

AERC STUDY No. 41

**IMPACT OF SOIL HEALTH CARD SCHEME ON PRODUCTION,
PRODUCTIVITY AND SOIL HEALTH IN PUNJAB**



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TABLE OF CONTENT

Sr. No.	CHAPTER	Page No.
1	INTRODUCTION	1-6
1.1	Background	1
1.2	Review of Literature	2
1.3	Major objectives and scope of the study	4
1.4	Data and Methodology	5
1.5	Limitations of the study	5
1.6	Chapter stream	5
2	SOCIO-ECONOMIC CHARACTERISTICS OF THE SAMPLE HOUSEHOLDS	7-10
2.1	General characteristics	7
2.2	Landholdings	8
2.3	Sources of irrigation	8
2.4	Cropping pattern	9
2.5	Gross income by agricultural production	9
3	STATUS OF AWARENESS ON SOIL HEALTH CARD SCHEME	11-16
3.1	Awareness on soil testing	11
3.2	Source(s) of information about soil testing	12
3.3	Training programs attended on application of chemical fertilizer	12
3.4	Method of application of fertilizers	13
3.5	Details of soil sampling	14
3.6	Source(s) for fertilizer purchase	14
3.7	Soil sampling	16
4	ADOPTION OF RCOMMENDED DOSES OF FERTILIZERS AS PER SOIL HEALTH CARD SCHEME	17-20
4.1	Recommended quantity of fertilizers based on soil test report	17
4.2	Organic fertilizer for reference crops (Paddy, basmati & maize)	18
4.3	Problems encountered while implementation of the SHC scheme	18
4.4	Suggestions for improvement of SHC scheme	19
5	IMPACT OF SOIL HEALTH CARD SCHEME	20-24
5.1	Impact of application of recommended doses of fertilizers on Yield	20
5.2	Visible changes found after the application of recommended doses of fertilizers	20
5.3	Cost of cultivation and income of major crops	21
6	SUMMARY AND POLICY SUGGESTIONS	25-28
6.1	Background	25
6.2	Socio-economic characteristics of sample households	25
6.3	Awareness on SHC scheme	26
6.4	Adoption of recommended doses of fertilizers on soil test basis	27
6.5	Impact of SHC scheme	28
6.6	Policy suggestions	28
	References	30-31

LIST OF TABLES

Table No.	Title	Page No.
2.1	General characteristics of sample households in Punjab, 2015-16	7
2.2	Operational landholdings of sample households in Punjab, 2015-16	8
2.3	Sources of irrigation of sample households in Punjab, 2015-16	8
2.4	Cropping pattern of the sample households in Punjab, 2015-16	9
2.5	Gross income realized by the sample households by agricultural production in Punjab, 2015-16	10
3.1	Awareness on soil testing among sampling households in Punjab 2015-16	11
3.2	Source(s) of information about soil testing among sampling households in Punjab, 2015-16	12
3.3	Training programs attended on application of chemical fertilizer by sampling households in Punjab, 2015-16	12
3.4	Method of application of fertilizers by sample households in Punjab, 2015-16	13
3.5	Details of soil sampling by soil-tested sample households in Punjab, 2015-16	14
3.6	Source(s) for fertilizers purchase on sample households in Punjab, 2015-16	15
3.7	Sources of soil sample collection by soil-tested sample households in Punjab, 2015-16	16
4.1	Average recommended quantity of fertilizers based on soil test report (as mentioned in the SHC) in Punjab, 2015-16	17
4.2	Applied organic fertilizers for reference crops in Punjab, 2015-16	18
4.3	Problems encountered while implementation of the SHC scheme in Punjab, 2015-16	18
4.4	Suggestions for improvement of SHC scheme in Punjab, 2015-16	19
5.1	Impact of application of recommended doses of fertilizers on yield of reference crops in Punjab, 2015-16	20
5.2	Visible changes found after the application of recommended doses of fertilizers in Punjab, 2015-16	21
5.3	Changes in cost of cultivation of paddy crop and income in Punjab, 2015-16	21
5.4	Changes in cost of cultivation of basmati crop and income in Punjab, 2015-16	22
5.5	Changes in cost of cultivation of maize crop and income in Punjab, 2015-16	23

PREFACE

Chemical fertilizers are important source for plant growth and development. In Punjab, the paddy-wheat cropping pattern has resulted in development of nutrient deficiencies in the soils. Since soils vary considerably in their capability to meet plants nutrient needs depending on factors such as soil parent material, texture, structure and current growing conditions, the soil test based application of such fertilizers in the form of "Soil Health Card" is gaining importance. The need based use of fertilizers in the fields/ soil can result in cost saving/ profit increasing at the farmers level. Govt. of India has been advocating widespread use of Soil Health Card by the farmers for efficient use of chemical fertilizers.

In view of the cited benefits of soil testing, the present study was undertaken with emphasis on to examine the awareness, level of adoption and impact of application of recommended doses of fertilizers on soil test basis and its impact on income from major crops in Punjab. This attempt would definitely be useful for further framing suitable policies for the benefit of farming community

