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Impact of Soil Health Card on Fertilizer Consumption and Yield of Sugarcane and *Kharif* Paddy in Gujarat State

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ABSTRACT

The present study was undertaken with a view to assess the impact of soil health card on fertilizer consumption and yield of sugarcane and *kharif* paddy in South Gujarat region of Gujarat State. The multistage random sampling technique comprised of 224 farmers was taken for the study. The extent of over utilization of nitrogenous fertilizer was less for farmers having soil health card as compare to without soil health card for sugarcane and *kharif* paddy crops. The extent of under utilization of phosphatic and potasic fertilizers were less for farmers having soil health card as compare to without soil health card for sugarcane and *kharif* paddy crops. The paired 't' test analysis showed positive and significant impact of Soil Health Card on per hectare yield of sugarcane and *kharif* paddy crops. Generally, with Soil Health Card farmers utilized the fertilizers judiciously as per the recommendation of Soil Health Card.

Keywords: Soil health card, fertilizer consumption, yield, Sugarcane, *kharif paddy*, Gujarat

In India, agricultural sector still occupies a predominant position in the country's economy, accounting for about 14 per cent of gross domestic product and one- fifth of foreign exchange. This sector provides employment to about 58.2 per cent (www.indiancensus, 2001) of the total labour force in the country. With the 2 per cent world's geographical area, India has the constantly increasing food grains production which has reached to 244.78 million tonnes in 2010-11, more than about five times the 50.8 million tonnes in 1950-51. With the success of green, white and blue revolution, India is now in the position of self-reliance in food grains production. It is expected that the total food grains demand by 2020 and 2025 is estimated to be 294 and 322 million tonnes, respectively (Kumar, 1998; Malavia, *et al*., 2000). Thus by 2025, we need to produce about 118 million tonnes additional food grains per year from the same or even less area. The most challenging problem which India faces today is the growth rate of food grains production which is lower than the population growth rate during last two decades. Growing population puts enormous pressure on the available natural resources and infrastructure, which become more and more fragile. Thus, in developing countries like India, reeling under population pressure, the efficient use of fertilizer must go hand-in-hand for a better tomorrow.

As a key element of the food grains production cycle, fertilizer usage contributed to about 50 per cent of increased food grains production in the world (Hegde and Sudhakarbabu, 2004; Tanwar and Bisvas, 2005). In India, fertilizer consumption is concentrated in about one-third of the cultivated area. It is key element to increase sustainable production of agriculture (Painuly and Dev, 1998).

The average yield per hectare of crops in India is very low due to exhausted soils which have been over cropped from centuries without adequate replenishment for plant nutrients through fertilizers. Such heavy removal of plant nutrients from soil leads to depletion of soil fertility, which shows up in crop yield decline and lowered factor productivity (Yadav *et at*., 1998). Therefore, application of fertilizers is essential to prevent soil degradation, keeping agriculture land productive and economically viable.

The fertilizer consumption in India has increased many folds from 65.6 thousand tonnes in 1951-52 to 281.22 lakh tonnes in 2010-11. The corresponding figures for total consumption of N_2, P_2O5 and K_2O during 2010-11 were 165.58, 80.50 and 35.14 lakh tonnes, respectively. The fertilizer consumption in India has grown considerably in the last five decades however; it is still low in comparison to other countries. The fertilizer consumption was 25.75 kg per hectare during 1970 and it increased to 75.43 kg per hectare during 1990s registering a growth rate of 3.94 per cent between 1990-91 and 2000-01 (Ramasamy, 2004). The average fertilizer consumption per hectare of cropped area in India rose from mere 0.55 kg in 1950-51 to 144.14 kg in 2010-11. It is disheartening to note that in spite of this impressive growth over the last five decades, per hectare fertilizer consumption in India is still very low as compared to that of many other countries.

