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Economic analysis, production potential and technological gap in lady finger and bitter gourd: A case study of Shahnehar area of Himachal Pradesh

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Abstract

Vegetables play an important role in economic and social spheres for enhancing income and nutritional status of the people in developing countries. India is the second largest producer of vegetables in the world next to China. However, the production is not enough to meet the essential requirements of vegetables to feed current population. The study was carried out around the command area of Shahnehar irrigation project, the only major irrigation project of the state. The project has facilitated the irrigation through canal water irrigation, lift irrigation and tube-well irrigation and as a result, farmers are shifting their area from traditional farming to modern high value crops viz, vegetables. The present study, based on both primary and secondary data, examines the cost concepts, net returns, input –output relationship and technological gap of the selected vegetable crops *i.e.* lady's finger and bitter gourd. The study revealed that lady's finger was more capital intensive than bitter gourd whereas, bitter gourd gave high net returns than lady's finger. The Cobb-Douglas production function was used to examine the input output relation which showed that $\bar{R}^2$ values for lady's finger and bitter gourd were observed to be 0.97 and 0.95 respectively, thereby, indicating that included factors in the analysis significantly affected the yield of lady's finger and bitter gourd. The study revealed that critical inputs like seed and farm yard manure were being used more than the recommended levels, whereas use of plant protection measures and fertilizers showed positive technological gap for both the crops.

Key words: Command area, high value crops, capital intensive, critical inputs, economic viability.

Introduction

With the changing lifestyles and food habits, the importance of vegetables in the diet is increasing day by day. Vegetables are important source of essential nutrients to the population of the country that is largely vegetarian. Their consumption in sufficient quantities provides taste, palatability, increase appetite and provide fair amount of fiber.

Vegetables play important role in economic and social spheres for enhancing income and nutritional status of the people in developing countries. The demand for vegetables is continuously increasing at a fast rate due to increasing population pressure and also due to rising per capita income over time. However, the consumption of vegetables in India, with a large vegetarian population, is surprisingly low, only 135 gm per capita per day compared to 285 gm as recommended by the Indian Council of Medical Research (ICMR) for a balance diet (Kainth, 1996). These factors along with the increasing awareness of nutritive value of vegetables have placed vegetable farming in a distinct advantage. The net result is the significant increase in the price of the vegetables which has made vegetable lucrative to the farmers and marketers.

The alarming population growth has led to a drastic fall in per capita availability of gross and net cultivated area and the farmers are left with the opportunity of using land effectively and efficiently to earn revenue as much as possible from their limited holdings. Normally vegetable crops give higher yield per unit as compared to cereal crops. Vegetable crops if properly grown give 5-10 times more returns than cereals. Moreover, more number of crops can be taken up in a year. Presently the yield per unit area of the most of the vegetables is very low in India as compared to many other countries.

India is the second largest producer of vegetables in the world next to China with its total production of 93.0 million tones from an area of 6.30 million hectares and average productivity of 14.8 tones per hectare (INDIA, 2008). However, the production is not enough to meet the essential requirements of vegetables to feed current population of more than one billion (Singh 2002). Thus, there is enormous scope to increase the production and productivity of vegetables in the country and Himachal Pradesh is no exception.

The hilly state of Himachal Pradesh, known as a fruit bowl of the country, has vast potential for vegetable cultivation. Agriculture in hilly areas, by and large, is of subsistence nature. The farmers particularly with low land holdings have been trapped in the vicious circle of the poverty, low income, low saving and investment and thus, low productivity. Moreover, in hilly areas having short cropping season, vegetable being short duration crop gets well fitted in the cropping system. In addition, vegetable cultivation being of short duration, is a labour intensive and more number of crops can be taken up per unit of area in a year and thus, employs small and marginal farmers gainfully. Vegetables when grown organically involve less capital and can yield returns in a short span.

In Himachal Pradesh, the only major irrigation project is Shahnehar Project. This project is the joint venture of Governments of India, Himachal Pradesh and Punjab. This project is located around Sansarpur Terrace area of Himachal Pradesh and has to provide irrigation facilities to 15,287 hectares of area falling on both banks of river Beas. The length of Right Bank Canal is 48.85 Km whereas, the length of Left Bank Canal is 33 Km. The Shahnehar project has facilitated the irrigation through canal water irrigation, lift irrigation and tube-well irrigation and as a result, farmers are shifting their area from traditional farming to modern high value crops viz, vegetables and fruits.

