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Factors Affecting Yield and Profitability of Carrot in Two Districts of Punjab

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ABSTRACT

The study was conducted to determine the factors causing yield variation in carrot cultivation and its profitability in two districts of the Punjab province. Kasur and Sheikhupura districts having the largest share of area under carrot cultivation in Punjab were selected for this purpose. A total of 100 farmers, 50 from each district, were interviewed by employing pre-tested questionnaires. Results showed that the carrot growers were getting higher yield in Sheikhupura as compared to those in Kasur. The main factors contributing towards higher yield in Sheikhupura were land preparation, seed and more application of phosphorus. Nevertheless, gross income and net returns per acre were far higher in Kasur than those in Sheikhupura. The main factor was the difference in the price of output between the selected districts. Results of Cobb Douglas type production function depicted that seed, fertilizer and sowing of carrot in the months of September and October were yield enhancing variables while the yield limiting factors were high prices of inputs, limited financial resource and inadequate availability of labour during peak load period. It is concluded that great potential exists in improving the carrot yield per acre in the selected districts. Farmers' access to certified seed, better land preparation, recommended dose of seed and fertilizer and availability of credit are the major factors that can enhance the carrot production.

Key Words: Carrot; Factors; Yield; Profitability; Production function; Districts; Punjab

INTRODUCTION

Vegetable production in Pakistan is well diversified in terms of the range of vegetable species grown. The major vegetable species grown are potato, onion, chillies, tomato, melons, and other cucurbits. Vegetables are more risky to produce than field crops, such as cereals, however, the former fetch higher returns to the farmers (Ali & Hau, 2001; IFPRI, 1998; Borcz, 1992; Singh & Sikha, 1992), are relatively inexpensive and provide micronutrients at a lower unit cost than other micronutrient-rich foods such as livestock (Ali & Tsou, 1997).

Mainly vegetable area is concentrated in specialized districts in the peri-urban areas of big urban centers like Lahore, Karachi, and Peshawar. Production of potato is specialized in Okara, Sahiwal, Sialkot, and Kasur around Lahore (Chaudhry & Ahmad, 2000). Potato occupies the larger share of area (34.01%) and the second important vegetable is onion that occupies around 8.87% of total vegetable area in Punjab. The relative share of carrot is 2.67% (Ahmad *et al.*, 2004).

Carrot is an important vegetable because of its large yield per unit area and its increasing importance as human food. It is orange-yellow in colour, which adds attractiveness to foods on a plate, and makes it rich in carotene; a precursor of vitamin A. It contains abundant amounts of nutrients such as protein, carbohydrate, fibre, vitamin A, potassium, and sodium (Ahmad *et al.*, 2004).

Carrot, like other vegetables, is a short duration crop and the farming community earns enormous profits through its cultivation. The farmers having small chunk of land holdings and surplus family labour earn huge amount of profit by growing this vegetable because carrot crop requires less amount of inputs and plant protection measures. However, it is sensitive to quality of irrigation water. It grows quite well in the presence of canal irrigation or ground water with good quality.

The carrot growers need the latest information relating to cost of production and profitability of this vegetable and they are also in a dire need of information regarding various factors that affect carrot yield. Present study has been planned to estimate profitability and various factors responsible for yield variation in carrot cultivation.

MATERIALS AND METHODS

For the purpose of this study, two districts i.e. Sheikhupura and Kasur being the most important in terms of area under carrot were selected. Share of Sheikhupura and Kasur in total carrot area in the Punjab province was found to be 25.36 and 13.52%, respectively (Ahamd *et al.*, 2004). Major carrot growing villages were purposively selected with the consultation of Department of Agricultural Extension in the Sheikhupura and Kasur districts. A total of 100 farmers, 50 from each district were taken by using purposive sampling technique. A well structured and field

pre-tested comprehensive interviewing schedule was used for the collection of detailed information on various aspects of carrot crop for the year 2002-03. Survey data contained information on socio-economic characteristics of the farmers, source of irrigation, management practices, and input-output quantities.