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Authors

IMPACT OF SOIL HEALTH CARD SCHEME ON PRODUCTION, PRODUCTIVITY AND SOIL HEALTH IN PUNJAB

Abstract

Punjab state is one of the leading states in India known for advent of green revolution in the country but with the passage of time, the rice-wheat monoculture has resulted in development of various agro-ecological problems. Although chemical fertilizers are the important source of nutrients for plant growth but its judicious and timely use is the need of the hour. The Union Government in February, 2015 had launched the 'Soil Health Card Scheme'. Under the scheme, the Government planned to issue Soil Health Cards (SHC) to the farmers to help them to get a good harvest by studying the quality of the soil. Punjab has become the first state in India to issue Soil Health Cards (SHCs) during the year 2015. Keeping in view the importance of SHC scheme the present study was undertaken to examine the awareness, level of adoption and impact of application of recommended doses of fertilizers on soil test basis and its impact on income of major crops in Punjab, if any. Primary data were collected from 60 soil-tested and 60 control group farmers from four clusters of villages in Ludhiana and Patiala districts which were leading districts in distribution of SHC to the farmers in the state. The results of the study revealed that the farmers in soil-tested farmers category was younger having large family size, better educated and there were more number of OBC and SC in this category. Also, soil-tested farmers were having larger holding size with more owned and leased-in land but there were fewer sources of irrigation on soil-tested farmer's category as compared to control farmers. Paddy dominated the cropping pattern on the sample farms with higher relative area on soil-tested farmer's category as compared to control farmers and it was major source of income for almost all the farmers on both the farm categories followed by sugarcane, basmati and maize for few of them. The results of the study revealed that about 34 to 77 per cent of the farmers were aware about various aspects related to soil testing and SAUs/KVKs were the major source of information about soil testing among soil-tested farmers and neighbours in case of control farmers category. It was also seen that although majority of the farmers did not attend any training programme regarding application of chemical fertilizers but they were well aware about the method of application of chemical fertilizers. Soil testing laboratory was not much far away from the farmer's fields and average area covered under soil testing was 5.83 acres on the sample household's farms. Also, it was seen that co-operative societies followed by private fertilizer shops/ dealers were the major source of fertilizer purchase by sample households. It was also observed that recommendations about fertilizer use provided in SHC showed that these have been given only for macro-nutrients use in paddy, basmati and maize crops. It was observed that farmers mostly preferred higher urea but lower DAP and MOP use in crops sown on their farms as compared to SHC recommendations. As far as application of organic fertilizers is concerned, only FYM was applied by some of the farmers in their fields. Major problems encountered by the respondents in implementing SHC scheme were; less organization of camps regarding soil testing, difficulty in understanding the SHC reports and delayed delivery of SHC reports. The respondent farmers suggested making aware the farmers about SHC scheme by organising more camps and timely disbursement of SHC reports. Policy suggestions brought out that to make farmers aware about the benefits of soil testing, more farmers training camps be organised along with soil testing campaigns. As far as impact of SHC scheme is concerned, in case of paddy and maize crops, there was slight decline in chemical fertilizer usage especially N and P and increase in K usage in case of paddy and increase in N usage in basmati on soil-tested farms which shows the balanced usage of chemical fertilizers as per recommendation. Also, there was slight increase in the yield in case of paddy, basmati and maize crops on soil-tested farms. The implication is that SHC scheme is a win-win situation for the farmers in terms of decline in fertilizer usage along with increase in crop productivity.

Chapter I: INTRODUCTION

1.1 Background

Punjab peasantry by adopting new farm technology in 1970s resulted in ushering green revolution thereby increasing the production and productivity of paddy and wheat crops and made the country self-sufficient in food grains production. It has been widely emphasized that with the passage of time, rice-wheat cropping system in Punjab has resulted in the appearance of macro and micro-nutrient deficiencies in plants/ crops and other problems such as; fast depleting underground water table and ecological and environmental issues due to paddy straw burning. It is well known fact that the chemical fertilizers are the important source of nutrients for plant growth. With the introduction of high yielding fertilizer responsive crop varieties, total consumption of nitrogenous (N), phosphatic (P) and potassic (K) fertilizers in Punjab increased from 2.13 lakh tonnes in 1970-71 to 17.17 lakh tonnes in 2014-15. But it has been apprehended by agricultural scientists that Punjab farmers are not making balanced and judicious use of chemical fertilizers. Hence, soil testing is the only alternative to address these issues at the farmer's level by providing soil test report/ soil health card for farmers holding/ farm.

The Union Government in February, 2015 had launched the "Soil Health Card Scheme". Under the scheme, the Government planned to issue Soil Health Cards (SHC) to the farmers to help them to get a good harvest by studying the quality of the soil. The card being a printed report given to the farmers once in three years for his land holding. The SHC contains all basic and crop-wise recommendation of fertilizers or nutrients required for farms of different soil types. It also provides crop-wise nutrient recommendation and other inputs in order to increase the productivity of farms. It also leads in profiling of soil structure which will in turn help in diversification of crops as per the soil content of that area as well.

Punjab had become the first state in India to issue Soil Health Cards (SHCs) during the year 2015. In this regard, every district of state has been assigned mobile soil testing lab. These labs take soil sample from every farm and issue a digitalised soil health details. The state government had 66 soil testing labs which have capability to test 3.5 lakh soil samples annually. State government also has made mandatory for these labs to check soil health on quarterly basis (General Knowledge Today, May 14, 2015).

Keeping in view the importance of SHC scheme, it become imperative to see the impact of the scheme in Punjab at the grass root level to find out the bottlenecks in its implementation.

1.2 Review of Literature

Fertilizer use on the basis of SHC is of utmost need to increase the yield of crops. Keeping this in view, review of various studies related to macro and micro-nutrients replenishment to soils have been undertaken which shows the importance of the soil testing for increasing crop productivity.

Prasad and Sinha (1995) indicated a decline of 23, 44 and 16 per cent in available N, P and K, respectively after six years where neither manures nor inorganic fertilizers were applied. Application of graded doses of fertilizers (50, 100 and 150% NPK) either in presence or absence of FYM showed an average increase of about 10 per cent in available nitrogen after 21 years of continuous rice-wheat cropping.

Reddy and Reddy (1998) reported that available N, P and micronutrients in soil were significantly influenced by the type and levels of manures application in conjunction with fertilizer. In all types of manures, the treatment with 100 per cent level of manure which was on par with 75 and 50 per cent level of manure showed higher available macro and micronutrients at the end of two cropping cycle in maize-soybean cropping system. This was attributed to the direct addition and slow release of N, P and K from manures added to soil.

Yaduvanshi (2001) reported that application of inorganic fertilizers along or in combination with green manure or FYM significantly enhanced the uptake of N by rice and wheat crop as compared to N alone and control treatment. The mean increase in uptake of N over control with 50 per cent recommended treatment and its combined use with green manuring and FYM and 100 per cent recommended treatments was 39.3, 78.1 and 77.3 kg per ha in rice and 36.8, 47.2 and 76.4 kg per ha in wheat, respectively. Nitrogen uptake by rice from green manuring or FYM or FYM with 50 per cent recommended treatment was similar to that from 100 per cent recommended treatment. The uptake of P and K increased significantly with the application of NPK and its combined use with green manuring and FYM.

Sharma and Sharma (2002) reported that application of different combinations of N, P and K did not show any significant effect on available N content of soil, whereas, application of NPK+FYM significantly increased available N content of soil over all combinations of FYM in rice -wheat cropping system.

Mann *et al* (2006) reported that available phosphorus content increased after 35 years to 15.1, 38.4, 27.4 and 38.7 kg per ha from the initial value of 13.7 in 50, 100, 150 per cent NP and

100 per cent NPK + FYM treatments, respectively. The higher build up of available phosphorus occur because phosphorus use efficiency range between 16 to 32 per cent during this period in soybean-wheat cropping system.