The present study is an attempt to examine the economic viability, productivity, production potential, technological gap and input-output relationships of different inputs used in production of selected vegetable crops *i.e.* Lady's finger and bitter gourd in the study area.

Materials and Methods

The command area of Shahnehar irrigation project consists of 93 villages from Indora and Fatehpur developmental blocks of Kangra district, formed the population for the present investigation. The area is located down stream side of the major irrigation project, which facilitates the irrigation through canal, lift and tube wells. The sampling design adopted for the study was three stage random sampling technique with *Patwar* circle as the primary sampling unit; village as the secondary and operational holding (farmers/ cultivators) as the tertiary and ultimate unit of sampling. The command area of the project spreads over both sides of river Beas and are mostly termed as Left Bank Canal (LBC) and Right Bank Canal (RBC). A complete list of *Patwar* Circles for Left Bank Canal and Right Bank Canal was obtained from the office of the Executive Engineer, Shahnehar Irrigation Project, Sansarpur Terrace. Left Bank Canal had two *Patwar* Circles and Right Bank Canal had four *Patwar* Circles. One *Patwar* Circle from Left Bank Canal and two *Patwar* Circles from Right Bank Canal were randomly chosen for the selection of villages. A complete list of villages falling under selected *Patwar* circles of Left Bank and Right Bank Canal was prepared with the help of the revenue officials and the Executive Engineer, Shahnehar Irrigation Project, Division 1, Sansarpur Terrace. Out of total 47 villages of chosen *Patwar* circles, 12 villages were randomly selected in proportion to the number of villages in each circle. A complete list of farmers in the selected villages was compiled with the help of revenue officials along with their land holdings. From each selected village, seven farmers were selected, thus, making total sample size of 84 farmers for ultimate analysis.

Both primary and secondary data were collected on well designed pre-tested schedules by using survey method. The data were collected by making personal visits to the respondents.

Cost and return analysis

Various concepts used in computing cost of cultivation and net returns are as under. The calculation has been made on per hectare basis, (CACP, 2004).

Cost A_1 included the following items:

1. Wages of hired labour
2. Value of Bullock labour (Bullock Pair Days)
3. Value of tractor services (hours)
4. Value of seed
5. Value of fertilizer
6. Value of manure
7. Land revenue
8. Value of crop protection measures
9. Irrigation charges
10. Interest on working capital for half of the growth period of the crop.
11. Depreciation of fixed capital

Cost A_2:

Cost A_1 + rent paid for leased-in land

Cost B_1:

Cost A_1 + interest on the value of owned fixed capital assets (excluding land).

Cost B_2:

Cost B_1 + rental value of owned land + 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 + value of management input (10 % of Cost C_2)

Computation of gross returns

The gross returns of enterprises were estimated by using the following relationship:

$$GR = Y_M P_M + Y_B P_B$$

Where,

GR = Gross returns per hectare of crop in Rs/ha

Y_M = Yield level of the main product of the crop in q/ha

P_M = Price per quintal of the main product of the crop in Rs/ha

Y_B = Yield level of the by-product of the crop in q/ha if any

P_B = Price per quintal of the by-product of the crop in Rs/ ha

Computation of Net Returns

The net returns of the crops were calculated by using following algorithm:

NR = GR - Cost concepts

Where,

NR = Net returns over cost concepts

GR = $Y_M P_M + Y_B P_B$

and cost concepts included Cost A_1, Cost A_2, Cost B_1, Cost B_2, Cost C_1, Cost C_2 and Cost C_3 over which net returns were computed.

Input-output relationship/ regression analysis

To examine the input- output relationship, The Cobb-Douglas production function of the following form was employed

$$Y = a X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b4} X_5^{b5} X_6^{b6} X_7^{b7} X_8^{b8} X_9^{b_9} e^u$$

Where,

Y = Yield of i^{th} crop in q/ha

a = Intercept/Constant term

X_1 = Seed rate (Kg/seedlings/ha)

X_2 = Farm yard manure (q/ha)

X_3 = Fertilizer (kg/ha)

X_4 = Value of plant protection measure (Rs/ha)

X_5 = Bullock labour (Bullock Paired Days)

X_6 = Tractor services (hrs)

X_7 = Family labour (man days)

X_8 = Hired labour (man days)

X_9 = Number of irrigations

$b_1 - b_9$ = Regression coefficients/ Elasticites of Production

e^u = Error term.