For economic analysis, partial budgeting was used to determine profitability of carrot growing. All the analyses were done on the basis of per acre because of the ease of computation and availability and nature of data. Methodology adopted by Ahmad *et al.* (1994, 2004) was used to determine cost of various inputs and profitability of carrot cultivation.

The production function was used to estimate the extent of effects of various factors influencing carrot yield. Cobb Douglas type production function was used to determine the impact of various independent variables on yield and due to its ease in computation and interpretation. Quantitative inputs such as seed, land preparation, irrigation, labour used for weeding and fertilizer were included in the function. Farmyard manure and plant protection measure were not incorporated in the function because the respondents of carrot growers made no use of farmyard manure and plant protection was a minor problem. Also, a number of qualitative variables were included in the model in order to take into account yield variation due to these variables. Important factors affecting yield were incorporated in the analysis, many were still left out.

Consider the following Cobb-Douglas production function in general form

$$y_i = \prod_{i=1}^{m} \chi_{ij}^{\ b_i} e^{u_i}$$

Where

i = 1, 2, …., m are inputs; j = 1, 2, …..,n are farms, y_i is output of the j-th farm; χ_{ij} is the level of i-th input on the j-th farm, b_i is parameters including intercept to be estimated, u_i is error term and e is the natural exponent (Ali & Chaudhry, 1990). We can write the above production function in log linear form as

$$\ln y = A + \sum_{i=1}^{m} b_i \ln \chi_{ij} + \mu$$

Where

A = lna and all other notations are as previously defined. Description statistics about the independent variables included in the model is given in Table I while brief description is explained below:

LnLP = Natural logarithm of land preparation in tractor hours

LnSEED= Natural logarithm of seed rate per acre in kg

LnIRRI = Natural logarithm of number of irrigations applied to one acre

LnFER = Natural logarithm of fertilizer nutrients applied per acre in kg

LnWEED= Natural logarithm of cost of weeding per acre in Rs

LnFEXP = Natural logarithm of farming experience of respondents in years

LnAGE = Natural logarithm of age of the respondents in years

EDUC = Dummy variable for education. It was taken as 1 if educated otherwise zero

VAR = Dummy variable for T-29 Variety. It was taken as 1 if T-29 otherwise zero

TSEP = Dummy variable for September sowing. It was taken as 1 if September otherwise zero

TOCT = Dummy variable for October sowing. It was taken as 1 if October otherwise zero

HINTPRC= Dummy variable for high input prices. It was taken as 1 if this problem was reported otherwise zero

INADFND= Dummy variable for inadequate availability of funds. It was taken as 1 if this problem was reported otherwise zero

INADLBR= Dummy variable for inadequate availability of labour. It was taken as 1 if this problem was recorded otherwise zero

DTENURE = Dummy variable for tenancy. It was taken as 1 if owner otherwise zero.

Despite incorporation of these factors affecting yield, many were still left out. Positive correlation existence between incorporated inputs and missing variables are likely to result in an upward bias to co-efficient estimation of the inputs included in the model. Moreover, data were based on farmer's willingness and memory. Inputs were usually over-estimated and output often underestimated. The results reported in this study may be viewed under these limitations.

RESULTS AND DISCUSSION

The present study seeks to explore the profitability and efficient production packages for carrot production in the economy of Punjab, Pakistan. To achieve this objective, profitability and farm management practices have been discussed separately for each district because the carrot growers of Kasur obtained less yield as compared to those of Sheikhupura, however, the net returns per acre were far higher in Kasur district. So, it was quite suitable to carry out analysis for each district separately and in this way, the difference in the farm management practices and quantities of inputs between two districts highlighted causes for yield variation.