Mishra *et al* (2006) studied the effect of integrated nutrient management practices involving FYM and GM on yield and N nutrition of rice. It was observed that integrated use of urea with organic sources increased nitrogen use efficiency in rice.

Singh *et al* (2006) studied the impact of integrated management of fertilizers, FYM and GM on productivity of rice for two years. It was reported that application of recommended fertilizers along with FYM 5 tons per ha and green manuring at 2.1 tons per ha gave more yield of rice as compared to chemical fertilizers only.

Babu *et al* (2007) conducted a field experiment on alluvial soils to study the effect of different organic manures along with inorganic fertilizers on physical, physico-chemical and chemical properties of alluvial soil. It was reported that application of poultry manure along with inorganic fertilizers resulted in higher cane yield in plant crop whereas application of FYM along with inorganic fertilizers resulted in the highest cane yield in ratoon crop.

Kumar *et al* (2008) conducted a long-term field experiment on integrated management of FYM, GM and crop residues with inorganic fertilizers in rice-wheat system. It was reported that long-term application of crop residues and organic manures increased organic carbon content of soil. Further, it was found out that combined use of crop residues, organic amendments and chemical fertilizers significantly increased the availability of N, P, K, S and micronutrients in soil over chemical fertilizer alone.

Singh and Chahal (2009) studied the extent of adoption of various recommended production technologies for wheat crop in Punjab. The data were collected from farmers for three years. The results revealed that nitrogen was being applied at more than the recommended level by the farmers while phosphorus was being applied at the recommended level and potash was not being applied by the farmers to wheat crop in Punjab. The study brought out that there existed a number of gaps in the adoption of recommended production technology for wheat crop, which needed to be properly plugged to enhance productivity as well as net returns to wheat producers in the Punjab state.

Kumar and Singh (2010) conducted an experiment on long-term integrated nutrient management under rice-wheat cropping system to assess the direct and residual effect of green manures on crops with and without farmyard manure (FYM). The highest grain and straw yields of rice and wheat were obtained with the application of 100 per cent NPK along with 5 tons FYM per ha each year.

Grover *et al* (2016) studied the soil test fertilizer usage in case of paddy and wheat crops in Ludhiana and Sangrur districts of Punjab. A sample of 120 soil test farmers and 60 control farmers growing both paddy and wheat crops were selected. The analysis revealed that only 40.83 per cent soil test farmers applied recommended doses of fertilizers to paddy and wheat crops. The most important constraint revealed by about 69 per cent soil test farmers in applying recommended doses of fertilizers was the difficulty in understanding the soil test report. In both paddy and wheat crops, average yield and value of output was higher on soil test farmer farms as compared to control farmers farms. The impact of application of recommended doses of fertilizers by soil test farmers in terms of adopting the soil health card recommendations was increase in yield by 3.70 per cent in case of paddy and 6.16 per cent in wheat crop. Also, there was a decline in fertilizer consumption on soil test farms for both paddy and wheat crops along with increase in yield. The major policy issues included; more trainings, exposure visits of farmers to the areas adopting resource conservation techniques, adoption and implementation of soil health card results by farmers on their fields for sustainable agricultural development of the state.

1.3 Major objectives and scope of the study

The objectives of the study were:

1. To examine the level of awareness about soil health card (SHC) scheme among Punjab farmers.
2. To study the adoption of recommended doses of fertilizers on soil test basis by farmers.
3. To analyse the impact of SHC scheme on cost of cultivation and income of major crops in Punjab.

It has been often emphasized that the over use of chemical fertilizers by Punjab farmers in the last few decades led to several problems affecting soil health, nutrient flow and environmental pollution. Balanced use of chemical fertilizers on soil test basis is the key to increase crop yield and decreasing the cost of production of crops. Although, soil testing is being promoted by the agricultural scientists since long but only few years back the Union

Government has taken vigorous initiatives on providing SHC to the farmers on priority basis. But most important aspect is the proper following the SHC recommendations at the farmer's fields. Therefore, the present study examined the awareness, level of adoption and impact of application of recommended doses of fertilizers on soil test basis and its impact on income from major crops in the state.

1.4 Data and Methodology

The present study relied on the primary data collected from the farmers. The reference period for the study was 2015-16. The list of farmers who got their soils tested was collected from Krishi Vigyan Kendra, Patiala and Ludhiana for the year 2015-16 to assess the adoption of recommended dose of fertilizers. Ludhiana and Patiala districts were selected based on the status of soil health card scheme in the state. A total of 60 soil test farmers and 60 control farmers were selected for the study. The data were collected from four clusters of villages from the two selected districts. The selected farmers were interviewed personally to collect the relevant data. The data on socio-economic characters of the respondents along with awareness about the SHC scheme, adoption of recommended doses of fertilizers by the farmers and impact of SHC scheme in terms of increase in income from major crops were collected from the selected farmers.

1.5 Limitations of the study

It has been well established that soil testing is a major activity to maintain and ameliorate the soil nutrient health. But the present study relied exclusively on the primary data/ information collected from respondent households related to soil health and impact of SHC scheme on the production and productivity of major crops. Although, farmers are the best judge when verification of proven agricultural technology is required but minute analysis of the reasons of increase/ decline in productivity require a broader view point in an overall perspective which most of the respondents lack. Also, there can be numerous other associated factors which influence the yield of the crop and thus it's too difficult to exclusively investigate the impact of SHC scheme on productivity and soil health from the farmer's point of view.

1.6 Chapter stream

The present report has been divided into six chapters. First chapter relates to the background information related to soil testing, brief review of literature, major objectives, scope of the study, data and methodology along with limitations of the study. Second chapter is concentrated on socio-economic characteristics of the sample households. Third chapter

relates to awareness of selected respondents about SHC scheme while fourth chapter deals with adoption of recommended doses of fertilizers (RDF) as per SHC scheme by respondent farmers. The impact of SHC Scheme has been dealt with in chapter fifth while sixth chapter contains summary and policy suggestions.

Chapter II SOCIO-ECONOMIC CHARACTERISTICS OF THE SAMPLE HOUSEHOLDS

The socio-economic characters of the respondents play an important role in adoption of new farm technology. There are farmers who are in the forefront for testing new agricultural technology but there are many laggards also, who always follow the pioneers, apprehending risk in going for new experiments. The current chapter emphasizes on the general characteristics of the farm households along with their size of holding, irrigation source, cropping pattern followed and gross income generated on their farms.

