of garlic is Central Asia and secondary is Mediterranean region. The economic yield is obtained from its underground part known as bulb. Garlic is a compound bulb consisting of 10 to 20 bulblets, popularly called as cloves (Pruthi, 1979). These individual bulblets are enclosed in a membranous bag that is whitish or purplish in colour. In its fresh form, garlic is usually sold as a composite bulb. Garlic is noted for its pungent odour, which is caused by organic sulphur compounds. These compounds reportedly possess antibacterial properties, which have played a role in folk medicine from time immemorial. The major use of garlic is as a flavoring in cooking. It is a popular remedy for ailments and physiological disorders. Its use in different diets has a marked impact on the immune system in human beings and if taken as a component of regular diet, it does not only prevent cancer but also upgrades the cardiovascular system. It acts as stimulant, carminative, digestive, metabolic corrector and a killer of intestinal worms. It also has laxative, diuretic expectorant, anti-inflammatory, aphrodisiac and rejuvenative properties.The importance of biological and pharmacological activities, such as anti-fungal, anti-bacterial, anti-tumor, anti-inflammatory and anti-thrombotic properties of certain steroid saponins and sapogenins, such as b-chlorogenin, has been recently demonstrated (Lanzotti, 2006).

The geographical and climatic peculiarities of Himachal Pradesh in general and Sirmaur district in particular are the major gifts of nature still providing us an upper hand in the ginger and garlic cultivation. Geographical advantages of the state coupled with the sterling efforts of the people, especially in the high ranges of the Sirmaur district, help us to produce the best quality garlic favoured all over the India.

A number of spice crops are grown in the state and there are some known agro-ecological niches which have made name in garlic cultivation. Sirmaur district of the state has become famous for production of garlic and ginger, and garlic crop has importance in the farm livelihood in the district. Further, it becomes more important because more and more farmers are adopting garlic cultivation and there is significant increase in the area under garlic cultivation which needs a clear view of commercial viability of this enterprise. Thus, there is a need for analysis focusing on efficiency ratio of input use for the maximum profitability and to ensure the optimal use of scare resources in the garlic cultivation.

## Data Sources and Methodology

The present study was undertaken during 2015-16 in the Sirmaur district of Himachal Pradesh ranging in altitude from 1800 to 2500 meters has a comparative advantage of growing garlic due to suitable climatic conditions for its growth. Thus, Sirmaur district of Himachal Pradesh was selected purposively for the present study, since it holds the highest area under garlic cultivation in state. A multistage simple random sampling technique was used for the selection of the respondents. At the first stage, out of six developmental blocks in the district, Sangrah block was selected by probability proportion method. At the second stage, a complete list of villages of the selected Sangrah block, having major garlic area was prepared. From this list, five villages Chadna, Gandhuri, Chauras, Deomanal and Nohradhar were selected randomly. At the third stage, complete list of farmers of selected villages was prepared and 12 respondents were selected randomly from the each selected village. A sample of 60 farmers was drawn randomly for the collection of data.

Multiple regression analysis was carried out to find the factors influencing the garlic production and for evaluating the economic efficiency of resources. Some of the non-strategic collinear variables were dropped from the analysis to improve the precision of regression parameter. The variables considered for explaining the level of production at the farmers end in regression equations. The Cobb-Douglas production function was employed in this study as it gave the best fit compared to the linear, exponential and semi-log functional forms. The linear stochastic form of the specified Cobb-Douglas function is given as;

$$Y = aX_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} u_i$$

$$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + \log u_i$$

Y = Production per hectare (quintals)
$X_1$ = Expenditure on Fertilizers (Kg)
$X_2$ = Expenditure on Farm yard manure (quintals)
$X_3$ = Seed (Kg)
$X_4$ = Human labour (mandays)
$X_5$ = Bullock labour (pair days)
$u_i$ = Stochastic error term
a = Intercept and $b_1$ to $b_5$ are the elasticity coefficients.

