Resource use efficiency in vegetable production in Manipur State

L. PRISCILLA and S.P. SINGH

Department of Agricultural Economics, College of Agriculture, G. B. Pant University of Agriculture and Technology, Pantnagar-263145(U. S. Nagar, Uttarakhand)

ABSTRACT: The study was undertaken in Thoubal district of Manipur state. Three vegetables viz., cabbage, cauliflower and peas were selected on the basis of cultivation acreage. Three stage sampling technique was employed for selection of block, villages and ultimate respondents. Al together, 60 vegetable cultivating farmers were selected for the study. To examine the resource use efficiency in vegetable production, log linear production function was fitted separately for each of the three vegetables taking yield as the dependent variable and per hectare expenditure on seed, expenditure on plant protection chemicals, expenditure on chemical fertilizers, expenditure on machine and bullock labour and expenditure on human labour were taken as the explanatory variables. It was observed that the vegetables were not cultivated according to the recommended package of practices and that these crops were grown without caring for resource productivity and resource use efficiency. The deviations from the optimal level of resource use which was found in all the three vegetables selected resulted in low productivity and efficiency of various inputs. In this regards, farmer's field trials and awareness campaigns on improved practices and correct method of use of inputs needs to be undertaken and this will ultimately benefit the producers

Key words: Cobb- Douglas, Manipur, resource use efficiency, vegetables

The horticulture sector has emerged as an economically rewarding and immensely viable option in diversification of agriculture. This sector contributed 30.4 per cent to GDP of agriculture during 2012-13 (Economic Survey, 2013-14). The total production of horticulture crops in India during 2013-14 was 277.35 Mt from an area of 24.19 Mha. Out of this, the area under and production of vegetables was more than that under fruits and other horticulture crops. During 2013-14, 162.89 Mt of vegetables was produced from an area of 9.39 Mha (Indian Horticulture Database, 2014) making India the second largest producer after China.

Vegetables occupy an important place in the food basket of the people of Manipur. Varied types of vegetables are grown in the state like cabbage, cauliflower, peas, lady's finger, brinjal etc. The diverse agro-climatic conditions of the state ranging from the temperate to tropical, fertile soils and abundance of rainfall offer an environment conducive for the production of these vegetables. Large scale cultivation of vegetables is done in the valley region of the state after the harvest of paddy, which is the staple food in the state. The total production of horticulture crops in Manipur during 2012-13 was 684.6 '000 t from an area of 84.1 '000 ha, out of which the production of vegetables was 219.8 '000 t from an area of 21.7 '000 ha (Handbook of Horticulture Statistics, 2014). The productivity of vegetables has increased from 6.2 t/ha in 2001-02 to 10.1 t/ha in 2012-13 (Indian Horticulture Database, 2014).

Vegetable production is labour intensive yet more profitable which fits well in the small farm production systems (Joshi *et al.*, 2006). Hence, it is expected that vegetable production would augment income and employment opportunities for the vegetable farmers of Manipur, majority of which falls under small and marginal category. The profitability of vegetable production is depended on the optimum use of inputs like seeds, fertilizers, plant protection chemicals, machine and bullock labour and human labour. But, inefficient use of these resources has resulted in low productivity. One way of increasing productivity by the small farmers is to efficiently use all the resources available in the production process. Successful result oriented farm planning and policies require the knowledge of productivities of farm resources to know the resources whose quantity or rate of use should be increased or decreased (Alimi, 2000). Hence, the knowledge of resource use efficiency is of great importance. Although, studies have been conducted on the resource use efficiency in vegetable production in other parts of India

such as Bhalerao *et al*. (1983), Sharma *et al.* (1992), Verma *et al.* (2004), Lokapur *et al.* (2014) etc., literature on such study for the state of Manipur is not available. Keeping this in view, the present study was carried out to find out resource use efficiency in vegetable production and to enhance the productivity and profitability in vegetable farms in Thoubal district of Manipur.

MATERIALS AND METHODS

The study was undertaken in Manipur state based on primary data. Out of the nine districts of Manipur, Thoubal district was purposively chosen as it had the highest acreage (3723 ha) under vegetable cultivation, accounting for 18.35 per cent of the total area under vegetables in the state during 2009-10 (Economic Survey Manipur, 2010**)**.