2.1 General characteristics

The general characteristics of sample households have been shown in Table 2.1. It is quite clear that the respondent farmers were young with overall average age of 44.78 years and it was 45.43 years for control and 44.12 for soil-tested farmers. All the respondents were males having agriculture as their main occupation. The average family size was 6.17 in overall scenario with 5.78 for control and 6.55 for soil-tested farmer's category. It was observed that more than one (1.29) people were engaged in farming with average age of experience of farming being nearly 23 years in both the farmer categories. Majority of the respondents i.e. 61 per cent belonged to general caste category followed by OBC (38%) and SC (1%). Although the respondents were not highly educated but their

Table 2.1: General characteristics of sample households in Punjab, 2015-16

Particulars	Control farmers	Soil-tested farmers	Overall
Average age of respondents (Years)	45.43	44.12	44.78
Average years of respondent education	8.0	9.30	8.65
Agriculture as main occupation (%)	100.0	100.0	100.0
Gender (% of respondents)			
Male	100.0	100.0	100.0
Female	-	-	-
Average family size (No.)	5.78	6.55	6.17
Average number of people engaged in farming (No.)	1.10	1.47	1.29
Average years of experience in farming (No.)	23.20	22.75	22.98
Caste (% of respondents)			
SC	-	2.0	1.0
ST	-	-	-
OBC	35.0	41.0	38.0
General	65.0	57.0	61.0

experience of farming was significant enough to go for new farm technology. Thus, farmers in soil-tested farmers category was younger having large family size, better educated and there were more number of OBC and SC in this category.

2.2 Landholdings

The operational landholdings of the respondent farmers have been depicted in Table 2.2. A perusal of the table reveals that net operated land was 12.55 acres in overall scenario while it was 11.55 acres for control farmers and 13.55 acres for soil-tested farmerø category. In overall scenario, about 35 per cent of net operated area was leased-in and leased out land was almost negligible. Rental value of lease-in land was about Rs. 40000 per acre and it was Rs. 39362 in case of control farmers and Rs. 40731 in soil-tested farmerø category. The entire net operated area was irrigated on both farmer categories. Hence, soil-tested farmers were having larger holding size with more owned and leased-in land.

Table 2.2: Operational landholdings of sample households in Punjab, 2015-16

Particulars	Control farmers	Soil-tested farmers	Overall
Owned land	8.23 (71.26)	8.75 (64.58)	8.49 (67.65)
Leased- in	4.01 (34.72)	4.80 (35.42)	4.41 (35.14)
Leased-out	0.69 (5.97)	-	0.35 (2.79)
Uncultivated land	-	-	-
Rental value of leased-in land (Rs/acre)	39362	40731	40046
Rental value of leased-out land (Rs/acre)	40000	-	40000
Total irrigated land	11.55 (100.00)	13.55 (100.00)	12.55 (100.00)
Total un-irrigated land	-	-	-
Net operated land	11.55 (100.00)	13.55 (100.00)	12.55 (100.00)

Figures in the brackets are the per cent area to net operated area

2.3 Sources of irrigation

Sources of irrigation on the sample households have been given in Table 2.3. It can be seen from the table that on control as well as soil-tested farmers category, entire area was being irrigated using bore well while 10 per cent area on control farmers category was having

Table 2.3: Sources of irrigation of sample households in Punjab, 2015-16

Particulars	Control farmers	Soil-tested farmers	Overall (% farmers)
Dug well	-	-	-
Bore well	100.0	100.0	100.0
Canal	-	-	-
Tank	-	-	-
Bore well+ Canal	10.0	-	5.0

canal as well as bore well as source of irrigation. This shows that there was adequate irrigation facility on the sample household farms. But there were fewer sources of irrigation on soil-tested farmerø category as compared to control farmers.

2.4 Cropping pattern

The cropping pattern during *kharif*, 2015 on the sample households in Punjab have been given in Table 2.4. It was observed that paddy was major crop on the sample households which occupied 79.62 per cent of the total sown area on control farmers and 82.11 per cent on soil-tested farmers category. Other crops grown by control farmers category was basmati (6.78%), sugarcane (4.40%), maize (2.16%) and fodder (7.04%). Similarly, on soil-tested farmers category other crops grown were; sugarcane (4.55%), basmati (3.81%), maize (2.77%), fodder (6.61%) and vegetables (0.15%). Thus, paddy crop dominated the cropping pattern on the sample farms with higher relative area on soil-tested farmerø category as compared to control farmers.

Table 2.4: Cropping pattern of the sample households in Punjab, 2015-16

Season	Crops	Control farmers		Soil-tested farmers	
		Area (acres)	% to total area	Area (acres)	% to total area
<i>Kharif</i> , 2015	Paddy	9.20	79.62	11.13	82.11
	Basmati	0.78	6.78	0.52	3.81
	Maize	0.25	2.16	0.38	2.77
	Sugarcane	0.51	4.40	0.62	4.55
	Fodder	0.81	7.04	0.90	6.61
	Vegetables	-	-	0.02	0.15
	Total Sown Area(Acres)	11.55	100.0	13.55	100.0

2.5 Gross income by agricultural production

Gross income realized by the sample households have been given in Table 2.5. A perusal of the table reveals that on control farmers farms, average quantity of paddy sold was 266.52 quintals and gross income obtained was Rs.386454 while from basmati it was Rs. 29806, from sugarcane Rs. 52597 and Rs.5517 from maize crop. On soil-tested farmers category, average quantity of paddy sold was 324.68 quintals with gross income obtained being Rs.470786 followed by sugarcane (Rs.64818), basmati (Rs.19440), maize (Rs.8306) and vegetables (Rs.2214). Thus, it can be seen that paddy was major source of income for almost all the farmers on both the farm categories followed by sugarcane, basmati and maize for few of them.

