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Gap in fertilizer use and its determinants among major selected crops in Saurashtra region of Gujarat

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ABSTRACT

The factor determining the use of fertilizers needs to be critically analyzed to narrow the gap in nutrient supply capacity of soil and nutrient requirement of the plant for sustainable productivity of the crops. The present study was undertaken to estimate the gap between actual use and recommended dose of fertilizer and to identify the factors determining the fertilizer use in major crops grown in Gujarat. The study revealed that the gap in respect of use of N was observed in all the selected crops but in case of P, The gap was observed only in bajra crop. The magnitude of gap was higher generally in large farmers. Use of K was found more than recommended dose in all the crops. In *Kharif* crops like groundnut and bajra, rainfall has great impact in determination of level of fertilizer use. Whereas in crops like cotton and wheat, irrigated area, per farm gross income, lagged prices and cropping intensity were the major factors which determine the level of use of fertilizers in these crops.

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Key words : Gap in fertilizer use, Cropping intensity, Determinants of fertilizer use

INTRODUCTION

Among all the modern inputs, fertilizer play a key role in modern agriculture. Fertilizer has been universally accepted as an integral part of package of practice for raising Indian agriculture to a higher technological plank. It is estimated that the combination of fertilizers in association with water towards increase in output can be as high as 70 per cent. Nearly 50 per cent of the increase in foodgrain production in the last decade in the world can be safely due to increased use of fertilizers (Borlaug, 1996). In spite of large areas of the country having the best kind of soil in the world, abundance of rainfall, plentiful sunshine and ideal temperature almost throughout the year for crop production, the average yield per hectare of crops in India is very low. It is due to exhausted soils which have been over cropped from centuries without adequate replacement of plant nutrients through fertilizers. The problems become more acute after Green Revolution because of widening gap between recommended doze of fertilizers and actual use by the farmers. Unless addition of plant nutrients which have been removed from these soils in the past is made, the soil will not be able to support

the supply of plant nutrients for getting continuously higher yields of crops. Plant nutrients are essential not only for increasing production but also for maintaining the fertility of soils at desired level. The factors determining the use of fertilizers need to be critically analyzed to narrow the gap in nutrient supply capacity of soil and nutrient requirement of the plant for sustainable productivity of the crops. With this aspects, the present study was undertaken to estimate the gap between the actual use and recommended dose of fertilizer and to identify the factors determining the fertilizer use in major crops grown in Gujarat.

MATERIALS AND METHODS

The Saurashtra region of Gujarat often faces the problem of irregular monsoon. It falls under arid and semi-arid tracks. The annual rainfall ranges from 400 to 1000 m.m. with an average of 596 mm. The irrigated area is nearly around 24 per cent of the gross cropped area. These characteristics have great impact on fertilizer use pattern and crop response to fertilizer. Hence, the present investigation is confined to Saurashtra region of Gujarat

state. The study area comprised two agro-climatic zones viz., South Saurashtra and North Saurashtra. Purposive random sampling technique was used for the selection of the sample. Rajkot and Jamnagar districts from North Saurashtra and Rajkot and Amreli districts from South Saurashtra were selected purposively as they acquire large area of the crops under study viz., groundnut, cotton, bajra and wheat. Number of villages were selected considering the availability of respective crop growers and required size of sample. In all, 280 farmers were selected randomly for the study during 2004-05, of which 35 farmers were for each crop from each zone.

The fertilizer gap was estimated by taking difference between actual use at farm level and recommended doze of fertilizers for selected crops in the respective agro-climatic zones.

The following type of regression model was used to study the determinants of fertilizer use in selected crops of the area under study.

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + U$$

where,

Y = Total fertilizer (N, P, K) consumption for selected

crops (kg/ha).

a = Intercept.

X₁ = Irrigated area under the crop in hectares.

X₂ = Per farm gross income in rupees.

X₃ = Annual average rainfall in village in mm.

X₄ = One year lagged average price of crop output

Rs./qtl.

X₅ = Cropping intensity in percentage.

X₆ = Size of farm in hectare.

U = Error term.

b_i = Regression coefficients of the respective variables.