Out of Thoubal district, Thoubal block was randomly selected. A list of all vegetable-growing villages was prepared for the selected block and a sample of three villages was selected randomly. Then, the complete list of vegetable growers in the selected villages was prepared. Finally, a sample of 60 farmers was proportionally allocated among the selected villages. Three vegetables, *viz*., cabbage, cauliflower and peas were selected on the basis of area under their cultivation in the district.

The Cobb-Douglas production function was selected to establish the input-output relations as it has been widely used in farm efficiency for developing and developed countries by many authors (Beringer, 1956; Heady, 1951). In case of vegetables, (Bhalerao *et al.*, 1983) used Cobb-Douglas production function to estimate the resource use efficiency. The functional form meets the requirement of being self-dual and also it allows examining economic efficiency. This type of production function is linear in its logarithmic form, and therefore easy to estimate by using Ordinary Least Square (OLS) estimation technique. The general form of the function fitted was specified as follows:

$$Y = a\, X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} e^{u}$$

Where, Y = Gross returns in Rs/ha; X_1= Expenditure on seed in Rs/ ha; X_2= Expenditure on chemical fertilizers in Rs/ ha; X_3= Expenditure on plant protection in Rs/ ha; X_4= Expenditure on human labour in Rs/ ha; X_5= Expenditure on machine or bullock labour in Rs/ ha; u = Error term;b1, b2, b3, b4 and b5 are the respective regression coefficients (elasticity of production) of the variables.

The Marginal Value Product (MVP) of each input was worked out at its geometric mean level. To examine the economic efficiency of resource use, the marginal value product of each input was compared with its acquisition cost. The marginal cost of all inputs was considered as one rupee, since these inputs have been measured in value terms. The marginal value product (MVP) of each resource was worked out by using the following formula:

$$MVP_{Xi} = MPP_{Xi}\,(P_Y)$$

$$MVP_{Xi} = b_i \frac{\bar{Y}}{\bar{X}_i}\,(P_y)\ [\therefore MPP_{Xi} = b_i \frac{\bar{Y}}{\bar{X}_i}\ ]$$

Where, MPP_{Xi} = marginal physical product of i^{th} input; P_Y = price of output per unit (Rs.); $\bar{Y}$ = geometric mean of output; $\bar{X}_i$ = geometric mean of i^{th} input; b_i = regression coefficients (i = 1,2,……, 5)

RESULTS AND DISCUSSION

Socio- economic profile of households

The socio-economic characteristics of the farmers effect the organization and management of the farm as well as the production and disposal of the produce. An analysis of the socio-economic characteristics of any region furnishes a base for further planning and development of agriculture. Under socio- economic aspects, classification based on gender, educational profile, family size, area under vegetables, operational size of holdings, sources of irrigation, occupation, and income of the sample vegetable growers were assessed and have been presented in Table 1.

The table reveals that a significant proportion of the vegetable growers i.e., 45 per cent belonged to the middle age group of 36-50 years followed by old age group (above 50 years) constituting 36.67 per cent of the total sample. In respect of educational status, majority of the sample belonged to middle group (35 per cent) followed by high school (26.67 per cent), secondary education (18.33 per cent) and graduate and above (8.33 per cent). Also, most of the sample respondents (95 per cent) were found belonging to marginal and small category with only 5 per cent of them having a land holding of more than 1 hectare. The average size of operational holding for the respondents was found to be only 0.45 hectare. Hence, for the present study the respondent farmers were not grouped into categories.

Table 1: Socio-economic characteristics of the sample vegetable growers (N=60)

Variables	Frequency		Percentage
Age (Years)			
Young (Upto 35)	11		18.33
Middle (36 to 50)	27		45.00
Old (Above 50)	22		36.67
Level of education			
Illiterate	7		11.67
Middle	21		35.00
High school	16		26.67
Secondary	11		18.33
Graduate & above	5		8.33
Operational land holding (hectares)			
0 - 0.25	18		30
0.25 - 0.5	27		45
0.5 - 1.0	12		20
> 1 ha	3		5
Average area		0.45	
Area under vegetables (hectares)			
Cabbage			
0-0.25	35		85.37
0.26-0.50	6		14..63
0.51-1.0	-		
Average area		0.296	
Cauliflower			
0-0.25	28		80.00
0.26-0.50	6		17.14
0.51-1.0	1		2.86
Average area		0.287	
Pea			
0-0.25	21		75.00
0.26-0.50	6		21.43
0.51-1.0	1		3.57
Average area		0.219	
Annual income			
Less than 50000	6		10.00
50000- 100000	31		51.67
More than 100000	23		38.33

The table also shows the distribution of area under vegetables in the sample vegetable farms. It shows that the average area under each of the three vegetables is almost the same. The table also revealed that majority of the respondents (51.67 per cent) had an annual income between 50 thousand to 1 lakh rupees. While 38.33 per cent had an annual income of more than 1 lakh annually, 10 per cent had an annual income of less than 50 thousand rupees.