Table 2.5: Gross income realized by the sample households by agricultural production in Punjab, 2015-16

Crops	Control farmers				Soil-tested farmers			
	% of farmers	Avg. qty sold (Qtls)	Avg. price (Rs/Qtl)	Gross income obtained (Rs)	% of farmers	Avg. qty sold (Qtls)	Avg. price (Rs/Qtl)	Gross income obtained (Rs)
Paddy	98.33	266.52	1450	386454	100.0	324.68	1450	470786
Basmati	16.67	14.77	2018	29806	21.67	9.60	2025	19440
Maize	10.00	4.27	1292	5517	11.67	6.35	1308	8306
Sugarcane	8.33	184.55	285	52597	15.00	227.43	285	64818
Vegetables	-	-	-	-	1.67	1.23	1800	2214

In brief it can be concluded that the farmers in soil-tested farmerø category were younger having large family size, better educated and there were more number of OBC and SC in this category. Also, soil-tested farmers were having larger holding size with more owned and leased-in land but there were fewer sources of irrigation on soil-tested farmerø category as compared to control farmers. Paddy dominated the cropping pattern on the sample farms with higher relative area on soil-tested farmerø category as compared to control farmers and it was major source of income for almost all the farmers on both the farm categories followed by sugarcane, basmati and maize for few of them.

Chapter III STATUS OF AWARENESS ON SOIL HEALTH CARD SCHEME

It is pre-requisite to study the level of awareness about soil testing technology among sample households to investigate about its adoption level. This chapter emphasizes on the awareness on soil testing, sources(s) of information about soil testing, training programs attended by respondent farmers on application of chemical fertilizers, method of application of fertilizers, details of soil sampling method and source(s) for fertilizer purchase.

3.1 Awareness on soil testing

The awareness of sample households on soil testing has been given in Table 3.1. It can be seen that 51.67 per cent soil-tested and 46.67 per cent control farmers were aware about the integrated nutrient management (INM) i.e. awareness about other nutrient sources such as farm yard manure (FYM), green manuring etc. Also, 48 per cent soil-tested and 47 per cent control farmers experienced reduction in chemical fertilizers due to INM. Awareness about the imbalanced use of fertilizers was widespread among soil-tested farmers (80%) as compared to control farmers (46.67%). Also, 68.33 per cent soil-tested farmers were having knowledge about ongoing programmes on Soil Health Mission and all were aware about Soil Health Cards. Besides, 53.33 per cent control farmers were also aware about Soil Health Cards. However, only 11.67 per cent soil-tested farmers were aware about grid system under SHC scheme. Thus, in overall about 34 to 77 per cent of the farmers were aware about various aspects related to soil testing on the sample farms.

Table 3.1: Awareness on soil testing among sampling households in Punjab 2015-16

(% farmers)

Particulars	Soil-tested farmers	Control farmers	Overall
Households know about INM	51.67	46.67	49.17
Households experienced the reduction in consumption of chemical fertilizers due to INM	48.33	46.67	47.50
Households awareness on imbalanced application of fertilizers and its effects	80.00	46.67	63.33
Households knowledge about ongoing programmes on Soil Health Mission	68.33	-	34.17
Households aware of Soil Health Cards	100.00	53.33	76.67
Households awareness on grid system under SHC scheme	11.67	-	5.83

3.2 Source(s) of information about soil testing

The source(s) of information about soil testing among sample households has been given in Table 3.2. It was observed that 96.67 per cent of the soil-tested farmers got information about soil testing from Krishi Vigyan Kendras(KVKs) while 3.33 per cent from State Agriculture Department. In control farmerø category, 43.33 per cent farmers came to know about soil testing from neighbours, 21.67 per cent from private companies, 5 per cent from SAUs/ KVKø, and 3.33 per cent from friends. Thus, SAUs/KVKø were the major source of information about soil testing among soil-tested farmers and neighbours in control farmers category .

Table 3.2: Source(s) of information about soil testing among sampling households in Punjab, 2015-16

Sources	(% farmers)		
	Soil-tested farmers	Control farmers	Overall
SAUs/ KVKs	96.67	5.00	50.83
Private companies	-	21.67	0.83
Agriculture department	3.33	-	1.67
Friends	-	3.33	1.37
Neighbours	-	43.33	21.67

3.3 Training programs attended on application of chemical fertilizers

Information about Training programmes attended by sampling households depicted in Table 3.3 reveals that only 26.66 per cent of the soil-tested, 18.33 per cent of control farmers and 22.50 per cent in overall scenario attended training programmes on application of chemical fertilizers of one day duration.

Table 3.3: Training programs attended on application of chemical fertilizers by sampling households in Punjab, 2015-16

Particulars	(% farmers)		
	Soil-tested farmers	Control farmers	Overall
% of farmers attended	26.66	18.33	22.50
Average number of days	1	1	1
Name of the training programme			
Balanced use of chemical fertilizers for higher returns	10.00	6.67	8.33
Make judicious use of fertilizers for better yield	8.33	5.00	6.67
Use of recommended dose of fertilizers to decrease cost of production	5.00	3.33	4.17
Importance of method of fertilisers application for higher fertilizers efficiency	3.33	3.33	3.33

During the survey, it was found that although majority of the farmers did not attend any training programme regarding application of chemical fertilizers but they were well aware about the method of application of chemical fertilizers.

3.4 Method of application of fertilizers

The method of application of fertilizers by sample households on the crops during *kharif*, 2015 season has been given in Table 3.4. It was seen that almost all the soil tested farmers applied urea and DAP to *kharif* crops by broadcasting while only 5 per cent applied SSP, 28.33 per cent potash and 76.67 per cent micronutrients to *kharif* crops by broadcasting. Thus, almost all the fertilizers were applied by broadcasting method during *kharif* season by soil tested farmers while 16.67 per cent farmers also applied micro-nutrients by spraying on their crops. In case of control farmers category, all the farmers applied urea to *kharif* crops by broadcasting while DAP was applied by 96.67 per cent farmers and micronutrients by 56.67 per cent farmers by broadcasting and 11.67 per cent also used micro-nutrients by spraying on their crops. Thus, in overall, fertilizers were mostly used by broadcasting method as revealed by farmers on both the farm categories

Table 3.4: Method of application of fertilizers by sample households in Punjab, 2015-16 (% farmers)

Method of fertilizer application	Urea	DAP	SSP	Potash	Micro nutrients	Complex fertilizers
Soil-tested farmers						
Broadcasting	100.0	100.00	5.00	28.33	60.0	-
Spraying	-	-	-	-	16.67	-
Fertigation	-	-	-	-	-	-
Drilling	-	-	-	-	-	-
Total	100.00	100.00	5.00	28.33	76.67	-
Control farmers						
Broadcasting	100.00	96.67	-	-	56.67	-
Spraying	-	-	-	-	11.67	-
Fertigation	-	-	-	-	-	-
Drilling	-	-	-	-	-	-
Total	100.00	96.67	-	-	68.34	-
Overall						
Broadcasting	100.00	98.33	2.50	14.17	58.33	-
Spraying	-	-	-	-	14.17	-
Fertigation	-	-	-	-	-	-
Drilling	-	-	-	-	-	-
Total	100.00	98.33	2.50	14.17	72.50	-

3.5 Details of soil sampling

The details of soil sampling by soil-tested sample households have been provided in Table 3.5. It was seen that soil testing was done at Rs. 20 per sample for macro nutrients but it was free of cost for the farmer as the concerned KVK paid for the soil testing and average distance from field to soil testing laboratory was 18.8 Kms. Also, average area covered under soil testing was 5.83 acres with average number of plots considered for soil testing being 2.21 and average samples taken for soil testing being two. Thus, soil testing laboratory was not much far away from the farmer's fields and average area covered under soil testing was 5.83 acres on the sample household's farms.

