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Research Paper

Profitability and Resource Use Efficiency of Cabbage Production in Temperate Zone (High- Hills) of Himachal Pradesh

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ABSTRACT

The present study pertained to the profitability and resource use efficiency of cabbage production in high hills of Himachal Pradesh. The study was based on primary data collected through a survey method for the agricultural year 2020-21. The gross and net returns over total were observed as higher in Zone-IV (₹ 296562.89 and ₹ 140713.96, respectively) in comparison to Zone-III, thus making it a profitable venture. Cobb- Douglas production function was used to determine the factors affecting the yield of cabbage in both zones. It has been observed that seed, fertilizer, FYM, irrigation and Labour were significantly affecting the production but plant protection chemical was not found significant. Efficiency ratio for cabbage in case of fertilizer, showed a negative impact on gross returns. It shows the overutilization of seed and fertilizer and adjustment in seed and fertilizer value is required. The findings of the study strongly recommend the optimum use of the resources in order to attain desired increase in cabbage cultivation and ultimately the productivity. The government should arrange a farmer training programme to ensure proper fertilizer use and other technical knowledge.

HIGHLIGHTS

- The study indicated that temperate zone (High hills) farmers were dependent on agriculture and farming was only source of income. Whereas, total cost of cultivation per hectare was highest in Zone-IV as compared to Zone-III farms.
- The study also indicated that Zone-IV farmers were more efficient and has more economies of scale as compared to Zone-III farmers.

Keywords: Profitability, production function, resource use efficiency, cabbage cultivation

Agriculture in India is primarily production-oriented, with a large number of uneven small holdings, and it is vital to the Indian economy. Agriculture, which employs approximately 56 per cent of the country's workforce, makes a significant contribution to overall economic growth and plays an important role in poverty reduction by providing employment and food security to the majority of the population. Fruit and vegetable cultivation has emerged as a profitable venture that not only provides nutritional security but also generates significant employment in rural areas and opens the door to export. India has exported 6, 82,085 metric tonnes of fresh vegetables other than onion to the world (APEDA, 2021). India is the second largest producer of vegetable next to China in the world. In India, vegetables are grown in an area 1, 03, 52 thousand hectares with the production of 1,917,69 thousand metric tones (NHB, 2021).

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Agriculture plays an important role in the economy of Himachal Pradesh as 67 per cent of the total population depends on agriculture for its livelihood. Only 11 per cent of the total geographical area is suitable for agriculture, out of which 80 per cent is rain-fed and the holdings are small and dispersed (Bala *et al.* 2011). Himachal Pradesh being a hilly state, more than 90 per cent of the population lives in villages and agriculture is the primary income source of the people in the state. The most significant accompanying change in the state's agriculture has been its shift from cereal-based subsistence agriculture to vegetable dominated commercial agriculture, particularly in temperate agro-climatic zones. Vegetables are predominantly grown throughout Himachal Pradesh's districts. The area under vegetables crop in Himachal Pradesh is 91.99 thousand hectares and production is 1,875.24 thousand metric tonnes with productivity of 20.38 MT/ha (Directorate of Economics and Statistics, 2021). In the valley areas of the district Kullu, the acreage of cereal crops has declined from 59 per cent to 5 per cent but has been recompensed by vegetable crops over a period from 1990-91 to 2002-03 (Bala and Sharma, 2005). The inputs used in the production process determine crop production and profitability. Seed is very essential input in any agricultural production system. Seed is the most important, strategic and relatively inexpensive input that determines the crop yield (Langyintuo, 2005). Inefficient use of inputs or resources leads to wastage of time, money, and effort which significantly reducing farm yield and profitability and contributing to weak agricultural economic growth. The purpose of the study was to investigate the profitability and resource use efficiency of cabbage production in Himachal Pradesh's high hills.

MATERIALS AND METHODS

Selection of the study area

Himachal Pradesh is classified into 4 agro-climatic zones. *Zone-I*: Sub-mountain, sub-tropical, low hills (Bilaspur, Hamirpur, Una, parts of Sirmaur, Kangra, Solan and Chamba), *Zone-II*: mid-hills, sub- humid (Kangra tehsil of Kangra district and Rampur tehsil of Shimla district, parts of Mandi, Kangra, Solan and Sirmour) *Zone-III*: high hills, temperate wet (Shimla, parts of Kullu, Solan, Chamba, Mandi, Kangra and Sirmaur) and *Zone-IV*: high hills, temperate dry (Kinnaur, Lahaul-Spiti and parts of Chamba) were selected. Two blocks from Zone-III (high hills, temperate wet) and Zone-IV (High hills, temperate dry) each were selected purposively for the present study.