In the above context, balanced use of fertilizer is essential to stabilize crop yield and sustain high crop productivity. The new strategy of judiciously use of fertilizer with well planned integrated plant nutrient supply system(IPNS) as an approach, which adapts plants nutrition to a specific farming system and particular yield targets, the physical resource base, the available plant nutrient sources and the socio-economic back ground should be adopted to overcome the environmental problems (Dudal and Roy, 1995). The sources of plant nutrients may be mineral fertilizers and/or biological nitrogen fixation and/or organic materials depending upon particular location. This integrated plant nutrient supply system should be science based, associating agronomy, ecology and social sciences. It should use a farming system approach and not limit itself to cropping system only. It should address both increased productivity and profitability and integrate maintenance and rehabilitation of natural resources. It will thus be possible to give a technical package of management requirement for a given soil- water - plant - environment situation for realizing maximum fertilizer input use efficiency.

In the context of changing policy environment, it seems likely that farmers will be under increasing pressure to pay higher prices for fertilizers. In the irrigated areas in Gujarat where the fertilizer use is widespread and has reached 1.5 times or more than the recommended rates, the issue of fertilizer use efficiency has increasingly become important (Desai, 1986).

The soil testing services is closely related to fertilizer use efficiency. It identifies soil specific requirements of different nutrients. In 2005, the then Hon. Chief Minister of Gujarat, Mr. Narendra Modiji has launched Soil Health Card Scheme in which Soil Health Card are issued for farmers containing the information on soil type, cropping pattern, crop sequence, fertilizer dose on the basis of soil analysis etc. The farmers are advised to use chemical fertilizers on the basis of information provided in soil health card, which resulted into optimum yield response and thereby increase in net income. No systemic study to examine the impact of Soil Health Card has been conducted. Hence, the present study was undertaken to assess the impact of soil health card on fertilizer consumption and yield of sugarcane and *kharif* paddy in South Gujarat region of Gujarat state.

Data and Methodology

The study was conducted in the South Gujarat region of Gujarat state. A multistage sampling technique was used for the selection of sample. Two districts of South Gujarat namely Surat and Navsari were selected purposively as they rank in the use of fertilizers per hectare; and two major crops like *kharif* paddy and sugarcane were selected as they acquired highest area in these Districts. At the first stage, two *talukas* were selected randomly from each district. In the second stage, four villages were selected from each *taluka* randomly and at final stage, 14 farmers (7 without soil health card + 7 with soil health card) were selected randomly from each village for the study. Thus, total sample comprised of 224 farmers from sixteen villages. The primary data for the study at micro level were collected by survey method adopting personal interview of the selected respondents with the help of well structured and pre-tested questionnaire. The survey work was carried out for the agricultural year 2010-11.

Since 2005, the Government of Gujarat has launched Soil Health Card scheme. The farmers are advised to use chemical fertilizers on the basis of information provided in soil health cards. Simple tabular analysis with percentage is used to examine the

impact of Soil Health Card on fertilizer consumption in the study area.

For sugarcane and *kharif* paddy the difference between with and without Soil Health Card farming in respect of yield per hectare was tested by using paired't' test with the following formula:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S}\sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

Where, $\overline{X}_1$ and $\overline{X}_2$ are the means of yield per hectare of with and without Soil Health Card farmers, respectively, n_1 and n_2 are the number of observations in the two samples and S is the standard deviation of the difference between two samples.

RESULTS AND DISCUSSION

Fertilizer consumption for with and without Soil Health Card in sugarcane crop

The crop wise and zone wise information on actual fertilizer use level, recommended dose of fertilizer, recommended dose as per Soil Health Card and extent of gap for the selected crops have been discussed in this section. The extent of gap in fertilizer use in sugarcane has been given in Table 1. In Navsari and Surat districts little more over utilization of N was observed for Soil Health Card farmers. The magnitude of over utilization ranged from 0.38 per cent in Navsari to 3.08 per cent in Surat district. While, the extent of over utilization was higher for without Soil Health Card farmers. It ranged from 8 per cent in Navsari to 12 per cent in Surat districts. The magnitude of over utilization of N in south Gujarat region for with Soil Health Card farmers and without Soil Health Card farmers was observed to the tune of 4.02 per cent and 13.20 per cent, respectively. It clearly indicated that there is an impact of Soil Health Card on consumption of fertilizers.

