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Fertilizer Use Pattern on Major Crops Grown in Karnal District of Haryana, India

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A B S T R A C T

The average quantity of fertilizer use per hectare of the cropped area in 2015-16 was found as 206 kg for the State as a whole. During the same period, it was 293.95 kg in Karnal district, which comes out 142 per cent of the State average. In total consumption of NPK the proportions of N, P and K were respectively, 80.29, 17.34 and 2.36 per cent in Karnal district whereas for the State as a whole these were 77, 21.5 and 1.5 per cent respectively. The study revealed that on small farms one hectare in size of holding increased the expenditure on fertilizers by Rs. 1383.20. However, on large holdings the one hectare increase in size of holding resulted in an increase of Rs. 1253.40 on fertilizers expenditure. The percentage of irrigated area on small farms was more as compared with large farms, the expenditure on fertilizer per hectare of net area shown is also more on large farms than the small farms. It was found that the extent of fertilizer consumption is dependent upon mainly on two factors namely area fertilized and the quantity of fertilizers used per hectare. Both of these in turn are dependent upon several factors namely; the economics of fertilizer use and ability of farmers to purchase fertilizers.

Introduction

The use of fertilizer depends largely on the availability of irrigation facilities and availability of working capital with the farmers for acquiring the purchased inputs. As the small farmers have inadequate capital base, the non-available of adequate credit may be a problem in exploiting the production potentials by them. The farmers may also have different attitudes to different crops grown on the farm regarding to application of fertilizer. This may be influenced by the relative profitability of the crops, degree of yield and price risks involved and the personal likings and consumption needs of the farm family.

Thus, institutional, financial and behavioural constraints condition the farmer's decisions concerning his farm practices in general and use of fertilizer in particular. These constraints must be evaluated for the level of their incidence and their impact of fertilizer use at farm level. Such a study is all the more important to keep up our farm production targets.

The present study was undertaken in the Karnal district of Haryana where the consumption of fertilizers per hectare of cropped area is very high, to examine the pattern and efficiency of fertilizer use in the major crops of the district.

Materials and Methods

Taking into consideration the both Zonal qualities and very high consumption of fertilizer nutrient per hectare of cropped area, Karnal district of Haryana was selected purposively on the ground that district Karnal having sandy to fine sandy loams and clayey loam, therefore most of the crops are grown in this district unlikely to other districts of Haryana.

Selection of villages

Stratified Random Sampling was used for selection of sample. District Karnal has been divided into four strata and Two villages were selected randomly from each of the five strata/tehsils namely; Assandh, Gharaunda, Karnal, Indri and Nilokheri, to cover the whole district

Selection of farmers

A list of farmers was prepared according to their operational holdings and Out of these ten villages a total of 60 farmers 6 from each selected villages was selected for the study.

Source of data

Both the primary and secondary data was used to fulfill the objectives of the study.

Selection of farmers

A list of all the farmers in each selected village was prepared with their operational holdings into ascending order and then it was divided into three categories i.e. small (acreage up to 2 ha), medium (from 3 ha to 10 ha) and large farmers (above 10 ha). Table 1 shows the number of farmers selected from each village in each class of operational holding.

Analytical techniques

Production function analysis was carried out to estimate the response of fertilizers on major crops grown on the selected farms under irrigated and conditions. Keeping in view the nature of data collected and objectives of the study, the Cobb-Douglas and quadratic forms of production function has been fitted to estimate the relationship between per hectare output of crops i.e. wheat, paddy, mustard, gram and Sugarcane and quantities of nitrogen and phosphorus applied in producing these crops.