Selection of the sample

Stratified multistage random sampling technique was used to select the ultimate respondents i.e. the vegetable growers. At first stage, two niche areas/ blocks were selected from high hill zone (Zone-III and IV) on the basis of area under vegetable cultivation. At the second stage, a list of Gram Panchayat from each selected bocks were prepared and out of which 5 Gram Panchayats were selected from each selected block. At the third stage, a list of vegetable growers of the selected Gram Panchayat was prepared and out of which 10 farmers from each selected Gram Panchayat were selected randomly for collection of primary data, thus a sample of 200 vegetable growers were selected for the present study.

Table 1: Detail of Selected blocks from each agro-climatic zone

Zones	No. of selected Blocks	No. of Selected Blocks	No. of farmers
Zone-III (high hills, temperate wet)	2	Kullu and Theog	100
Zone-IV (high hills, temperate dry)	2	Kalpa and Lahaul	100
Total	**4**		**200**

Analytical tools

Cost analysis: Following farm management cost concept was used

Cost A_1 = Cost of human hired labour, bullock labour, farm machinery, seeds, fertilizer and manure, plant protection chemicals and interest on working capital + depreciation + land revenue.

Cost A_2 = Cost A_1 + Rent paid for leased in land

Cost B_1 = Cost A_1 + Interest on value of owned fixed capital excluding land.

Cost B_2 = Cost B_1 + Rental value of owned land (net of land revenue) + Rent paid for leased in-land.

Cost C_1 = Cost B_1 + Imputed value of family labour.

Cost C_2 = Cost B_2 + Imputed value of family labour.

Cost C_3 = Cost C_2 + 10 per cent of Cost C_2 (as managerial cost)

Farm income measures

To evaluate the farm income and profits, the following measures of farm income and profit were employed.

Farm Business Income = Gross Income – Cost A_1

Family Labour Income = Gross income – Cost B_1

Net Farm Income = Gross income – Total (Cost $C_{3)}$

Farm Investment Income = Farmer Business Income – Imputed value of family labour

$$\text{Output-input ratio} = \frac{\text{Gross Income}}{\text{Cost } C_3}$$

Break-even analysis

The point at which the two curves, i.e., total cost curve and total revenue curve intersect is called the break-even point (BEP) which indicates the level of production at no profit and no loss. In other words, the quantity at which all costs allocated to a product are equal to all revenue from its sale is known as break-even point

$$\text{Break-even output} = \frac{F}{P - V}$$

$$\text{Break-even output (in monetary value)} = \frac{F}{1 - \frac{V}{P}}$$

Where,

F = Fixed costs in rupees per farm size

P = Price per quintal

V = Variable costs per quintal

Production function analysis

The elasticity of inputs/factor used in the production of vegetables has been worked out by fitting, Cobb-Douglas production function. Cobb-Douglas production function was fitted on the basis of higher value of R^2, theoretical plausibility of sign and magnitude of parameter estimate and severity of multicollinearity. The following variables, were used in order to determine the factors affecting the yields of hundred mango trees.

$$Y = aX_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6}$$

Log-log equations

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

Y = Gross returns (₹/farm)

X_1 = Expenditure on seeds/planting material (₹/farm)

X_2 = Expenditure on manure & fertilizer (₹/farm)

X_3 = Expenditure on fertilizer (₹/ farm)

X_4 = Irrigation (No.)

X_5 = Expenditure on Plant protection chemicals (₹ /farm)

X_6 = Human labor expenditure (₹/farm)

a = Intercept

b_1 to b_5 are the elasticity coefficients.

Resource-use Efficiency

To ensure maximum, profit and efficiency of resources, a cashew farmer must utilize resources at the level where their marginal value product (MVP) is equal to their marginal factor cost (MFC) under perfect competition (Tambo and Gbemu, 2010). The efficiency of a resource would be determined by the ratio, of MVP of inputs (based on the estimated regression coefficients) and the MFC.

$$MVP_{xi} = \left\{ b_i \frac{\bar{y}}{\bar{x}_1} \left(P_y \right) \right\}$$

Where,

$\bar{y}$ = Geometric mean of output

$\bar{x}_l$ = Geometric mean of inputs

b_i = Regression coefficients

i = 1, 2, 3 …n

P_y = Price of unit output

The decision rule for the efficiency analysis is if:

r = 1; resource is been used efficiently

r >1; resource is under-utilization and increased utilization will increase output.

r <1; resource is over utilized and reduction in its usage would lead to maximization of profit.

