

Effects of Poor Quality of Ground Water on Carrot Production: A Comparative Study

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ABSTRACT

The present paper compared the effects of ground water on carrot cultivation in Multan and Toba Tek Singh districts. Cross sectional data were used to determine the effects of ground water on carrot production. Results of production function analysis indicated that poor quality of ground water in Toba Tek Singh was significantly decreasing the carrot production. Moreover, uses of other inputs were also lower in Toba Tek Singh district as compared to Multan district, where quality of ground water was comparatively better.

Key Words: Carrot; Ground water; Poor quality; Yield; Production function

INTRODUCTION

Presence of high amounts of salts in soil and water is considered as one of the most important factors that has increased desertification in arid and semi-arid regions of the world (Szaboles, 1992; Khan, 1993; Qureshi, 1993). In Pakistan, the quality of the ground water is deteriorating day by day. Problem of water logging, salinity and sodicity is an important constraint in increasing agricultural production. It was estimated that to feed the increasing population, 40% more food would be required by the year 2025 (Alam & Bhutta, 1996). This food requirement could be fulfilled if sufficient amount of irrigation water would be available.

To fulfill crops water requirements, ground water is supplemented and its use is consistently increasing. Ground water abstraction in the Pakistan has increased from 3.34 MAF in 1959 to 48 MAF in 1996-97 (PWP, 1999). This enhanced use of ground water has sprouted many allied problems. The consistent use of poor quality water not only deteriorates chemical and physical properties of soil (World Bank, 1994) but also results in loss of agriculture production of the order of 14000 million rupees per annum (Pato, 1998).

The present paper aims to investigate the effects of poor quality of the ground water on carrot production and to compare the use of inputs and output between two districts i.e. Multan and Toba Tek Singh.

METHODOLOGY

The present study was conducted in Toba Tek Singh and Multan districts of Pakistan in year 2003-04. A total of 60 respondents were selected purposively, 30 from each district. Farmers who were growing carrot were chosen in each district. It was considered that quality of ground water in Multan is relatively good and fit for cultivation of

vegetables and other crops. Also, availability of canal water was not serious problem in Multan as compared to Toba Tek Singh. Quality of ground water was not suitable for cultivation of vegetables and fruits in many areas of this district. During data collection from Toba Tek Singh, care was taken for selecting the respondents regarding severity of poor quality of ground water. Only those carrot growers were interviewed who were facing problems like shortage of canal irrigation water and poor quality of the ground water. A comprehensive questionnaire was used to collect information regarding use of various inputs and output.

Data collected from these farmers were used to compare the use of various inputs in two districts. Cost of various inputs was calculated by using the methodology as discussed by Ahmad *et al.* (1994, 2003a,b).

Three types of production functions namely Cobb Douglas type, translog and quadratic were employed to analyse the effect of ground water and other crucial inputs on carrot production. Using the highest R² value, Cobb Douglas type production function was found explaining explanatory variables more accurately. Four most important regressors such as tractor hours used for land preparation, number of irrigation, inorganic nutrients (NP in kg) and labour hours used for weeding/hoeing were incorporated in the model.

Log linear form of the production function is as under:

$$\ln Y = \beta_0 + \beta_1 \ln LP + \beta_2 \ln IRRI + \beta_3 \ln FER + \beta_4 \ln LABOR + \mu$$

Where, $\ln Y$ = Natural log of carrot yield in kg per acreage

$\ln LP$ = Natural log of tractor hours for land preparation per

acreage, $\ln IRRI$ = Natural long of number of irrigation per

acreage, $\ln FER$ = Natural log of fertilizer (NP in kg) per

acreage, $\ln LABOR$ = Natural log of labour hours used

for weeding/hoeing per acreage

β_i are coefficients to be estimated and μ is disturbance term

RESULTS AND DISCUSSION

Descriptive statistics for various inputs is given in Table I. Results depict that the respondents belonging to Multan district were making more use of inputs as compared to those in Toba Tek Singh. Use of inorganic nutrients such as nitrogen and phosphorus was 23.40% more in Multan than Toba Tek Singh. Similarly, tractor hours used for land preparation, seed rate and number of irrigation water were more intensively applied by the carrot growers of Multan than those of Toba Tek Singh. However, labour hours used for weeding were less in Multan by 7.69%. More use of labour hours in Toba Tek Singh could be because of weed infestation in Toba Tek Singh. Because of such difference in the use of inputs made possible higher yield per acre in Multan.