For selecting a particular equation as the 'best fit' two empirical criteria were used in this study. One criterion was the magnitude of the coefficient of determination, $R^{2,}$ assuming errors to be normally and independently distributed, with R^2 indicating the proportion of variance in the dependent variable accounted for by a particular type of equation, the larger value was taken to indicate the form which was most appropriate for estimates. Other related statistical used as empirical criteria was 't' test (the null hypothesis of regression coefficient at zero level). The constant in both the equations was computed and't' test was used to indicated terms. While selecting a particular equation as the 'best fit' both R^2 value and 't' test was considered. An equation with a high value of R^2 and relatively more number of significant constant terms was ultimately selected as the 'best fit'. On these tests, out of the two functions fitted the following form of quadratic equation was considered as the 'best fit' for estimating the response of fertilizers in different crops.

$Y=a + b_1 N + b_2 P - b_3 N^2 - b_4 P^2 + b_5 NP$ (1)

Where,

Y= Yield (output) in quintals per hectare

a= constant (yield in quintals per hectare at zero level of nitrogen and phosphorus)

N= Nitrogen in Kg per hectare

P= Phosphorus in Kg per hectare; and

b_1, b_2, b_3, b_4 and b_5 are the coefficient attached to N and P indicating transformation ration of different magnitudes of N and P.

Marginal Value Productivity

The marginal value productivities (MVPs) of nitrogen and phosphorus (at their mean levels) was estimated by taking the partial derivative of the production function of the concerned crop and multiplying it with the price of its output (py)[1].

Thus, MVP of nitrogen was calculated as

$$\frac{\partial Y}{\partial N} = b_1 - 2b_3 N + b_5 P \quad (2)$$

$$MVP_N = (b_1 - 2b_3 N + b_5 P) P_y \quad (3)$$

Similarly, MVP of phosphorus was calculated as-

$$\frac{\partial Y}{\partial P} = b_2 - 2b_4 N + b_5 P \quad (4)$$

$$MVP_P = (b_2 - 2b_4 N + b_5 P) P_y \quad (5)$$

Regression analysis was done to estimate the contribution of the size of operational holding and irrigated area on the fertilizer use. Other variables like area under high yielding varieties/ commercial crops and the annual income of the farmer were not considered in the analysis because these were found correlated either with the irrigated area or with the size of the holding. Tabular analysis was done to drive some of the results of first and third objectives of the study.

Results and Discussion

Crop-wise expenditure on fertilizer use

The crop-wise expenditure on fertilizer use under irrigated conditions on sample farms of different categories in Karnal district has been presented in Tables 2, 3, 4 and 5. Maximum expenditure was incurred in Sugarcane (Rs. 2152/- per acre) which accounted for about 5.37 per cent of the total cost of Sugarcane production.

Sugarcane was followed by Wheat in terms of expenditure on fertilizers (Rs. 1683/-). Paddy is the next important crop in that order where the expenditure on fertilizers was Rs. 1553/-. Though Mustard is also an important crop of the district in kharif season the average expenditure on fertilizer use in this crop was only Rs. 722/- per acre.

Among all the major crops of the district minimum expenditure was in Gram (Rs.460/- per acre) which accounted only 6.38% of the total cost of production of Gram.

Marginal productivity of the fertilizer application for major crops of the district

As in district Karnal during 2015-16 out of total NPK consumption the share of Nitrogen is 80.29%, Phosphorus 17.34% and of Potassium is only 2.36% which is very low as compare to other two, therefore in analysis the MVP of Nitrogen and Phosphorus was calculated.

Table.1 Number of farmers selected from sample villages

Tehsil	Villages	Number of farmers selected			
		Small	Medium	Large	Total
Assandh	Ballah	3	2	1	6
	Phaphrana	3	2	1	6
Gharaunda	Gagsina	3	2	1	6
	Rasin	3	2	1	6
Karnal	Shekhpura	3	2	1	6
	Gheer	3	2	1	6
Indri	Gharhi Birbal	3	2	1	6
	Jainpur sadhaan	3	2	1	6
Nilokheri	Sagga	3	2	1	6
	Anjalthali	3	2	1	6
Grand Total		30	20	10	60