Resource Use Efficiency

The regression coefficients or production elasticities of different inputs considered in vegetable production is given in Table 2 and the ratio of marginal value productivities and marginal input costs of inputs whose regression coefficients were found statistically significant in the production function are presented in Table 3.

Table 2: Regression coefficient of production functions of Cabbage, Cauliflower and Peas

Sl. No.	Variable	Cabbage	Cauliflower	Peas
1.	Intercept	3.802	11.699	2.901
		(1.0723)	(2.49221)	(7.8079)
2.	Seed (Rs./hac)	0.040	0.651*	0.945*
		(0.037)	(0.071)	(0.353)
3.	Chemical fertilizers (Rs./ha)	0.163*	-1.070*	0.692**
		(0.049)	(0.379)	(0.347)
4.	Plant protection chemicals (Rs./ha)	0.686*	0.307*	-0.809**
		(0.102)	(0.125)	(0.409)
5.	Human labour (Rs./ha)	-0.759*	-1.077	-0.117
		(0.285)	(2.873)	(0.4)
6.	Machine and bullock labour (Rs./ha)	-0.189	1.147	0.149
		(0.285)	(0.745)	(0.323)
7.	Coefficient of determination (R2)	0.83	0.81	0.85
8.	No. of observations (N)	41	28	35

Note: Figures in parentheses are the standard errors of the regression coefficients.

* Significant at 1 per cent ; ** Significant at 5 per cent

Table 3: Estimated MVP/MIC ratios of significant variables for Cabbage, Cauliflower and Peas.

Sl. No.	Variable	Cabbage	Cauliflower	Peas
1.	Seed (Rs./hac)	-	8.61257	23.5048
2.	Chemical fertilizers (Rs./hac)	2.8877	-24.8241	22.1617
3.	Plant protection chemicals (Rs./hac)	34.2789	19.40641	-21.3007
4.	Human labour (Rs./hac)	-3.4187	-	-
5.	Machine and bullock labour (Rs./hac)	-	-	-

Table 2 reveals that the R^2 was highest for peas followed by cabbage and cauliflower with values of 0.85, 0.83 and 0.81 respectively. The table shows that on the cabbage growing farms, regression coefficient of expenditure on chemical fertilizers and expenditure on plant protection chemicals was positive and statistically significant. Expenditure on human labour was found to have a significant negative effect and indicated that a unit per cent increase in it will lead to 0.7596 per cent decrease in the yield. In case of cauliflower, the regression coefficient of expenditure on seeds and expenditure on plant protection chemicals had a significant and positive effect. Expenditure on chemical fertilizers was negative and statistically significant on the cauliflower growing farms. For peas, the regression coefficient of expenditure on seeds and expenditure on chemical fertilizers was positive and statistically significant on the pea growing farms. Expenditure on plant protection chemicals had a negative and significant effect on pea production and indicated that one per cent increase in it would result in 0.8095 per cent decrease in the productivity of pea.

From Table 3, we see that the MVP/MIC ratio of the statistically significant variables i.e., chemical fertilizers and plant protection chemicals , in case of cabbage , were greater than one indicating that the inputs have not been completely exploited and there is still scope for increasing the yield by increasing the use of these resources. But negative MVP/MIC ratio of human labour indicated that farmers were using the resource beyond the optimal level. In order to increase the yield the use of human labour has to be reduced. In case of cauliflower, the MVP/MIC ratio of the statistically significant variables i.e., seeds and plant protection chemicals being greater than one indicated that the inputs are not being efficiently utilized and level of their use has to be increased in the production process to get optimum yield. But in case of chemical fertilizers, the MVP/MIC ratio was negative (-24.8241) indicating that the farmers are using the resource beyond the optimal level. In order to increase the yield the use of chemical fertilizers has to be reduced. The MVP/MIC ratio of the statistically significant variables, i.e., seeds and chemical fertilizers being greater than one indicated that the inputs were not being efficiently utilized and level of their use needed to be

increased in the production process to get optimum yield. But in case of plant protection chemicals, ratio was negative indicating that the farmers were using the resource beyond the optimal level. In order to increase the yield, the use of plant protection chemicals had to be reduced.