Returns to scale are estimate by the sum of the elasticity of the various inputs. The decision rule for the return to scale is that if :

$\Sigma\beta_i = 1$, implies constant returns to scale

$\Sigma\beta_i < 1$, implies decreasing returns to scale

$\Sigma\beta_i > 1$, implies increasing returns to scale

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

Costs and Returns of Vegetable Cultivation

The cost of cultivation seems to be crucial in determining the net income from various crops. Obtaining data on the cost of agricultural product cultivation provides useful information to farm planners, allowing them to identify regions where there is an economic advantage in producing different goods, as well as for the development of agro-based industries based on agricultural raw materials. These data also assist the farm planner in making proper resource allocation decisions and increasing crop production efficiency through the integration of improved farming techniques. Therefore, such data enables the experts of farm management to study the efficiency, of various cultivation practices and alter the crop planning, by reflecting the profitability that is realized from various practices.

Table 2 showed that per hectare cost of cultivation for cabbage, Cost A_1 was highest in Zone-IV (₹ 87324.78) and Cost-B_2 and Cost- C_3 was also highest in Zone-IV (₹ 102022.03), and ₹ 155848.94 as compared to Zone-III. Per hectare gross returns received from cabbage was highest in Zone-IV ₹ 296562.89 followed by Zone-III (₹ 260683.45), respectively. Farmers in Zone IV were able to receive higher prices because they supplied the majority of their produce early in the season, when prices were high. The Costs C_1 and C_2 gave the additional impression of the imputed cost of the family labour. This also indicated the fact that vegetable cultivation could generate sufficient employment in the rural and hilly areas. The cost of production per quintal was found to be highest in Zone-IV (₹ 926.59) and lowest in Zone-III (₹ 818.76) with an overall level, it was ₹ 872.68. There is no difference was registered between cost A_1 and cost A_2, which implied that the leasing-in and leasing-out of land was practiced by farmers at a very small scale. A considerably high jump was observed from cost B to cost C in cabbage crop which indicated that vegetable production was a labour-intensive venture. Similar results was reported by Bala *et al.* (2005).

Table 2: Cost and return of Cabbage cultivation in the study area (₹/ha)

Particulars	Zone-III	Zone-IV	Overall
Cost A_1	77921.72	87324.78	82623.25
Cost B_1	80734.26	89893.30	85313.78
Cost B_2	95868.95	102022.03	98945.49
Cost C_1	113339.78	129552.13	121445.96
Cost C_2	128474.46	141680.85	135077.66
Cost C_3	141321.91	155848.94	148585.43
Production (Qtl)	172.61	168.20	170.41
Gross Returns	260683.45	296562.89	278623.17
Cost of production (₹/ Qtl)	818.76	926.59	872.68

Profitabilty Measures

The primary goal of any vegetable cultivation programme is to increase land productivity, meet the basic needs of the rural population, create employment opportunities in general, and promote socioeconomic prosperity. Determining the profitability of a programme, as well as its income and employment effects, requires careful analysis. The results of the profitability measures of cabbage cultivation in the study area have been calculated based on 2020-21 prices. Among these zones, family business income for cabbage varied between ₹ 182761.73 to ₹ 209238.12 with an overall level, it was ₹ 195999.93 (Table 3).

Per hectare maximum net farm income was earned to be ₹ 140713.96 in Zone-IV and minimum in Zone III (₹ 119361.54). The Table 3 indicated that cabbage cultivation was more profitable in Zone IV as indicated by the higher output input ratio of 1.90 as compared to other zones.

Table 3: Farm profitability measures of cabbage crop

Particulars	Zone-III	Zone-IV	Overall
Yield (Qtl)	172.61	168.20	170.41
Gross Returns	260683.45	296562.89	278623.17
Farm Business Income	182761.73	209238.12	195999.93
Family Labour Income	179949.19	206669.59	193309.39
Net Farm Income	119361.54	140713.96	130037.75
Farm Investment Income	150156.21	169579.30	159867.76
Output input ratio	1.84	1.90	1.87
Break-even yield (Qtl)	29.64	29.81	29.73
Break-even returns	52173.75	52559.90	52366.83

At overall level, it was 1.87. So, cultivation of cabbage is economically feasible, since the output-input ratio was more than unity. Similar results were reported by Kumari *et al.* (2022) and also by Barwal *et al.* (2022). This relationship of costs and income with land holding shows better utilization of other input factor in order to get the maximum possible farm income.