To know the extent to which all the explanatory variables affect the dependent variable, the coefficient of multiple determination (R^2) was computed. The value of R^2 also increases as the number of variables in the function increases. Thus, to overcome this lacuna adjusted R^2 ($\bar{R}^2$) was computed as follows:

$$\bar{R}^2 = 1-(1-R^2)\frac{n-1}{n-K-1}$$

Where,

$\bar{R}^2$ = Adjusted coefficient of multiple determination

R^2 = Coefficient of multiple determination

n = Number of observations

K = Total number of parameters to be estimated

The significance of coefficient of multiple determinations (R^2) was tested with the help of F-test as under:

$$F_{(K,n-K)} = \frac{R^2}{1-R^2} \times \frac{K-1}{n-K}$$

Where,

R^2 = Coefficient of multiple determination

n = Number of observations

K = Total number of parameters to be estimated

Technological and yield gap

The technological and yield gap in the cultivation of selected vegetable crops were examined by using following algorithms:

Technological gap (per cent)

$$= \text{Recommended technology} - \frac{\text{Existing technology}}{\text{Recommended technology}} \times 100$$

Yield gap (per cent)

$$= \frac{\text{Potential yield} - \text{Existing yield}}{\text{Potential yield}} \times 100$$

Results and Discussion

Cost concepts

Different costs of cultivation for selected crops were estimated and depicted in Table 1. Lady's finger was an important vegetable crop in the study area. On overall farm situation, cost C_3 for lady's finger was calculated to be Rs 67,823/ha. Whereas, cost C_2, cost C_1, cost B_2, cost B_1, cost A_2, and cost A_1 were calculated to be Rs 61,658/ha, Rs 56,658/ha, Rs 45,960/ha, Rs 40,960/ha, Rs 40,752/ha and Rs 40,752/ha respectively.

Table 1. Different cost concepts on overall farms, study area (Rs/ha)

Particulars	Cost A_1	Cost A_2	Cost B_1	Cost B_2	Cost C_1	Cost C_2	Cost C_3
Lady finger	40752	40752	40960	45960	56658	61658	67823
Bitter gourd	27419	27419	27627	32627	40779	45779	50357

In case of bitter gourd, cost C_3 was observed to be Rs 50,357/ha. Whereas, cost C_2, cost C_1, cost B_2, cost B_1, cost A_2, and cost A_1 were calculated to be Rs 45,779/ha, Rs 40,779/ha, Rs 32,627/ha, Rs 27,627/ha, Rs 27,419/ha and Rs 27,419/ha respectively. The study analyzed that lady's finger was more capital intensive than bitter gourd.

Returns over different costs

Returns over different costs for different crops were shown in Table 2. On an overall farm situation, the gross returns for lady's finger were computed as Rs 1,02,366/ha and net returns (return over cost C_3) were observed to be Rs 34,543/ha. Whereas, returns over cost C_2, cost C_1, cost B_2, cost B_1, cost A_2, and cost A_1 were calculated to be Rs 40,708/ha, Rs 45,708/ha, Rs 56,406/ha, Rs 61,406/ha, Rs 61,614/ha and Rs 61,614/ha respectively.

For bitter gourd gross returns were observed to be Rs 1,01,625/ha and net return (return over cost C_3) were Rs 51,268/ha.. It was observed that small farms had maximum gross and net returns followed by medium and large farms for both crops. It was attributed to the better management on the small farms.

Table 2. Returns over different cost concepts on overall farms, study area (Rs/ha)

Particulars	Returns over cost A_1	Returns over Cost A_2	Returns over Cost B_1	Returns over Cost B_2	Returns over Cost C_1	Returns over Cost C_2	Returns over Cost C_3	Gross Returns
Lady finger	61614	61614	61406	56406	45708	40708	34543	102366
Bitter gourd	74206	74206	73998	68998	60846	55846	51268	101625

Cobb-Douglas production function

To explain the input –output relationship Cobb-Douglas production function was tried. The results of Cobb-Douglas production function have been presented in Table 3. In case of lady's finger, the regression coefficient for irrigation was found to be significant at 1 per cent level of significance (Table 3). It showed that 1 per cent increase in irrigation will increase the yield of lady's finger by 0.452 per cent keeping all other inputs constant at their geometric mean level. The value of $\overline{R}^2$ was observed to be 0.97. The value of R^2 was significant at 1 per cent level of significance and revealed that 97 per cent of variation in yield was explained by the included factors.

