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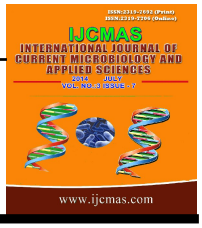

Original Research Article

Pattern of fertilizer use on major crops grown in Hisar District of Haryana, India

Vijay Kumar Kaushik[1*] and N.C.Paharia[2]

[1]Department of Economic & Statistical Analysis, Bays No. 21-28, Yojna Bhawan, Sector-4, Panchkula (Haryana), India
[2]College of Humanity and Social Sciences, NIMS University, Jaipur (Rajasthan), India
**Corresponding author*

A B S T R A C T

The average quantity of fertilizer use per hectare of the cropped area in 2009-10 was found as 213.46 kg for the State as a whole. During the same period, it was 178.53 kg in Hisar district, which comes out 83.63 per cent of the State average. In total consumption of NPK the proportions of N, P and K were respectively, 70.95, 24.57 and 4.47 per cent in Hisar district whereas for the State as a whole these were 76.98, 21.08 and 1.93 per cent respectively. The study revealed that on small farms one hectare in size of holding and one hectare increase in the irrigated area increased the expenditure on fertilizers by Rs. 1598.24 and Rs. 2397.36, respectively. However, on large holdings the one hectare increase in size of holding resulted in an increase of Rs. 1541.65 on fertilizers expenditure. Whereas one hectare increase in irrigated area on these farm increased the fertilizer expenditure by Rs. 2158.31. 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.

Keywords

Fertilizer uses, NPK, determinants of fertilizer use at farm level

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 behavioral 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 Hisar 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, Hisar district of Haryana was selected purposively on the ground that district Hisar having all types of soil i.e. Sandy & loam soil in some part of Hisar and Adampur tehsil, Alluvial soil, semi sandi and sandy black soil in Hansi and Nanaund, 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 Hisar has been divided into four strata and Two villages were selected randomly from each of the four strata/tehsils namely; Hisar, Hansi, Adampur and Narnaund, to cover the whole district

Selection of farmers

A list of farmers was prepared according to their operational holdings and Out of these eight villages a total of 200 farmers 25 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 No.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 both under irrigated and unirrigated conditions separately. 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, cotton, barley, mustard, gram, jowar and bajra 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.

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

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

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

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

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

To study the pattern of fertilizer use on major crops grown in the district

Crop-wise expenditure on fertilizer use

The crop-wise expenditure on fertilizer use under irrigated and unirrigated conditions on sample farms of different categories in Hisar district has been presented in Tables 2, 3, 4 and 5. It is evident from the Table 5 that the average expenditure on fertilizer use under irrigated condition is much higher than the unirrigated conditions for all the crops. This shows the less use of fertilizers under rainfed conditions.

Maximum expenditure was incurred in Paddy (Rs. 2669.43 per hectare) which accounted for about 15.84 per cent of the total cost of Paddy production. Paddy was followed by Wheat in terms of expenditure on fertilizers (Rs. 2290.62). Cotton is the next important crop in that order where the expenditure on fertilizers was Rs. 2199.51. Though Bajra is also an important crop of the district in kharif season the average expenditure on fertilizer use in this crop was only Rs. 1245.42 and Rs. 831 per hectare under irrigated and unirrigated conditions, respectively.

Table.1 Number of farmers selected from sample villages

Tehsil	Villages	Number of farmers selected			
		Small	Medium	Large	Total
Hisar	Ladwa	15	7	3	25
	Gunjar	15	6	4	25
Hansi	Puthi Mangal Khan	13	8	4	25
	Umra	17	5	3	25
Adampur	Siswal	14	9	2	25
	Ashrawan	16	6	3	25
Narnaund	Pali	15	7	3	25
	Kapro	15	8	2	25
Grand Total		**120**	**56**	**24**	**200**

Table.2 Fertilizer expenditure on sample farms (Small farms) in different crops in Hisar district, 2009-10 (Rupees per hectare)

Crops	Fertilizer expenditure		Total	Average cost of production	% of fertilizer expenditure to total cost of production
	N	P_2O_5			
Bajra	837.9	420	1257.88	6801	19.24
Wheat	1520	1058.1	2578.06	13693	19.58
Gram	260.2	237.36	497.52	6373	8.12
Barley	958.2	813.24	1771.45	12220	15.08
Mustard	607.2	448.9	1056.14	8155	13.47
Paddy	1581	1034.7	2615.4	17011	15.99
Cotton	1299	1072.2	2370.93	10504	23.47
Jowar	638.6	0	638.57	8915	7.45