**Resource-use Efficiency**

The estimated coefficients of significant independent variables were used to compute the marginal value products (MVP) and the resources-use efficiency (r) was worked out (Rahman and Lawal, 2003):

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

$$Where,\ MVP_i = \beta_i \frac{\bar{Y}}{\bar{X}} \times P_y$$

Here,
$MVP_i$ = Marginal value product of the $i^{th}$ input,
$\bar{Y}$ = Geometric mean of the value of output,
$X_i$ = Geometric mean of the ith input,
$\beta_i$ = Estimated coefficient (or) elasticity of the ith input, and
$P_y$ = Price of output.
The decision rule for the efficiency analysis is if:
r = 1; resource is been used efficiently
r >1; resource is under-utilized and increased utilization will increase profit
r <1; resource is over-utilized and decreased utilization will increase profit

**Significance of efficiency ratio**

$H_0$ = resources are efficiently used
$H_1$ = resources are inefficiently used
t statistic was used to compare with significant t table value at 0.05 level of probability.

## Results and Discussion

### Farm specific characteristics of garlic growers in the Sirmaur district

The size and structure of the family, work force and literacy status among the sampled farmers are the important factors which influencing the production. These factors determine the socio-economic well-being and standard of living of the family that plays a vital role in farm business and marketing activities. The socio-economic characteristics of sampled household in the study area have been presented in Table 1.

The perusal of table shows that total number of families has been found to be 60, out of which 36.67 per cent were joint families and 63.33 per cent nuclear families in the sampled households. The average size of family was 5.50 members per family out of which 52.80 per cent member per family were male and 47.20 per cent member per family were female in the sampled households, and number of

**Table 1. Farm specific characteristics of sampled household**

| Particulars | Value |
|---|---|
| Number of the Family | 60 |
| Joint Family (%) | 36.67 |
| Nuclear Family (%) | 63.33 |
| Average size of Family | 5.50 |
| Male (%) | 52.80 |
| Female (%) | 47.20 |
| Sex ratio | 903 |
| Literacy rate (%) | 86.10 |
| Literacy index | 2.54 |
| Service (%) | 4.74 |
| Business (%) | 7.32 |
| Agriculture (%) | 87.94 |
| Average No. of workers (%) | 78.18 |
| Average No. of dependents (%) | 21.82 |
| Dependency ratio w.r.t. family size | 0.24 |
| Average area under garlic (ha) | 0.77 |
| Irrigated land (%) | 12.39 |
| Total cultivated area (ha) | 1.13 |
| Total land holding (ha) | 2.60 |
| Cropping intensity (%) | 180.53 |
| Animal standard unit | 6.26 |

females per thousand of males were found to be 903. The literacy rate and literacy index of the study area was 86.10 per cent and 2.54, respectively. This highlights the fact that literacy rate in the study areas was quite higher, but the quality of education was poor as indicated by low literacy index. It was also observed that 78.18 per cent of the average family size was active workers and also 21.82 per cent was dependents in the family. It is noted that agriculture has the main occupation as 87.94 per cent of work force were practice farming. On an average, 4.74 per cent workers population were engaged in public/private services as secondary occupation and 7.32 per cent population engaged in business. Dependency ratio with respect to family size was found to be 0.24 in the selected households. Average size of land holding per sampled respondents was found to be 2.60 hectare, out of which 43.46 per cent hectare was cultivated area. Area under garlic has been found to be 68.14 per cent out of total cultivated land. The cropping intensity and average animal standard unit per household has been found to be 180.53 per cent and 6.26, respectively.

**Cost of cultivation of garlic crop**

The cost of cultivation of garlic included both variable cost and fixed cost. The total variable cost included the cost of labour, seed, manure, fertilizer, and interest on working capital. The fixed cost included rental value of owned land, depreciation on fixed assets, land revenue and interest on owned fixed capital. The average annual cost of garlic cultivation for different farm group was worked out and the results are presented in Table 2.

The cost of garlic cultivation was worked out to Rs. 271903 per ha. The total variable cost was found to be Rs. 257935 which contributes 94.86 per cent and contribution of the fixed cost to the total cost was 5.14 per cent. The major share in total cost of cultivation was contributes by human labour i.e. 35.16 per cent followed by seed (31.76 %). FYM (10.18%) and individual share of all other cost components was less than 5 per cent. The output input ratio was found to be 1.39 which indicates the one rupee investment leads to the profit of 0.39 paisa.