CONCLUSION

The average landholding size of the sample farms has been found to be 0.45 ha. It was observed that the vegetables were not cultivated according to the recommended package of practices in the study area. The results revealed that these crops were grown without much attention to resource productivity and resource use efficiency.

In cabbage production, chemical fertilizers and plant protection chemicals were found to be used sub-optimally revealing their under utilization. This meant that the inputs have not been exploited completely and there is still scope to increase the yield by increasing the use of these resources. But, human labour was used beyond the optimal level and yield could be increased by reducing the use of human labour. In case of cauliflower, seeds and plant protection chemicals were observed to be inefficiently utilized and level of their use needed to be increased in the production process to get optimum yield. But, chemical fertilizers were used by the farmers beyond the optimal level. In order to increase the yield, the use of chemical fertilizers had to be reduced. Similarly in case of peas, seeds and chemical fertilizers were not being efficiently utilized and level of their use has to be increased in the production process to get optimum yield. But in case of plant protection chemicals, the farmers were found to use the resource beyond the optimal level and yield could be increased by reducing the use of plant protection chemicals.

The deviations from the optimal level of resource use in all the three vegetables resulted in low productivity and efficiency of various inputs. Because of lack of adequate alternative avenues of employment in the region, the human labour use in few cases was found to be excessive generating negative productivity. It is therefore suggested that new employment opportunities in the region should be provided. The study also indicated potential for generating higher income through vegetable crops. This, however, calls for adequate support in the form of development of infrastructural facility and provision for credit and fertilizer. In this regards, farmer's field trials and awareness campaigns on improved practices and correct method of use of inputs needs to be undertaken and this will ultimately benefit the producers.

REFERENCES

Alimi, T. (2000). Resource use efficiency in food crop production in Oyo State of Nigeria. *Journal of Agriculture and Environment*, 1 (1): 1-7.

Beringer, C. (1956). Estimating enterprise production functions from input-output data on multiple enterprise farms. University of Idaho. *Journal of Farm Economics*, 38:1201-1205.

Bhalerao, M.M., Ansari, S.L., and Venkateswarlu, V. (1983). Efficiency of Resource use in Vegetable Production, *The Andhra Agricultural Journal,* 30(2):112-115.

Economic Survey (2013-14), Ministry of Finance, Economic Division, Department of Economic Affairs, Govt. of India.

Economic Survey Manipur (2010), Directorate of Economics and Statistics, Govt. of Manipur.

Handbook of Horticulture Statistics (2014), Ministry of Agriculture, Department of Agriculture and Cooperation, Govt. of India, New Delhi.

Heady E.O. (1951). A production function and marginal rate of substitution in the utilization of feed resources by dairy cows. Iowa State University, *Journal of Farm Economics*, 33: 485-498.

Indian Horticulture Database (2014), National Horticulture Board, Department of Agriculture and Cooperation, Govt. of India.

Joshi, P.K., Joshi, L. and Pratap, S.B. (2006). Diversification and its impact on smallholders: Evidence from a study on vegetable production, *Agricultural Economics Research Review*, 19(2): 219-222

Lokapur, S, Kulkarni, G.N., Gamangatti, P.B. and Gurikar, R. (2014). Resource use efficiency of major vegetables in Belgaum district in Karnataka, *International Research Journal of Agricultural Economics and Statistics,* 5 (1): 108-110.

Sharma, A.K., Moorti, T.V. and Oberoi, R.C. (1992). Economics of vegetable farming in mid-hills of Himachal Pradesh, *Agricultural Situation in India*, 47(1): 11-14

Verma, A.R., Rajput, A.M. and Patidar, R.S. (2004). Economic Analysis of Production, Resource Use Efficiency and Constraints of Onion in Indore District of Madhya Pradesh, *Agricultural Marketing*, 56 (4): 22-31.

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