Cost of production. Carrot seeds germinate well in thoroughly prepared land. The respondents of Sheikhupura used more number of tractor hours (6.07) to prepare their land for carrot growing. On the contrary, the farmers of Kasur used 4.79 tractor hours for land preparation (Table II). These findings are close to 5.48 tractor hours estimated by Bakhsh (2002) in Multan. The difference in number of

Table I. Descriptive statistics of various variables

Variables	Mean	Standard error	Minimum	Maximum
Age of the respondents (years)	40.20	1.26	20.00	80.00
Farming experience (years)	22.52	1.26	3.00	65.00
Owners-cum-tenants (no.)	74	-	-	-
Educated farmers (no.)	48	-	-	-
Growing T-29 variety (no.)	52	-	-	-
Growing in September (no.)	61	-	-	-
Growing in October (no.)	6	-	-	-
Land preparation (tractor h ac^{-1})	5.43	0.14	3.00	10.00
Seed (kg ac^{-1})	8.35	0.22	5.00	14.00
Fertilizer (kg ac^{-1})	34.64	21.28	00.00	103.00
Irrigation (no. ac^{-1})	5.81	1.83	3.00	10.00
Weeding (Rs. ac^{-1})	1018.85	862.54	200.00	4600.00
Claiming high input prices (no.)	32	-	-	-
Claiming shortage of labour (no.)	30	-	-	-
Claiming limited finance (no.)	31	-	-	-
Yield (kg ac^{-1})	7599	357.70	3000	16000

tractor hours is due to type of soil under carrot cultivation in each district.

Given the other factors, seed rate determines the plant population and thus is an important factor in determining yield. It was observed that the respondents of Kasur used 6.74 kg seed, which was far below the recommended rate. They were also the early growers of carrot. Early sowing of carrot requires more seed per acre because of low germination of seed when temperature is high especially in the month of August. That was one of the important reasons that they obtained low yield per acre. The respondents of Sheikhupura used recommended levels of seed and thus, obtained higher yield. Seed rate was statistically different between Sheikhupura and Kasur (Table II).

Fertilizer is the major farm input in vegetable production. Use of nitrogen was almost the same between the selected districts. However, use of phosphorus was statistically higher in Sheikhupura (13.84 kg) than in Kasur (7.69 kg). Irrigation is essential for increasing the efficiency of inputs and enhancing cropping intensity and crop productivity (Dhawan, 1988; Vaidyanathan *et al.*, 1994; Narayanamoorthy, 1996). Efficient use of available water is an important means to expand irrigation benefits. Number of irrigations by using own tube-well ranged from 1.62 to 5.00 and in case of fields irrigated by purchased tube-well water, the number varied from 1.44 to 3.02 (Table II).

It is generally considered that carrot crop needs less use of plant protection measures as insect or disease attack is a minor problem. But in Kasur, it was observed that the carrot-growing respondents made use of pesticides because of insect attack. The number of sprays applied was 0.38. On the other hand, carrot-growing farmers of Sheikhupura made no use of pesticide (Table II).

Total cost and variable cost per acre incurred on carrot cultivation were higher in Kasur (Rs. 12874.00 & 11293.66) than those of Sheikhupura (Rs. 12571.95 & 10684.64). This was due to more number of irrigations, more use of

Table II. Input Use and Cost of Production in Sheikhupura and Kasur

Particular		Sheikhupura			Kasur		
	Unit	Quantity	Rate (Rs)	Amount (Rs)	Quantity	Rate (Rs)	Amount (Rs)
Land preparation	T.hours	6.07[a]	220	1335.40	4.79[b]	232	1111.28
Seed	Kg	9.97[a]	130.76	1303.68	6.74[b]	140.20	944.95
Sowing	Hours	0.52[a]	12.18	6.33	0.50[a]	12.15	6.08
Fertilizers							
N	Kg	23.68[a]	22.04	521.91	24.06[a]	21.15	508.87
P	Kg	13.84[a]	26.78	370.64	7.69[b]	27.74	213.32
Labour	Hours	0.76[a]	12.18	9.26	0.63[a]	12.15	7.66
Irrigation							
Own tube-well	No.	1.62[a]	156.88	254.15	5.00[b]	163.40	817.00
Purchased t-well	No.	3.02[a]	210.76	636.50	1.44[b]	206.18	296.90
Labour	Hours	11.97[a]	12.18	145.80	14.51[b]	12.15	176.30
Plant protection	No.	--	--		0.38	163.33	62.07
Labour	Hours	--	--		0.64	12.15	7.78
Weeding/Hoeing							
a. Labor	Hours	70.43[a]	12.18	857.84	72.71[a]	12.15	883.43
b. Weedicide	No.	0.08[a]	345	27.60	0.14[a]	282.86	39.60
Labour	Hours	0.01[a]	12.18	0.12	0.04[a]	12.15	0.48
Harvesting							
Labour	Hours	309.82[a]	12.18	3773.61	297.22[a]	12.15	3611.22
Transportation	Kg	8010.00[a]	0.18	1441.80	6516.8[a]	0.40	2606.72
Land rent	Rs.			1772.17			1465.20
Water rates				115.14			115.14
		Total cost		12571.95[a]			12874.00[a]
		Variable cost*		10684.64[a]			11293.66[a]
Cost/kg				1.57[a]			1.98[a]