Table 3.5: Details of soil sampling by soil-tested sample households in Punjab, 2015-16

Particulars	Soil-tested farmers
Average cost of soil testing (Rs/sample)	20.00
Average distance from field to soil testing lab (kms)	18.8
Average samples taken for soil testing	2.0
Average no. of plots considered for soil testing	2.21
Average area covered under soil testing (Acre)	5.83

3.6 Source(s) for fertilizer purchase

The source of fertilizer purchase has been given in Table 3.6. It was observed that private fertilizer shop/dealers as well as co-operative societies were major source of fertilizer purchase on the sample households. Many respondents purchased fertilizers from both the sources. Hence, 90 per cent soil tested farmers purchased urea and DAP from co-operative societies while micronutrients purchase was by 18.33 per cent, potash by 5 per cent and SSP by 1.67 per cent from co-operative societies. Similarly, 36.67 per cent respondents purchased both urea and DAP from private fertilizer shops/dealers and the micronutrient purchase was by 58.33 per cent, potash by 25 per cent and SSP by 3.33 per cent respondents from private fertilizer dealers.

In case of control farmers, 85 per cent purchased urea and 83.33 per cent DAP from co-operative societies while micronutrients purchase was by 16.67 per cent. Also, 31.67 per cent respondents purchased both urea and DAP from private fertilizer shops/dealers and the micronutrient purchase was by 51.67 per cent respondents from private fertilizer dealers.

In overall scenario it was observed that co-operative societies followed by private fertilizer shops/ dealers were the major source of fertilizer purchase as revealed by the sample households.

Table 3.6: Source(s) for fertilizers purchase on sample households in Punjab, 2015-16
(% farmers)
(Multiple response)

Sources	Urea	DAP	SSP	Potash	Complex	Micronutrient	Bio-fertilizers
Soil-tested farmers							
Private fertilizer shops/dealers	36.67	36.67	3.33	25.00	-	58.33	-
Company authorized dealers	-	-	-	-	-	-	-
Co-operative societies	90.00	90.00	1.67	5.00		18.33	
Government agency	-	-	-	-	-	-	-
Others	-	-	-	-	-	-	-
Control farmers							
Private fertilizer shops/dealers	31.67	31.67	-	-	-	51.67	-
Company authorized dealers	-	-	-	-	-	-	-
Co-operative societies	85.00	83.33	-	-		16.67	
Government agency	-	-	-	-	-	-	-
Others	-	-	-	-	-	-	-
Overall							
Private fertilizer shops/dealers	34.17	34.17	1.67	12.50	-	55.00	-
Company authorized dealers	-	-	-	-	-	-	-
Co-operative societies	87.50	86.67	0.83	2.50	-	17.50	-
Government agency	-	-	-	-	-	-	-
Others	-	-	-	-	-	-	-

3.7 Soil sampling

The source of soil sample collection by sample households in Punjab has been given in Table 3.7. It was observed that 42 per cent of the soil-tested households collected soil samples themselves while on 55 per cent farms soil samples were taken with the assistance KVK officials and on 3 per cent by farmer facilitators.

Table 3.7: Sources of soil sample collection by soil-tested sample households in Punjab, 2015-16

Particulars	(% farmers)
	Soil-tested farmers
Self	42.00
RSK officials	-
SAUs/ KVKs	55.00
Farmer facilitators	3.00

It can be summarized that about 34 to 77 per cent of the farmers were aware about various aspects related to soil testing and SAUs/KVKs were the major source of information about soil testing among soil-tested farmers and neighbours in case of control farmers category. It was observed during the course of the study that although majority of the farmers did not attend any training programme regarding application of chemical fertilizers but they were well aware about the method of application of chemical fertilizers. It was also found that soil testing laboratory was not much far off from the farmer's fields and average area covered under soil testing was 5.83 acres on the sample household's farms. Also, it was seen that co-operative societies followed by private fertilizer shops/ dealers were the major source of fertilizer purchase as revealed by the sample households.

Chapter IV ADOPTION OF ROCOMMENDED DOSES OF FERTILIZERS AS PER SOIL HEALTH CARD SCHEME

Soil health card is an important document depicting the nutrient status of soil but it is more important that the recommendations/ prescriptions given in soil health card are adopted by the respondent farmers. This chapter includes the recommended quantity of fertilizers based on soil test results, application of organic fertilizer to the crops, problems encountered while implementation of the SHC scheme and suggestions for improvement of SHC scheme.

4.1 Recommended quantity of fertilizers based on soil test report

Recommended quantity of fertilizers based on soil test report has been given in Table 4.1. It was seen that recommended quantity of fertilizers for paddy crop was 114 kg. urea, 25 kg. di-ammonium phosphate (DAP) or 75 Kg. single super phosphate (SSP) and 20kg. muriate of potash (MOP). Similarly, for basmati crop only 30 kg. urea was recommended per acre. In case of maize crop recommendation level of urea was 123 kg per acre besides 50 kg. DAP or 140 kg. SSP and 20 kg. MOP. Thus, recommendations about fertilizer use in SHC showed that these have been given only for macro-nutrients use in paddy, basmati and maize crops.

Table 4.1: Average recommended quantity of fertilizers based on soil test report (as mentioned in the SHC) and as per farmers opinion in Punjab, 2015-16
(Kgs/acre)

Crops	FYM	Urea	DAP/SSP	MOP	MgSo4
As per soil test report					
Paddy	-	114	25/75	20	-
Basmati	-	30	-	-	-
Maize	-	123	50/140	20	-
As per the farmer's opinion					
Paddy	1.29*	130	4	3	-
Basmati	-	81	-	-	-
Maize	-	103	42	-	-

* Quantity in tonnes

According to farmers opinion requirement of urea was higher for paddy and basmati and lower for maize crop as compared to SHC report. Also, as per farmers opinion, requirement of DAP and MOP in paddy and DAP in maize was also lower vis-a-vis based on SHC recommendations. Thus, farmers mostly preferred higher urea but lower DAP and MOP use in crops as compared to SHC recommendations.