Cobb-Douglas Production Function for Cabbage Cultivation

Table 4 showed that in Zone-III, the elasticity coefficient for FYM, fertilizer, irrigation and human labour were positive and significant at 1,5 and 10 per cent level.

Table 4: Estimates of Cob-Douglas production function for Cabbage cultivation in study area

Particulars	Coefficient		
	Zone-III	Zone-IV	Overall
Intercept	0.39 (0.12)	0.40 (0.22)	0.24 (0.12)
Seed	-0.03 (0.11)	0.29*** (0.12)	0.20** (0.10)
FYM	0.20* (0.07)	0.27 (0.21)	0.22** (0.10)
Fertilizers	0.16*** (0.10)	0.05 (0.07)	-0.13*** (0.07)
Irrigation	0.20*** (0.09)	0.31* (0.08)	0.24*** (0.12)
Plant protection chemical	0.06 (0.12)	0.27** (0.12)	0.11 (0.09)
Human labour	0.35* (0.09)	0.20 (0.28)	0.38** (0.19)
R^2	0.89	0.79	0.83
Σb_i	0.91	0.87	0.91

, **, and * significant at 1 per cent, 5 per cent and 10 per cent level of significance; Figures in parentheses are standard error.*

If there is increasing the value of FYM, fertilizers, irrigation and human labour by one per cent will be an increase in the gross returns by 0.20, 0.16, 0.20 and 0.35 per cent, respectively. Similar finding was observed by Barwal *et al.* (2022) who reported that FYM was positive and statistically significant. In case of Zone-IV, coefficient for irrigation (0.31) and plant protection chemical (0.27) were found statistically significant at 1 and 5 per cent level of significant, whereas seed (0.29) was found statistically significant at 10 per cent level. The results showed that if there is 1 per cent change in seed, irrigation, plant protection chemical the gross returns will change by 0.29, 0.31 and 0.27 per cent, respectively. At overall level, the sum of elasticity coefficient (0.91) is less than unity, which shows decreasing returns to scale.

Resource Use Efficiency of Cabbage Cultivation

Table 5 showed that efficiency ratio in these zones, efficiency ratio for all the input resources were greater than unity except the value of seed was less than unity.

Table 5: Resource use efficiency of Cabbage in the study area

Particulars	Zone-III	Zone-IV	Overall
Seed/Planting material	-0.78	0.96	0.71
FYM	1.31	2.20	1.29
Fertilizer	1.43	1.11	-2.17
Irrigation	2.40	2.06	2.29
Plant protection chemical	1.28	1.92	1.84
Human labour	1.75	1.56	1.70

It shows the overutilization of seed and adjustment in seed value is required. Similar finding was observed by Ojo *et al.* (2009) who reported an efficiency ratio for quantity of seed was over-utilized. At overall level, the ratio of MVP (Marginal Value Product) to MFC (Marginal Factor Cost) was greater than the unity for all resources used in cabbage production except fertilizer (0.71) and seed (-2.17) which was less than unity indicating the under-utilization of these resources. The efficiency ratio for fertilizer showed a negative impact on gross returns. Over utilization of fertilizer was also explored in previous studies (Taru *et al.* 2008; Ibitoye *et al.* 2015).

CONCLUSION

The study has concluded that the off-season vegetable cultivation is a highly remunerative enterprise in the study area. Vegetable production being a labour-intensive activity can provide gainful employment to the rural populace. The results indicated that cabbage cultivation was more profitable in Zone IV as indicated by the higher output input ratio of 1.90 as compared to Zone-III. So, cultivation of cabbage is economically feasible, since the output-input ratio was more than unity. In these zones, increasing returns to scale was observed which implied that doubling the inputs will result in increasing the output more than double. At overall level, The Cobb-Douglas production function for cabbage indicated that the elasticity coefficient of all the resources used by the farmers was positive and significant excluded the coefficient of fertilizer, it was negative but significant. Efficiency ratio for cabbage in case of seed and fertilizer showed a negative impact on gross returns. It shows the over-utilization of seed and fertilizer and adjustment in seed and fertilizer value is required. The government should arrange a farmer training programme to ensure proper fertilizer use and other technical knowledge.

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