**Table 2. Cost of cultivation of garlic crop in the study area**

| Particulars | Quantity | Value (Rs/ha) |
|---|---|---|
| **Variable Cost** | | |
| Human labour (man-day/ha) | 273.16 | 95606.11 (35.16) |
| Family Labour (man-day/ha) | 225.39 | 78887.46 (29.01) |
| Hired Labour (man-day/ha) | 47.77 | 16718.65 (6.15) |
| Bullock (pair days/ha) | | 12215.7 (4.49) |
| **Material cost** | | |
| Seed (Kg/ha) | 909.05 | 86359.28 (31.76) |
| Fertilizer (Kg/ha) | 582.6 | 5534.7 (2.04) |
| FYM (Kg/ha) | 11066.55 | 27666.38 (10.18) |
| **Sub total** | | 119560.36 (43.97) |
| Interest on working capital (@9% for 4 months) | | 3950.44 (1.45) |
| Risk margin (@10% of working capital) | | 13301.16 (4.89) |
| Managerial cost (@10% of working capital) | | 13301.16 (4.89) |
| Total variable cost | | 257934.93 (94.86) |
| **Fixed Cost** | | |
| Land Revenue | | 6 (0.0022) |
| Depreciation | | 337.18 (0.12) |
| Interest on fixed capital | | 374.64 (0.14) |
| Rental value of land | | 13250 (4.87) |
| Total Fixed Cost | | 13967.82 (5.14) |
| Cost $A_1$ | | 152788.33 |
| Cost B | | 166412.97 |
| Cost C | | 245300.43 |
| Cost D | | 271902.75 (100.00) |
| Yield (Kg/ha) | 8438.80 | |
| Cost of production (Rs/kg) | | 32.31 |
| Gross Return | | 379324.1 |
| Output-input ratio | | 1.39 |

**Resource use efficiency of garlic growers in the Sirmaur district**

Resource use efficiency has been used to explain the contribution of individual input in the total output; production function analysis is helpful to evaluate the efficiency of various inputs or resources used by the farmers. The elasticity coefficient of inputs used in the production of garlic has been worked out by fitting Cobb-Douglas production function. The input-output data for garlic were converted into their respective per hectare area equivalents. The estimates of the fitted production function were used to study the effect of different variables on output, production elasticity, resource use efficiency and return to scale. The estimated regression coefficients with their standard error and the value of adjusted coefficient of multiple determination are given and discussed below.

The results of the production function analysis of garlic have been given in Table 3. In the analysis of this regression equation, five explanatory variables are included, based on the theoretical considerations. Analysis of garlic farms shows that the value of ($R^2$) is 0.58 and the same is found to be significant at 5 per cent level. This indicated that 58 per cent of variation in the total output of garlic was explained by the independent variables, included in the function. The sum of elasticity coefficients ($\sum b_i$ =0.79) is less than unity, which shows decreasing returns to scale on average farm of garlic and thus operated at over-optimal level. The inputs bullock labour and FYM has to be decreased to achieve the profit maximization level. Amongst the variable included, it has been found that fertilizer was highly significant at 1 per cent level and also similar result has been showed by Chand et al (2017) and Singh et al (2018).

**Table 3. Estimated production function of garlic growers in the Sirmaur district**

| Particulars | Value | Std error |
|---|---|---|
| Intercept | 1.70 | 0.30 |
| Human labour (X1) | 0.21** | 0.09 |
| Bullock labour (X2) | 0.01 | 0.04 |
| Seed (X3) | 0.18** | 0.08 |
| Fertilizers (X4) | 0.28* | 0.07 |
| FYM (X5) | 0.12 | 0.07 |
| $R^2$ | 0.58** | |
| $\sum b_i$ | 0.79 | |
| F-statistic | 14.81 | |