4.2 Organic fertilizer for reference crops (Paddy, basmati & maize)

The application of organic fertilizers for reference crops in Punjab has been shown in Table 4.2. A perusal of the table reveals that only 52 per cent of the selected farmers applied farm yard manure (FYM) to the reference crops and average area covered under FYM was 2.74 acre. On an average 1285.58 kg. FYM valued at Rs 0.275 per kg. was applied to the reference crop on the sample farms. It was also observed that no farmer in the sample applied bio-fertilizer, other organic manure and undertook green manuring of their fields etc.

Table 4.2: Applied organic fertilizers for reference crops in Punjab, 2015-16

Particulars	FYM	VC/Biogas	Bio-fertilizer	Green manure	Other organic manure
% of farmers applied organic fertilizers	52.00	-	-	-	-
Average area covered under organic fertilizers (Acres)	2.74	-	-	-	-
Average quantity applied (Kgs/acre)	1285.58	-	-	-	-
Price (Rs/kg)	0.27	-	-	-	-

4.3 Problems encountered while implementation of the SHC scheme

The major problems encountered by the soil-tested farmers in implementing SHC scheme have been shown in Table 4.3. It was revealed by 32 per cent farmers that no farmers training camp was organised emphasizing on the benefits of soil testing in their village. Also, it was reported by seven per cent respondents that they are not at all aware about the technique of taking soil sample/ testing procedure. Nearly five per cent respondents revealed that while taking soil sample proper method was not followed by the officials collecting soil sample from their fields and two per cent respondents also revealed that they were not involved in taking soil sample and soil test report delivery was delayed.

Table 4.3: Problems encountered while implementation of the SHC scheme in Punjab, 2015-16

Problems	% farmers
No farmers training camp was organized	32.00
Not aware about the technique of taking soil samples	7.00
Proper method not followed by the officials for collecting soil sample	5.00
Lack of involvement of the farmers while taking soil sample	2.00

4.4 Suggestions for improvement of SHC scheme

Major suggestions given by soil-tested farmers for improving SHC scheme have been given in Table 4.4. A perusal of the table reveals that 67 per cent respondent farmers suggested for making aware the farmers about the SHC results for proper implementation of the scheme. Also, regular field demonstrations by agricultural experts on implementation of SHC results were suggested by 47 per cent farmers and 32 per cent farmers suggested organizing farmers training camps emphasizing on the benefits of soil testing. Further, it was suggested by two

Table 4.4: Suggestions for improvement of SHC scheme in Punjab, 2015-16

Problems	% farmers
Making aware the farmers about SHC	67.00
Regular field demonstrations by agricultural experts	47.00
Regularly organizing farmers training camps	32.00
Following proper soil sampling procedure for better results	2.00

per cent farmers that for better SHC results, proper soil sampling procedure be followed along with timely receiving of the SHC by the beneficiaries.

It was found that recommendations about fertilizer use provided in SHC showed that these have been given only for macro-nutrients use in paddy, basmati and maize crops. As far as application of organic fertilizers is concerned, only FYM was applied by some of the farmers in their fields. Major problem revealed by the respondents about implementation of SHC scheme was organising lesser number of farmers training camps about soil testing and suggested for organizing more camps for spreading awareness about SHC scheme.

Chapter V IMPACT OF SOIL HEALTH CARD SCHEME

There are many schemes launched by the Govt. for the welfare of the masses but it is more important to investigate their impact to know about the penetration of such schemes. This chapter emphasizes on the impact of application of recommended doses of fertilizers on yield, visible changes in crops along with cost of cultivation and income of major crops.

5.1 Impact of application of recommended doses of fertilizers on Yield

The impact of application of recommended dose of fertilizers on yield of reference crops has been given in Table 5.1. It was observed that there was slight edge in the yield of major *kharif* crops in case of soil-tested farmers as compared to control farmers. Although there can be numerous reasons associated with increase or decline in the yield of crops. But it was found that after application of recommended doses of fertilizers there was 0.48 per cent higher yield of paddy on soil-tested farms as compared to control farms while the increase in case of basmati crop was 0.94 per cent and 1.33 per cent in maize. Thus, there was marginally higher yield of reference crops on soil tested farms due to the application of recommended doses of fertilizers as compared to control farms.

Table 5.1: Impact of application of recommended doses of fertilizers on yield of reference crops in Punjab, 2015-16

Crop	Season	Average yield (Quintal/acre)		% Change
		Soil-tested farmers	Control farmers	
Paddy	Kharif-2015	29.21	29.07	0.48
Basmati		19.41	19.23	0.94
Maize		17.56	17.33	1.33

5.2 Visible changes found after the application of recommended doses of fertilizers

Visible changes found after the application of recommended doses of fertilizers has been given in Table 5.2. It was seen that 31.67 per cent of the respondent households revealed that there was increase in crop yield as most important reason and 3.33 per cent as important reason due to application of recommended doses of fertilizers. Similarly, improvement in crop growth was revealed by 18.33 per cent farmers as most important, 10 per cent as important and 6.67 per cent as least important reason. Also, improvement in grain filling was noticed by 3.33 per cent farmers as most important reason, 15 per cent as important and least important as visible change due to the application of recommended doses of fertilizers.