RESULTS AND DISCUSSION

The extent of gap in fertilizer use in groundnut has been given in Table 1. The extent of gap in respect of N ranged from 4.64 to 9.68 per cent, 5.52 to 37.28 per cent, and 6.64 to 18.96 per cent in South Saurashtra, North Saurashtra and for Saurashtra as a whole, respectively among various categories of the farmers. The gap was higher in large farmers as compared to small and medium

Table 1 : Gap between recommended doze and actual use level of fertilizers in groundnut (kg/ha)

Zone	Size	Particular	N	P	K
		Recommended doze	12.50	25.00	0.00
South Saurashtra	S	Actual use	12.80	31.08	12.69
		Gap	+0.30 (2.40)	+6.08 (24.32)	+12.69
	Me	Actual use	11.29	27.63	5.03
		Gap	-1.21 (9.68)	+2.63 (10.52)	+5.03
	L	Actual use	11.92	25.17	3.93
		Gap	-0.58 (4.64)	+0.17 (0.68)	+3.93
All	Actual use	11.88	26.09	4.83	
	Gap	-0.62 (4.96)	+1.09 (4.36)	+4.83	
North Saurashtra	S	Actual use	11.81	31.05	10.51
		Gap	-0.69 (5.52)	+6.05 (24.02)	+10.51
	Me	Actual use	11.55	30.71	12.59
		Gap	-0.95 (7.60)	+5.71 (22.84)	+12.59
	L	Actual use	7.84	18.99	4.30
		Gap	-4.66 (37.28)	-6.01 (24.04)	+3.93
All	Actual use	9.27	23.46	7.18	
	Gap	-3.33 (25.84)	-1.54 (6.16)	+7.18	
Saurashtra	S	Actual use	11.67	29.97	12.23
		Gap	-0.83 (6.64)	+4.97 (19.88)	+12.23
	Me	Actual use	11.45	29.50	9.63
		Gap	-1.05 (8.40)	+4.50 (18.00)	+9.63
	L	Actual use	10.13	22.46	4.09
		Gap	-2.37 (18.96)	-2.54 (10.16)	+4.09
All	Actual use	10.63	24.83	5.96	
	Gap	-1.87 (14.96)	-0.17 (0.68)	+5.96	

(Figures in parentheses indicate per cent of gap)

farmers in North Saurashtra (37.28 %) and Saurashtra (18.96 %). The extent of gap in respect of P ranged from 6.16 to 24.04 per cent, 0.68 to 10.16 per cent in North Saurashtra zone and Saurashtra as a whole among various categories of the farmers but there was no gap in North Saurashtra zone. The K was found overutilized in both the zones and Saurashtra as a whole among various categories of the farmers. On an average farm (overall), there was more gap in respect of N in South Saurashtra, North Saurashtra and for Saurashtra as a whole.

The extent of gap in fertilizer use in cotton crop is presented in Table 2. With respect to N, it ranged from 10.37 to 17.08 per cent, 7.81 to 20.77 per cent and 8.83 to 18.43 per cent in South Saurashtra, North Saurashtra and Saurashtra, respectively. The gap was wider in North Saurashtra zone. The gap was found wider in large farmers as compared to small and medium farmers in cotton crop, in both the zones and in Saurashtra. There was no gap in case of P and K utilization in cotton but over utilization of these nutrients was observed in all the categories of farms in both the zones.

The gap in fertilizer use in bajra is presented in Table 3. The gap with respect to N ranged from 6.26 to 8.50 per cent, 14.03 to 22.23 per cent and 8.54 to 18.98 per cent and in respect of P ranged from 1.08 to 3.78 per cent, 13.00 to 33.53 per cent and 6.18 to 8.68 per cent in South Saurashtra, North Saurashtra and Saurashtra, respectively. The highest gap in respect of N was found in medium farmers (22.23%) in North Saurashtra and in respect of P it was found the highest in large farmers (33.53 %) in North Saurashtra. Thus, there was more gap in use of both N and P in North Saurashtra as compared to South Saurashtra.

The gap in fertilizer use in wheat crop is given in Table 4. There was no gap in South Saurashtra in fertilizer use. In North Saurashtra and South Saurashtra, the gap of N ranged from 11.90 to 29.82 per cent and 1.76 to 18.10 per cent, respectively. The gap in respect of P was found only in medium farmers in North Saurashtra. Thus, the gap in use of N and P in wheat crop was observed in North Saurashtra only.

The details about the determinants of fertilizer use

Table 2 : Gap between recommended doze and actual use level of fertilizers in cotton (kg/ha)

Zone	Size	Particulars	N	P	K
		Recommended doze	160.00	0.00	0.00
South Saurashtra	S	Actual use	140.51	52.4	8.85
		Gap	-19.49 (12.18)	+52.57	+8.85
	Me	Actual use	143.41	52.57	6.78
		Gap	-16.19 (10.37)	+52.57	+6.78
	L	Actual use	132.67	62.16	5.46
		Gap	-27.33 (17.08)	+62.16	+5.46
All	Actual use	135.44	59.41	6.08	
	Gap	-24.56 (15.35)	+59.41	+6.08	
North Saurashtra	S	Actual use	144.83	91.34	30.36
		Gap	-15.17 (9.48)	+91.34	+30.36
	Me	Actual use	147.50	50.92	16.28
		Gap	-12.50 (7.81)	+50.92	+16.28
	L	Actual use	126.77	46.68	15.66
		Gap	-33.23 (20.77)	+46.68	+15.66
All	Actual use	136.24	53.32	17.65	
	Gap	-23.76 (14.85)	+53.32	+17.65	
Saurashtra	S	Actual use	140.50	85.48	21.65
		Gap	-19.50 (12.19)	+85.48	+21.65
	Me	Actual use	145.87	51.58	12.48
		Gap	-14.13 (8.83)	+51.58	+12.48
	L	Actual use	130.51	56.50	9.19
		Gap	-29.49 (18.43)	+56.50	+9.19
All	Actual use	135.78	56.36	11.06	
	Gap	-24.22 (15.14)	+56.36	+11.06	