Cost of various inputs and gross returns were calculated on per acre basis. These results are given in Table II. Findings of the study indicate that cost of land preparation, seed and fertilizer was well above in Multan as compared to Toba Tek Singh. As it was expected, cost of irrigation water was higher in Multan district as against Toba Tek Singh. However, that of weeding was higher in Toba Tek Singh as is reflected by use of more labour hours in that district. As a result, gross returns per acre were significantly higher in Multan than Toba Tek Singh and the difference of gross returns per acre between two districts was 20.18%.

Production function analysis. The summary statistics of the Cobb Douglas type production function are shown in Table III. The value of R^2 , which is commonly used to measure the goodness of fit, is 0.347 and 0.403 for Multan and Toba Tek Singh respectively. The main interest was to know the direction of the effect whether the application of irrigation water had a negative or positive influence on the carrot production.

A total of four parameters were estimated of which three were significant in case of Toba Tek Singh and two in Multan.

Land preparation plays a vital role for obtaining higher yield per acre. Nature of carrot seed demands well prepared land for its better germination. Results of Table III depict that coefficient of land preparation was positive and statistically significant at 15% probability level in Toba Tek Singh. Although statistically non-significant, it was negative in Multan.

The main focus of this study was to determine the effect of irrigation water on carrot yield. Poor quality of the ground water is a serious problem in Toba Tek Singh and it is mainly causing substantial decline in vegetable production in this district. As expected, the coefficient of irrigation application had a negative sign and was significant at ten percent probability level. The result indicates that one percent increase in application of poor quality of the ground water could further decline carrot yield by 0.153%. However, this coefficient was positive and significant in

Table I. Comparison of average inputs and output in carrot cultivation

Inputs/Output	Toba Tek Singh	Multan	Difference (%)
Yield (kg/acre)	6454	8241	12.16
Land preparation (Tractor hours)	5	6.5	13.04
Seed (kg/acre)	8	11	15.78
Fertilizer (kg/acre)	18	29	23.40
Irrigation (No.)	3	5	25.00
Weeding (Hours)	42	36	-7.69

Table II. Comparison of cost and returns (Rs per acre)

Inputs/Output	Toba Tek Singh	Multan	Difference (%)
Gross returns (Rs/acre)	13682	20603	20.18
Land preparation (Rs/acre)	1100	1495	15.22
Seed (Rs/acre)	1040	1540	19.38
Fertilizer (Rs/acre)	439	754	26.40
Irrigation (Rs/acre)	630	1075	26.10
Weeding (Rs/acre)	525	468	-5.74

Table III. The Production Function Estimates of Carrot

Variables	Toba Tek Singh		Multan		t value	
	coefficients	Stand. error	coefficients	Stand. error		
Constant	6.841**	0.501	13.664	6.509**	1.321	4.927
LnLP	0.174	0.116	1.504	-0.340	0.496	-0.500
LnIRRI	-0.153*	0.082	-1.868	0.890*	0.57	1.688
LnFER	0.113**	0.056	2.037	0.269**	0.132	2.040
LnLABOR	0.184**	0.082	2.244	0.140	0.290	0.484
F value	4.381 3.320					
R ²	0.403 0.347					

*Significant at 10 percent probability level

** Significant at 5 percent probability level

Multan implying one percent additional application of ground water could enhance carrot yield by 0.89%. This was due to relatively good quality of ground water in Multan.

Coefficient of NP nutrients had a positive sign and was statistically significant at 5% level of significance in both districts. However, the coefficient of fertilizer was larger in Multan as compared to Toba Tek Singh. This large coefficient in Multan indicated that due to comparatively good quality of the ground water, application of fertilizer could cause an increase carrot yield by 0.269% if fertilizer doses were increased up to 1%.

Labour hours used for weeding/hoeing were positively influencing carrot yield in both districts. However, its coefficient was statistically significant in Toba Tek Singh. Weed infestation was a serious problem in carrot production in Toba Tek Singh; therefore, the farmers had to make more use of labour for weeding.

CONCLUSIONS AND SUGGESTIONS

Like other vegetables, carrot crop is sensitive to poor quality of the ground water and application of this type of water results in substantial losses in carrot production.

Results of the study indicated that the application of the ground water was significantly decreasing carrot yield in Toba Tek Singh, where the ground water was usually not fit for irrigating vegetables. Due to poor quality of the ground water and non-availability and or inadequate availability of canal water, use of other inputs like nitrogen and phosphorus was significantly low in Toba Tek Singh as compared to Multan district.

Findings of the study indicate that there is a strong need to evolve such varieties of vegetables especially carrot that could tolerate poor quality of the ground water. Soil scientists should emphasize soil reclamation oriented research and give suitable recommendations where the problem of soil sodicity and brackish water are serious problems.

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