As far as P is concern, the gap observed was negative for all farmers. It indicated that there was under utilization of P in sugarcane crop. But the extent of gap was smaller for with Soil Health Card farmers as compared to without Soil Health

Table 1: Fertilizer consumption for with and without Soil Health Card in sugarcane crop

(kg/ha)

District	Particular		N	P	K
Navsari	With Soil Health card	As per Soil Health Card doze	260	124	99
		Actual use	261	119	90
		Gap	+1 (0.38)	-5 (4.03)	-9 (9.09)
	Without Soil Health card	Recommended doze	250	125	125
		Actual use	270	93	79
		Gap	+20 (8.00)	-32 (25.60)	-46 (36.80)
Surat	With Soil Health card	As per Soil Health Card doze	227	127	82
		Actual use	234	121	73
		Gap	+7 (3.08)	-6 (4.72)	-9 (10.98)
	Without Soil Health card	Recommended doze	250	125	125
		Actual use	280	111	94
		Gap	+30 (12.00)	-14 (11.20)	31 (24.80)
South Gujarat	With Soil Health card	As per Soil Health Card doze	238	130	88
		Actual use	248	122	87
		Gap	+10 (4.02)	-8 (6.15)	-1 (1.14)
	Without Soil Health card	Recommended doze	250	125	125
		Actual use	283	110	94
		Gap	+33 (13.20)	-15 (12.00)	-31 (24.80)

(Figures in parentheses indicate per cent of gap)

Note : + and – sign indicate over and underutilization of fertilizers, respectively.

Card farmers. This gap ranged from 4.03 per cent in Navsari to 4.72 per cent in Surat district for with Soil Health Card farmers. This gap was wide for without Soil Health Card farmers. It ranged from 25.60 per cent in Navsari to 11.20 per cent in Surat district. For south Gujarat as a whole, the extent of gap was 6.15 per cent for with Soil Health Card farmers to 12 per cent for without Soil Health Card farmers.

The extent of gap in respect of K in both the districts was observed. This gap ranged from 9.09 per cent in Navsari district to 10.98 per cent in Surat district for with Soil Health Card farmers. This gap was wider for without Soil Health Card farmers. It ranged from 36.80 per cent in Navsari district to 24.80 per cent in Surat district. The overall gap in South Gujarat was just 1 per cent for with Soil Health Card farmers and 24.80 per cent for without Soil Health Card farmers. It indicated that extent of gap was small for with Soil Health Card farmers as compared to without Soil Health Card farmers. These results are in conformity with the results obtained by Trivedi and Patel (1994), Dhyan Singh (1996) and Prasad and Rao (2002).

Fertilizer consumption for with and without Soil Health in *kharif* paddy crop

The extent of gap in fertilizer use in *kharif* paddy has been given in Table 2. In Navsari and Surat districts less over utilization of N was observed for Soil Health Card farmers. The magnitude of over utilization ranged from 1 per cent in Navsari to 5.77 per cent in Surat district. While, the extent of over utilization was higher for without Soil Health Card farmers. It ranged from 10 per cent in Navsari district to 23 per cent in Surat districts. The magnitude of over utilization of N in South Gujarat region for with Soil Health Card farmers and without Soil Health Card farmers was observed to the tune of 2.94 per cent and 15.00 per cent, respectively. It clearly indicated that there is some impact of Soil Health Card on consumption of fertilizers.

As far as P is concern, the gap observed was negative for all farmers. It indicated that there was underutilization of P in *kharif* paddy crop. But the extent of gap was smaller for with Soil Health Card farmers as compared to without Soil Health Card

Table 2: Fertilizer consumption for with and without Soil Health Card in *kharif* paddy crop (kg./ha.)

District	Particular		N	P	K
Navsari	With Soil Health card	As per Soil Health Card doze	101	31	0
		Actual use	102	28	0
		Gap	+1 (0.99)	-3 (9.68)	0
	Without Soil Health card	Recommended doze	100	30	0
		Actual use	110	26	0
		Gap	+10 (10.00)	-4 (13.33)	0
Surat	With Soil Health card	As per Soil Health Card doze	104	28	0
		Actual use	110	27	0
		Gap	+6 (5.77)	-1 (3.57)	0
	Without Soil Health card	Recommended doze	100	30	0
		Actual use	123	28	0
		Gap	+23 (23.00)	-2 (6.67)	0
South Gujarat	With Soil Health card	As per Soil Health Card doze	102	30	0
		Actual use	105	28	0
		Gap	+3 (2.94)	-2 (6.66)	0
	Without Soil Health card	Recommended doze	100	30	0
		Actual use	115	27	0
		Gap	+15 (15.00)	-3 (10.00)	0

(Figures in parentheses indicate per cent of gap)

Note : + and – sign indicate over and underutilization of fertilizers, respectively.