(Figures in parentheses indicate per cent of gap)

Table 3 : Gap between recommended doze and actual use level of fertilizers in bajra (kg/ha)

Zone	Size	Particulars	N	P	K
		Recommended doze	80.00	40.00	0.00
South Saurashtra	S	Actual use	73.20	39.57	1.69
		Gap	-6.80 (8.50)	-0.43 (1.08)	+1.69
	Me	Actual use	74.99	38.49	0.00
		Gap	-5.01 (6.26)	-1.51 (3.78)	0.00
	L	Actual use	73.89	38.74	0.00
		Gap	-6.11 (7.64)	-1.26 (3.15)	0.00
All	Actual use	74.06	38.84	0.36	
	Gap	-5.94 (7.43)	-1.16 (2.90)	+0.36	
North Saurashtra	S	Actual use	63.54	32.55	0.00
		Gap	-16.46 (20.58)	-7.45 (18.63)	0.00
	Me	Actual use	62.14	34.80	0.00
		Gap	-17.86 (22.23)	-5.20 (13.00)	0.00
	L	Actual use	68.78	26.59	6.18
		Gap	-11.22 (14.03)	-13.41 (33.53)	+6.18
All	Actual use	64.82	31.40	1.64	
	Gap	-15.18 (18.98)	-8.60 (21.50)	+1.64	
Saurashtra	S	Actual use	69.39	36.53	0.85
		Gap	-10.61 (18.98)	-3.47 (8.68)	+0.85
	Me	Actual use	71.39	37.53	0.00
		Gap	-8.61 (10.76)	-2.47 (6.18)	0.00
	L	Actual use	73.17	37.02	0.88
		Gap	-6.83 (8.54)	-2.98 (7.45)	+0.88
All	Actual use	71.76	36.99	0.68	
	Gap	-8.24 (10.30)	-3.01 (7.53)	+0.68	

(Figures in parentheses indicate per cent of gap)

Table 4 : Gap between recommended doze and actual use level of fertilizers in wheat (kg/ha)

Zone	Size	Particulars	N	P	K
		Recommended doze	120.00	60.00	0.00
South Saurashtra	S	Actual use	120.56	75.95	26.01
		Gap	+0.56 (0.47)	+15.95 (26.58)	+26.01
	Me	Actual use	124.08	87.09	20.74
		Gap	+4.08 (3.40)	+27.09 (45.15)	+20.74
	L	Actual use	121.19	87.59	12.60
		Gap	+1.19 (0.99)	27.59 (45.98)	+12.60
All	Actual use	121.61	86.36	15.29	
	Gap	+1.61 (1.34)	+26.36 (43.93)	+15.29	
North Saurashtra	S	Actual use	84.22	70.78	0.00
		Gap	-35.78 (29.82)	+10.17 (16.95)	0.00
	Me	Actual use	85.70	57.59	1.72
		Gap	-34.30 (28.58)	-2.41 (4.02)	+1.72
	L	Actual use	105.72	81.22	0.00
		Gap	-14.28 (11.90)	+21.22 (35.37)	0.00
All	Actual use	93.39	68.84	0.82	
	Gap	-26.61 (22.18)	+8.84 (14.73)	+0.82	
Saurashtra	S	Actual use	98.28	69.63	9.39
		Gap	-21.72 (18.10)	+9.63 (16.05)	+9.39
	Me	Actual use	101.55	69.77	9.57
		Gap	-18.45 (15.38)	+9.77 (16.28)	+9.57
	L	Actual use	117.89	66.23	9.91
		Gap	-2.11 (1.76)	+6.23 (10.38)	+9.91
All	Actual use	112.20	80.52	10.47	
	Gap	-7.80 (6.50)	+20.52 (34.20)	+10.47	

(Figures in parentheses indicate per cent of gap)