Table.2 Fertilizer expenditure on sample farms (Small farms) in different crops in Karnal district, 2015-16

(Rupees per Acre)

Crops	Fertilizer expenditure		Total	Average cost of production	% of fertilizer expenditure to total cost of production
	N	P_2O_5			
Wheat	900	805	1705	12080	14.11
Gram	150	380	530	7480	7.09
Mustard	344	402	746	8720	8.56
Paddy	725	940	1665	17240	9.66
Sugarcane	1400	870	2270	38400	5.91

Table.3 Fertilizer expenditure on sample farms (Medium farms) in different crops in Karnal district, 2015-16

(Rupees per acre)

Crops	Fertilizer expenditure		Total	Average cost of production	% of fertilizer expenditure to total cost of production
	N	P_2O_5			
Wheat	880	805	1685	11510	14.64
Gram	140	320	460	7208	6.38
Mustard	321	402	723	8760	8.25
Paddy	704	805	1509	17940	8.41
Sugarcane	1310	870	2180	40080	5.44

(Figures in parentheses indicate the quantities of fertilizer in terms of nutrients)

Table.4 Fertilizer expenditure on sample farms (Large farms) in different crops in Karnal district, 2015-16

(Rupees per acre)

Crops	Fertilizer expenditure		Total	Average cost of production	% of fertilizer expenditure to total cost of production
	N	P_2O_5			
Wheat	855	805	1660	12780	12.99
Gram	120	300	420	7640	5.50
Mustard	295	402	697	8910	7.82
Paddy	680	805	1485	18170	8.17
Sugarcane	1200	805	2005	41830	4.79

(Figures in parentheses indicate the quantities of fertilizer in terms of nutrients)

Table.5 Existing expenditure on fertilizer on sample farms in Karnal district in 2015-16

(Rupees per acre)

Crops	Fertilizer expenditure		Total	Average cost of production	% of fertilizer expenditure to total cost of production
	N	P_2O_5			
Wheat	878	805	1683	12123	13.89
Gram	137	333	470	7443	6.31
Mustard	320	402	722	8797	8.21
Paddy	703	850	1553	17783	8.73
Sugarcane	1303	848	2152	40103	5.37

Table.6 Marginal value productivity of nitrogen and phosphorus in major crop in Karnal district

Crops	Marginal value productivity (Rs.)	
	Nitrogen	Phosphorus
Wheat	21.3	41.6
Gram Irrigated	32.8	46.7
Mustard Irrigated	23.6	32.4
Paddy	22.9	45.2
Sugarcane	34.2	47.8

Crop production functions

The regression coefficients for all the major crops namely Sugarcane, Paddy, Wheat, Mustard, Gram were worked out. The regression coefficients of Nitrogen and Phosphorus for all the crops were found positive and significant at 5 per cent probability level under irrigated conditions. The values of the coefficient of multiple determinations (R2) of the estimated production functions were also consistent.

Marginal value productivity of Nitrogen and Phosphorus

The marginal value productivities (MVPs) of Nitrogen and Phosphorus (at their mean levels) were estimated by taking partial derivative of the production function of the concern crop and multiplying with the price of its output and have been presented in Table 6.

Determinant of fertilizer use

The regression analysis was carried out to find out the influence of size of holdings and area under irrigation on the total expenditure on fertilizers.

The functions reveal that on small farms one hectare increase in size of holding the expenditure on fertilizers by Rs. 1383.20. However, on large holdings the one hectare increase in size of holding resulted in an increase of Rs. 1253.40 on fertilizer expenditure. The analysis reveals that there is an inverse relationship between the size of holding & per hectare expenditure on fertilizer. On overall basis it was found that the fertilizer expenditure increased by Rs. 1316.0 with the increase in size of holding by one hectare. The study shows that the percentage of irrigated area in small farms is more as compared with large farms therefore; the expenditure on fertilizer per hectare of net area shown is more on small farms than the large farms.

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