* It includes cost of land preparation, seed, fertilizer, irrigation, pesticides and labour.

Different superscript in a row implies that the hypothesis of equality in parameter values across the districts was rejected, while the same superscript implies that the hypothesis of equal parameter value cannot be rejected at the 15% level by using F-test.

pesticides and higher transportation cost for marketing the produce in Kasur district (Table II). Bakhsh (2002) calculated approximately the same cost for carrot cultivation in Multan district. The cost per kg of carrot cultivation was Rs. 1.57 in Sheikhupura as compared to Rs. 1.98 in Kasur district (Table II). The lower cost per kg was due to higher per acre yield in Sheikhupura.

Returns from carrot cultivation. Time of sowing affects the yield per acre. Late sowing improves the yield of carrot because of low temperature. It was found that majority of carrot growers of Sheikhupura planted their crop in September and October. So, yield per acre was higher in Sheikhupura (8010 kg) as compared to that in Kasur (6516.80 kg). However, the price of their produce was lower as compared to that in Kasur (Table III).

In spite of statistically higher cost of growing one acre of carrot and lower yield per acre, gross income, gross margin and net returns per acre were estimated far higher in Kasur than those in Sheikhupura. This was the result of higher output price in Kasur. The respondents of Kasur were early growers of carrot crop, so, they received higher prices for their produce. Gross income and net returns per kg and per 40 kg were estimated statistically significant between the selected districts (Table III).

Production function analysis. The statistics of the Cobb Douglas type production function indicated that the model performed excellent in correctly foretelling about the increase in yield of carrot. The value of R^2 and adjusted R^2 came to be 0.612 and 0.543, respectively showing that the model fitted the data well. The value of R^2 indicated that independent variables included in the model contributed 61% in the yield of carrot. Results of production function are reported in Table IV.

Coefficient of land preparation (LnLP) had a positive sign. However, it was statistically non-significant. Seed (LnSEED) with positive coefficient was statistically significant at one% probability level. One% increase in seed rate was found improving the yield of carrot by 0.337%. This implies that well populated fields of carrot have a greater chance for obtaining the higher yield per acre. Although statistically non-significant, number of irrigation (LnIRRI) was found negatively affecting the yield of carrot. It was due to poor quality of ground water. Excess use of this type of water causes decrease in yield per acre and also badly affect the soil fertility. Bakhsh *et al.* (2005) and Bakhsh and Hassan (2005) estimated negative effect of poor quality of water on carrot and radish cultivation, respectively. Fertilizer use (LnFER) had a positive coefficient implying that when other variables were held constant, it increased the yield by 0.062% by using additional one% fertilizer. Although statistically non-significant, cost incurred on weeding (LnWEED) showed that better weed management could increase the yield up to 0.039% when weed management expenditures were increased by one%. The coefficients of farming experience (LnFEXP) and age of the farmers were statistically non-significant. Education is considered as an important tool to enhance the productivity of labour and agriculture. Dummy variable of education (EDUC) being one of the crucial qualitative variables was positive. This implied that one% increase in education level caused an increase in yield by 0.103%. Since the relationship between education and agricultural development is a two way. First relates to positive effect of education on agricultural output and second is that increase in agricultural production raises farm incomes, and this might increase the educational levels of rural population. The coefficients of education and variety were statistically non-significant.