Table 3: Comparison of crop yield between farmers for with and without soil health card in South Gujarat

Crop	District	Parameters	With SHC	Without SHC	't' test	Probability
Sugarcane	Surat	Mean	101.10	95.70	3.3019**	0.0014
		S.D.	59.74	64.40		
		No. of observation	46	47		
	Navsari	Mean	92.18	85.92	6.3129**	0.00003
		S.D.	15.71	14.7624		
		No. of observation	33	29		
	South Gujarat	Mean	97.37	91.97	4.1956**	0.00004
		S.D.	60.49	67.91		
		No. of observation	79	76		
Paddy	Surat	Mean	4934.50	4641.88	2.0905*	0.0464
		S.D.	48183.38	351886.44		
		No. of observation	17	21		
	Navsari	Mean	5317.23	4804.69	2.6401*	0.0119
		S.D.	976741.64	189765.94		
		No. of observation	30	37		
	South Gujarat	Mean	5178.79	4745.74	3.1841**	0.0021
		S.D.	667085.04	249550.77		
		No. of observation	47	58		

farmers. This gap ranged from 3.57 per cent in Surat district to 9.68 per cent in Navsari district for with Soil Health Card farmers. This gap was wide for without Soil Health Card farmers. It ranged from 6.67 per cent in Surat district to 13.33 per cent in Navsari district. For south Gujarat as a whole, the extent of gap was found to 6.66 per cent for with Soil Health Card farmers and 10 per cent for without Soil Health Card farmers. It indicated that the gap was smaller for with Soil Health Card farmers as compared to without Soil Health Card farmers.

These results are in conformity with the results obtained by Dhyan Singh (1996) and Prasad and Rao (2002).

Comparison of crop yield between farmers for with and without Soil Health Card in South Gujarat

The yield obtained per unit area is one of the crucial parameters for economic gain for farmers. An attempt has been made to quantify the effect of Soil Health Card on yield of selected crops in the study area. The paired 't' test is used to find out the effect of Soil Health Card on yield obtained by with and without Soil Health Card farmers.

The different parameters related to 't' test were presented in Table 3. The data revealed that for sugarcane crop, the mean yield was found higher for with Soil Health Card farmers (101.10 tonnes/ha.) as compared to without Soil Health Card farmers (95.70 tonnes/ha.) in Surat district. While, for Navsari district it was 92.18 tonnes per hectare and 85.92 tonnes per hectare, respectively.

In both the districts, the yield differences for with and without Soil Health card farmers were found statistically significant at 1 per cent level of significance. The similar trend was also observed in South Gujarat region as a whole. In case of *kharif* paddy, the mean yield was found higher for with Soil Health Card farmers (4934.50 kgs/ha.) as compared to without Soil Health Card farmers (4641.88 kgs/ha.) in Surat district. While, for Navsari district it was 5317.23 kgs per hectare and 4804.69 kgs per hectare, respectively. In both the districts, the yield differences for with and without Soil Health card farmers were found statistically significant at 5 per cent level of significance. For South Gujarat region, it was found significant at 1 per cent. Thus, our hypothesis was supported by these results that Soil Health Card is beneficial for farmers. This might be due to balanced fertilizer use

by with Soil Health card farmers. The similar type of results was also obtained by Desai *et al.* (1993).

On the examination of paired 't' test applied to quantify the effect of Soil Health Card on per hectare yield obtained by with and without Soil Health Card farmers for sugarcane and *kharif* paddy crops reflected positive and significant effect of Soil Health Card on selected crop yields in South Gujarat region.

CONCLUSION

In general, with Soil Health Card farmers of Navsari and Surat districts used the fertilizers judiciously as per recommendation of Soil Health Card as compared to without Soil Health Card farmers. The paired 't' test reflected positive and significant effect of Soil Health Card on sugarcane and *kharif* paddy yield in South Gujarat region.

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