Variables	Groundnut		Bajra		Wheat	
	SS	NS	SS	NS	SS	NS
Constant	32.7316	21.3315	25.2311	15.5617	63.0317	76.7000
Regression error variance	0.013	1.9837	3.855	5.8018	3.010	5.5101*
Adjusted R ²	(0.0810)	(2.9113)	(1.8917)	(1.568)	(1.1115)	(1.3311)
Per farm gross income	0.2515	0.0002	0.0001	0.0001	0.0001	0.0002*
(R ²)	(0.0012)	(0.0001)	(0.0001)	(0.0005)	(0.0001)	(0.0001)
Annual average rainfall	0.0120**	0.0331	0.0310*	0.211**	0.0051	0.1732
(R ²)	(0.0028)	(0.0206)	(0.0110)	(0.0559)	(0.0113)	(0.3292)
One year lagged average price (Rs./t)	0.2319	0.0315	0.0218	0.112**	0.0013	0.1261**
(R ²)	(0.165)	(0.1822)	(0.2181)	(0.0111)	(0.0116)	(0.0216)
Cropping intensity (%)	0.0915	0.2101	0.0838	0.3195	0.1125	0.9226**
(R ²)	(0.1263)	(0.1289)	(0.0915)	(0.2192)	(0.1321)	(0.1801)
Size of farm (ha)	2.2638	3.8851*	2.0193	3.6388	2.0113	1.9161
(R ²)	(0.6193)	(1.863)	(1.0185)	(2.6815)	(2.2625)	(2.2381)
Adjusted R ²	0.1810	0.1018	0.0769	0.3118	0.6098	0.1096
SS	32.7316	21.3315	25.2311	15.5617	63.0317	76.7000
NS	1.9837	2.9113	3.855	5.8018	3.010	5.5101*
SS	0.0810	0.0002	0.0001	0.0001	0.0001	0.0002*
NS	(0.0012)	(0.0001)	(0.0001)	(0.0005)	(0.0001)	(0.0001)
SS	0.0120**	0.0331	0.0310*	0.211**	0.0051	0.1732
NS	(0.0028)	(0.0206)	(0.0110)	(0.0559)	(0.0113)	(0.3292)
SS	0.2319	0.0315	0.0218	0.112**	0.0013	0.1261**
NS	(0.165)	(0.1822)	(0.2181)	(0.0111)	(0.0116)	(0.0216)
SS	0.0915	0.2101	0.0838	0.3195	0.1125	0.9226**
NS	(0.1263)	(0.1289)	(0.0915)	(0.2192)	(0.1321)	(0.1801)
SS	2.2638	3.8851*	2.0193	3.6388	2.0113	1.9161
NS	(0.6193)	(1.863)	(1.0185)	(2.6815)	(2.2625)	(2.2381)
SS	0.1810	0.1018	0.0769	0.3118	0.6098	0.1096
NS	0.1096	0.1096	0.1096	0.1096	0.1096	0.1096

for groundnut, cotton, bajra and wheat crop are presented in Table 5. It is revealed from the table that only the coefficient of annual average rainfall was found positive and significant in South Saurashtra zone as well as for Saurashtra region, whereas coefficient of size of farm was negatively significant in North Saurashtra zone in groundnut.

In cotton crop the value of R² indicates poor fit of the regression however, the results indicated that irrigated area under the crop and cropping intensity has significant impact on use of fertilizer in cotton crop in South Saurashtra but size of farm has negative effect on fertilizer use in this region. In North Saurashtra region, coefficient of irrigated area under the crop was found significant and positive (85.8968). Per farm gross income has also significant and positive impact on fertilizer use in cotton in North Saurashtra. In Saurashtra region, average annual rainfall and one year lagged price have found to have positive and significant impact on fertilizer consumption in cotton crop.

It can be seen from the table that the effect of annual average rainfall was found positive and significant for South Saurashtra and North Saurashtra in bajra.

It was found from the results that one year lagged price has positive and significant impact on in fertilizer consumption in wheat in South Saurashtra. In North Saurashtra region, the for irrigated area under the crop (15.7017) and per farm gross income (0.0002), one year lagged price (0.1264) and cropping intensity (0.9226) were significant. In Saurashtra region, annual average rainfall (1.0032) and cropping intensity (0.5953) showed positive and significant effect on fertilizer use.

Conclusion:

The study revealed that the gap in respect of use of N was observed in all the selected crops but in case of P, the gap was observed only in bajra crop. The magnitude of gap was higher generally in large farmers. Use of K was found more than recommended dose in all the crops. In *Kharif* crops like groundnut and bajra, rainfall has great impact in determination of level of fertilizer use. Whereas in crops like cotton and wheat, irrigated area, per farm gross income, lagged prices and cropping intensity were the major factors which determine the level of use of fertilizers in these crops.

Policy implications:

– While arranging fertilizer use awareness, campaign/ training/ demonstrations, organizers/ extension agencies should target the large farmers to reduce the fertilizer use gap in Saurashtra region.

– The factors like rainfall and gross irrigated area should be taken into account while fixing the districtwise targets.

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