The time of sowing appears to be another critical variable, since late sowing of carrot was found to have a higher chance of getting larger produce. Two months i.e. September and October were incorporated in the model. The coefficients for time of sowing were positive and highly significant indicating that carrot crop sown in September and October gave higher yield than the carrot crop sown in August. However, dummy coefficient for October (TOCT) was higher than that of September (TSEP). Dummy for high input prices (HINTPRC) as one of the major production

Table III. Output and Returns in Carrot Cultivation

Particulars	Sheikhupura	Kasur
Yield (kg ac^{-1})	8010.00	6516.80
Price (kg ac^{-1})	2.12	3.13
Gross returns (kg ac^{-1})	16981.20	20397.58
Gross margin $acre^{-1}$	6296.56	9103.92
Gross margin /40 kg	30.80	56.00
Gross margin kg^{-1}	0.77	1.40
Gross income/40 kg	84.80	125.20
Gross income kg^{-1}	2.12	3.13
Net returns $acre^{-1}$	4409.25	7523.58
Net returns/40 kg	22.00	46.40
Net returns kg^{-1}	0.55	1.16

Table IV. Production Function Estimates of Carrot

Variable	Coefficients	Std. Error	t value	Sig.
Constant	7.360	0.599	12.284	0.000
LnLP	0.181	0.133	1.359	0.178
LnSEED	0.337	0.128	2.627	0.010
LnIRRI	-0.029	0.110	-0.266	0.791
LnFER	0.062	0.035	1.806	0.075
LnWEED	0.039	0.042	0.927	0.355
LnFEXP	0.060	0.070	0.864	0.390
LnAGE	-0.058	0.151	-0.388	0.697
EDUC	0.103	0.126	1.483	0.142
VAR	0.052	0.063	0.826	0.411
TSEP	0.244	0.071	3.427	0.001
TOCT	0.307	0.137	2.240	0.028
HINTPRC	-0.111	0.066	-1.691	0.094
INADFND	-0.364	0.069	-5.296	0.000
INADLBR	-0.134	0.067	-1.993	0.050
DTENURE	-0.042	0.079	-0.523	0.602
R^2				0.612
Adjusted R^2				0.543
F value				8.85
No. of observation				100

Dependent variable = logarithm of yield in kg

constraint was incorporated in the production function to analyse its effect on the yield of carrot. Results of the model indicated that this variable had a negative coefficient and was statistically significant. One% rise in the prices of inputs decreased the yield of carrot by 0.111%. The farming community in general and carrot growing farmers in particular have limited financial resources. The increase in the prices of inputs badly affects the purchasing power of carrot growers to use important inputs. Availability of cash is a very serious constraint for the resource poor vegetable-growing farmers. Another production constraint was inadequate availability of funds (INADFND) and it had a negative coefficient and was statistically significant at one% probability level. This showed that one percent decrease in the availability of funds diminished yield by 0.364%. The carrot growers had small holdings. Because of this, they were unable to get loans from the institutions. Continuous increase in the prices of fertilizer, seed and diesel severely affected financial standing of the carrot growers. The coefficient of dummy variable for non-availability or inadequate availability of labour (INADLBR) had a negative sign and was significant at five% level of significance. The carrot growers were facing problems in getting casual hired labour for farming activities like weeding, harvesting, etc. Inadequate availability of labour during peak load periods was a serious problem and it negatively affected per acre yield of carrot. On the other hand, the wage rate was also high and farmers' financial resources were limited to fulfill labourers' demand for high wages. Although statistically non-significant, the coefficient for tenure dummy (DTENURE) was negative showing that the carrot yields was lower on owner farms than that on farms of their counterparts. This could be related to the fact that the tenants were expected to be more competitive as they could exploit their excessive as well as cheap labour source. Iqbal *et al.* (2001) also estimated the same relationship between wheat yield and tenure system.

The major objective of this study was to give efficient production packages for getting maximum economic returns. Land prepared thoroughly increases the chances of carrot seed germination. The carrot growers could increase the produce by using recommended doses of seed and timely sowing of carrot. On the basis of these results, it is suggested that the carrot growers should increase fertilizer up to recommended level to improve per acre yield.

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