In case of bitter gourd the regression coefficients for all inputs were computed to be non significant (Table 4). The value of $\overline{R}^2$ was calculated as 0.95. The value of R^2 was significant at 1 per cent level of significance and thereby indicating that included factors in the analysis significantly affected the yield of lady's finger and bitter gourd.

Technological gap

In ladyfinger, maximum positive technological gap was observed in plant protection measures followed by fertilizer application (94.78 per cent and 68.29 per cent respectively). Also, it was observed that critical inputs like seed and FYM were being used more than recommended levels. The yield gap was calculated to be 13.97 per cent (Table 5).

Table 3. Cobb-Douglas production function for lady finger on all farms

Sr. No.	Particulars	Production elasticities									
		Constant	Seed	FYM	Fertilizer	Chemicals	Bullock labour	Tractor labour	Family labour	Hired labour	Irrigation
			X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
1	Production function	-0.064	0.163	0.259*	0.171	-0.023	-0.075	-0.023	0.094	0.016	0.452**
2	Standard error	0.123	0.088	0.134	0.107	0.035	0.099	0.025	0.078	0.035	0.074
3	t-value	-0.520	1.852	1.932	1.598	-0.657	-0.757	-0.92	1.21	0.457	6.108
4	R^2	0.972**									
5	$\bar{R}^2$	0.97									
6	F-value	146.552									
7	Degree of freedom	38									

** Significant at 1 per cent level of Significance
* Significant at 5 per cent level of Significance

Table 4. Cobb-Douglas production function for bitter gourd on all farms

Sr. No.	Particulars	Production elasticities									
		Constant	Seed	FYM	Fertilizer	Chemicals	Bullock labour	Tractor labour	Family labour	Hired labour	Irrigation
			X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
1	Production function	-1.164	0.034	1.721	-0.285	0.082	-1.506	-0.632	-0.291	-0.403	0.115
2	Standard error	4.086	0.047	2.087	0.229	0.091	5.004	2.125	0.206	0.523	0.221
3	t-value	-0.285	0.723	0.824	-1.244	0.901	-0.301	-0.297	-1.412	-0.770	0.520
4	R^2	0.991**									
5	$\bar{R}^2$	0.95									
6	F-value	24.942									
7	Degrees of freedom	32									

** Significant at 1 per cent level of Significance
* Significant at 5 per cent level of Significance

Table 5. Technological gap in lady finger

Sr.No.	Operations	Recommended	Existing	Technological gap (per cent)
1	Seed (Kg/ha)	12	15.78	-31.5
2	FYM(q)	100	124.33	-24.33
3	Ploughing (No)	3	2.19	27
4	Irrigation (No)	20	6	70
5	Fertilizer (Rs)	2520	799	68.29
6	Plant protection (Rs)	4375	2248	94.78
7	Yield (q/ha)	140	120.43	13.97

In bitter gourd, maximum positive technological gap was observed in fertilizer application and plant protection measures (74.20 per cent and 73.34per cent respectively). Also it was observed that critical inputs like seed and farm yard manure were being used more than the recommended levels. The yield gap was calculated to be 27.14 per cent (Table 6).

Table 6. Technological gap in bitter gourd

Sr.No.	Operations	Recommended	Existing	Technological gap (per cent)
1	Seed (kg/ha)	5	5.11	-2.2
2	FYM (q)	100	125.85	-25.85
3	Ploughing (No.)	3	2.06	31.33
4	Irrigation (No.)	20	7	65
5	Fertilizer (Rs.)	2570	663	74.20
6	Plant protection (Rs.)	4267	2406	73.34
7	Yield (q/ha)	175	127.03	27.41

Conclusion

The study of yield gap revealed that there was great potential for increasing the productivity of vegetable crops in the study area. The net returns were observed to be Rs 34,543/ha and Rs 51,268/ha from lady's finger and bitter gourd respectively, which are many fold greater than cereals. Positive technological gap were observed for plant protection measures and fertilizer application and inputs like seed and farm yard manures were observed to be used more than the recommended level. This shows that farmers of the study area required effective training and government should focus on the extension services which will help farmers to increase their technical knowhow and thereby increase in vegetable productivity.

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