The result shows that one per cent change in fertilizer leads to change in the yield level by 0.28 per cent. It has been observed that partial regression coefficient of manure was found to be 0.12 which was positive and but found non-significant. The regression co-efficient of labour for a garlic growers has been found to be 0.21 which has been significant at 5 per cent level and similar results were presented by Chapke et al (2011). It also indicates that considering all other factors constant, one percent increase in labour would increase gross return by 0.21 per cent. The bullock labour not found to be statistically significant but it is positive which means positively affect the production. If there is one per cent change in bullock labour, the garlic production will increase by 0.01 per cent. This analysis shows that for getting the maximum output, the proper combination of these variables should be used to increase the efficiency of the resources under garlic cultivation. The regression co-efficient of seed for garlic growers have been found to be 0.18 which has been significant at 5 per cent level.

**Table 4. Efficiency of resource use in garlic production**

| Particulars | Geometric mean | APP | Elasticity coefficient | MPP | MVP | MFC | r |
|---|---|---|---|---|---|---|---|
| Human Labour | 318.34 | 34.12 | 0.21 | 7.14 | 464.18 | 300.00 | 1.55 |
| Bullock | 20.75 | 523.43 | 0.01 | 0.70 | 45.82 | 600.00 | 0.08 |
| Seed | 945.24 | 11.49 | 0.18 | 2.03 | 131.99 | 90.00 | 1.47 |
| Fertilizer | 461.59 | 23.53 | 0.28 | 6.68 | 434.32 | 12.00 | 36.19 |
| FYM | 27780.44 | 0.39 | 0.12 | 0.05 | 3.04 | 100.00 | 0.03 |

**Efficiency of Resource use in garlic cultivation**

Resource use efficiency in agriculture is defined to include the concepts of technical efficiency, allocative efficiency and environmental efficiency. Public investment, subsidies and credit for agriculture are used in an efficient manner. There are large scale inter regional as well as inter farm variations in factor productivity due to varying influence of different factors in different regions. A number of management factors such as timeliness, sowing, irrigation and application of right doses of inputs and input mix play an important role in influencing inter-farm variation in crop productivity (Haque 2006). Given the level of technology and prices of both inputs and outputs, efficiency of resource use can further be ascertained by equating the MVP to the productive MFC of resources. A resource is said to be optimally allocated if there is no significant difference between the MVP and MFC i.e. if the ratio of MVP to MFC =1.

It has been observed from Table 4 that efficiency ratio (r) in case of fertilizer was found to be greater than unity which means under utilized and increase its usage would lead to maximization of profit and the similar results were presented by Wongnaa and Ofori (2012) and Singh et al (2018). Since, FYM and bullock labour was over utilized hence there is need to reduce its usage for the profit maximization. The efficiency ratio of seed (1.47) shows that underutilization of the seed by the farmers due to lack of technical knowledge and also they do not have the knowledge about plant population in the field. This suggests that the farmers have to incur more cost in seed and increase the number of plants in the field to become more efficient. Amongst the variables under study, that human labour is greater than unity (1.55) which was also found to be under utilized and increased utilization will increase profit. The reason behind under-utilization of labour is the shifting of family labour from farm to non-farm sector. Similar results were obtained Tambo et al (2010) and Singh et al 2018.

## Conclusion and Policy Implications

The resource use efficiency of garlic production has been estimated by Cobb-Douglas production function. The study has shown that fertilizer, seed and human labour were significantly affecting the garlic production. These resources were under utilized thus there is need for proper utilization of the resources for optimum level of

production. Decreasing trends in returns to scale of garlic steers the planner to plan production strategies for long run so as to safeguard the interests of farmers' involved in production process. The balanced use of these inputs by the growers can enhance the garlic productivity. For better disposal of garlic produce, the producer-industry linkages needs to developed as this crop has potential for processing and preservation. Model of cooperative farming should be developed to ensure better marketing for the harvest of the crop. Adoption of modern farm techniques should be encouraged by creating awareness among the producers. Short term training programs should be organized in the garlic producing areas regarding the seed, high density plant population and scientific methods of cultivation in order to enhance the skill of producers to maximize the net profit.

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