Table.3 Fertilizer expenditure on sample farms (Medium farms) in different crops in Hisar district, 2009-10 (Rupees per hectare)

Crops	Fertilizer expenditure		Total	Average cost of production	% of fertilizer expenditure to total cost of production
	N	P_2O_5			
Bajra	814	430	1244	7366	17.56
Wheat	1369	778.9	2148.1	12845	17.39
Gram	184.7	254.1	438.8	6319	7.222
Barley	1004	836.61	1840.41	12619	15.17
Mustard	621.6	442.21	1063.81	8862	12.48
Paddy	1562	1103.7	2665.3	16110	17.21
Cotton	1041	986.7	2027.3	11565	18.23
Jowar	701.4	0	701.4	8185	8.912

(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 Hisar district, 2009-10 (Rupees per hectare)

Crops	Fertilizer expenditure		Total	Average cost of production	% of fertilizer expenditure to total cost of production
	N	P_2O_5			
Bajra	839.4	395.0	1234.4	7431.7	17.27
Wheat	1512.1	633.6	2145.7	14548.6	15.34
Gram	207.1	237.8	444.9	6407.4	7.22
Barley	1030.1	808.2	1838.3	13166.3	14.52
Mustard	572.6	471.0	1043.6	10095.7	10.75
Paddy	1530.2	1197.4	2727.6	17435.4	16.27
Cotton	1180.2	1020.1	2200.3	11973.3	19.11
Jowar	698.4	0.0	698.4	8220.2	8.84

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

Table.5 Existing expenditure on fertilizer on sample farms in Hisar district in 2009-10 (Rupees per hectare)

Crop	**Expenditure on fertilizer**	**%of the total cost of production**
Bajra		
Irrigated	1245.42	17.29
Unirrigated	831	11.92
Wheat	2290.62	16.72
Barley		
Irrigated	1816.72	14.34
Unirrigated	1230	9.67
Gram		
Irrigated	460.40	7.23
Unirrigated	289.82	4.49
Mustard		
Irrigated	1054.51	11.66
Unirrigated	551.1	6.01
Paddy	2669.43	15.84
Cotton	2199.51	19.38
Jowar	679.45	8.05

Table.6 Marginal value productivity of Nitrogen and Phosphorus in major crop in Hisar district

Crops		Marginal value productivity (Rs.)	
		Nitrogen	Phosphorus
Wheat	Irrigated	19.9	16.2
Barley			
	Irrigated	10.4	13.47
	Unirrigated	7.7	10.56
Gram			
	Irrigated	33.6	18.6
	Unirrigated	13.4	11.3
Mustard			
	Irrigated	28.9	13.3
	Unirrigated	11.2	7.3
Bajra			
	Irrigated	23.8	16.5
	Unirrigated	7.2	10.9
Paddy	Irrigated	21.4	17.6
Cotton	Irrigated	23.4	16.8
Jowar	Irrigated	21.6	

Among all the major crops of the district minimum expenditure was in Gram (Rs. 460.40 and Rs. 289.82 per hectare under irrigated and unirrigated conditions, respectively) which accounted only 7.23 and 4.49 per cent respectively of the total cost of production of Gram.

To work out the marginal productivity of the fertilizer application for major crops of the district.

As in district Hisar during 2009-10 out of total NPK consumption the share of Nitrogen is 68.84%, Phosphorus 26.59% and of Potassium is only 4.55% which is very low as compare to other two, therefore in analysis the MVP of Nitrogen and Phosphorus was calculated.

Crop production functions

The regression coefficients for all the major crops namely Paddy, Wheat, Barley, Cotton, Gram, Mustard, Jowar and Bajra were worked out. The estimated production functions under irrigated and un-irrigated conditions, separately, are given in Table 12.

The regression coefficients of Nitrogen and Phosphorus for all the crops were found positive and significant at 5 per cent probability level under irrigated and unirrigated 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.

To identify the determinants of fertilizer use at farm level

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 and one hectare increase in the irrigated area increased the expenditure on fertilizers by Rs. 1598.24 and Rs. 2397.36 respectively. However, on large holdings the one hectare increase in size of holding resulted in an increase of Rs. 1541.65 on fertilizer expenditure, similarly, one hectare increase in irrigated area on these farms also increased the fertilizer expenditure by Rs. 2158.31.

The analysis reveals that there is an inverse relationship between the size of holding/irrigated area & per hectare expenditure on fertilizer. On overall basis it was found that the fertilizer expenditure increased by Rs. 1552.01 with the increase in size of holding by one hectare. While increase in irrigated area by one hectare results in an increase of fertilizer expenditure by Rs. 2226.08. 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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