Table 5.2: Visible changes found after the application of recommended doses of fertilizers in Punjab, 2015-16

(% farmers)

Reasons	Most important	Important	Least important	Overall
Increase in crop yield	31.67	3.33	-	35.00
Improvement in crop growth	18.33	10.00	6.67	35.00
Improvement in grain filling	3.33	15.00	15.00	33.33
Improvement in soil texture	-	-	-	-
Less incidence of pest and diseases	-	-	-	-
Changes in application of other inputs like seed, labour, pesticide etc. (increase/decrease (ç))	-	-	-	-

5.3 Cost of cultivation and income of major crops

The changes in cost of cultivation and income from paddy crop on the sample households have been given in Table 5.3. A perusal of the table reveals that there was minor decline in the

Table 5.3: Changes in cost of cultivation of paddy crop and income in Punjab, 2015-16

(Per acre)

variables	Unit	Soil-tested farmers		Control farmers		Difference	
		Qty	Cost (Rs)	Qty	Cost (Rs)	Qty	Cost (Rs)
Total labour cost	-	-	7697	-	7544	-	153
Manure/ FYM	Tonnes	1.29	354	1.89	520	-0.60	-166
Seed	Kgs	4.20	691	4.13	670	0.07	21
Fertilizers- N	Kgs	60.63	777	64.92	846	-4.29	-69
P	Kgs	2.00	79	3.51	132	-1.51	-53
K	Kgs	2.00	56	1.27	36	0.73	20
Complex	Kgs	-	-	-	-	-	-
Micro nutrients	Kgs	3.35	157	4.39	169	-1.04	-12
Plant protection chemicals	Litres	-	1574	-	1559	-	15
Irrigation	No.	30	263*	30	295	-	-32
Rental value of land	Rs.	-	20366	-	19681	-	685
Land revenue	-	-	-	-	-	-	-
Total cost	-	-	32014	-	31452	-	562
Main product yield	-	29.21	42355	29.07	42152	0.14	203
By- product yield (Rs/Qt)	-	-	-	-	-	-	-
Net income	-	-	10341	-	10700	-	-359

* Expenses on diesel for irrigation

use of nitrogen (N) by 4.29 kg valued at Rs. 69 and phosphorus (P) by 1.51 kg. valued at Rs.53 on soil-tested farms while there was slightly higher use of potash (K) valued at Rs.20

on these farms. Also, there were higher expenses on labour cost, seed and plant protection measures on soil-tested farms as compared to control farmers group. Total cost on control farms was higher by Rs.562 vis-a-vis soil-tested farms. There was slightly higher yield i.e. 0.14 quintal per acre on soil-tested farms valued at Rs. 203 and net income difference from control farms was worked out at Rs. 359 per acre. Thus, by using recommended level of fertilizers there was slightly higher yield of paddy on the soil- tested farms as well as minor decline in fertilizer use. However, it is pertinent to mention here that there are numerous associated factors determining the yield of a crop and fertilizer use is one of them.

The changes in cost of cultivation and income from basmati crop on the sample households have been given in Table 5.4. A perusal of the table reveals that there was slightly higher (0.53 kg.) use of nitrogen (N) fertilizer on the soil-tested farms as compared to control farms.

Table 5.4: Changes in cost of cultivation of basmati crop and income in Punjab, 2015-16 (Per acre)

variables	Unit	Soil-tested farmers		Control farmers		Difference	
		Qty	Cost (Rs)	Qty	Cost (Rs)	Qty (Kgs)	Cost (Rs)
Total labour cost	-	-	8838	-	8780	-	58
Manure/ FYM	Tonnes	-	-	-	-	-	-
Seed	Kgs	4.12	803	4.05	805	0.07	-2
Fertilizers- N	Kgs	37.33	467	36.80	460	0.53	7
P	Kgs	-	-	-	-	-	-
K	Kgs	-	-	-	-	-	-
Complex	Kgs	-	-	-	-	-	-
Micro nutrients	Kgs	1.15	35	3.00	90	-1.85	-55
Plant protection chemicals	Litres	-	1254	-	1300	-	-46
Irrigation	No.	18	-	18	-	-	-
Rental value of land	Rs.	-	20222	-	20063	-	159
Land revenue	-	-	-	-	-	-	-
Total cost	-	-	31619	-	31498	-	121
Main product yield	-	19.41	39305	19.23	38806	0.18	499
By- product yield (RS/Qtl)	-	22.38	1618	21.90	1566	0.48	52
Net income	-	-	9304	-	8874	-	430

Also, there was slight decline in expenses on seed, micro-nutrients and plant protection chemicals on soil-tested farms. There was higher basmati yield on soil-tested farms by 0.18 quintal per acre valued at Rs. 499 and net income was higher by Rs. 430 as compared to

control farms. The changes in cost of cultivation and income from maize crop on the sample households have been given in Table 5.5. A perusal of the table reveals that there was higher use of nitrogen (N) and phosphorus (P) fertilizer on the control farms. But there were higher expenses on labour cost and seed on soil-tested farms as compared to control farms. It was seen that maize yield was higher by 0.23 quintals valued at Rs.578 per acre on soil-tested farms as compared to control farms and net income was negative for both farm categories due to higher total cost.

Table 5.5: Changes in cost of cultivation of maize crop and income in Punjab, 2015-16
(Per acre)

variables	Unit	Soil-tested farmers		Control farmers		Difference	
		Qty	Cost (Rs)	Qty	Cost (Rs)	Qty	Cost (Rs)
Total labour cost	-	-	7833	-	7800	-	33
Manure/ FYM	Tonnes	-	-	-	-	-	-
Seed	Kgs	8	1308	8	1267	-	41
Fertilizers- N	Kgs	55.03	877	67.67	1051	-12.64	-174
P	Kgs	19.17	720	21.08	792	-1.91	-72
K	Kgs	-	-	-	-	-	-
Complex	Kgs	-	-	-	-	-	-
Micro Nutrients	Kgs	-	-	-	-	-	-
Plant protection chemicals	Litres	-	592	-	608	-	-16
Irrigation	No.	3	-	3	-	-	-
Rental value of land	-	-	16900	-	16250	-	-650
Land revenue	-	-	-	-	-	-	-
Total cost	-	-	28230	-	27768	-	462
Main product yield		17.56	22968	17.33	22390	0.23	578
By- product yield (RS/Qtl)	-	19.80	1996	19.30	1872	0.50	124
Net income	-	-	-3266	-	-3506	-	240

Thus, in case of paddy, basmati and maize crops there was judicious use of fertilizers on soil-tested farms which was quite evident from slightly higher yield recorded for these crops on these farms as compared to control farms. Although, there are numerous associated factors

determining crop yield besides efficient input use. Besides this, net income was higher in paddy and basmati crops on soil-tested farms as compared to control farms.

Chapter VI SUMMARY AND POLICY SUGGESTIONS

6.1 Background

Punjab has been at the forefront of green revolution by adopting new farm technology in 1970s thereby increasing the production and productivity of paddy and wheat crops and made the country self-sufficient in food grains production. Paddy-wheat monoculture in Punjab has resulted in the appearance of macro and micro-nutrient deficiencies in crops. It is well known that chemical fertilizers are the important source of nutrients for plant growth. But it has been advocated by the agricultural scientists to have balanced and recommended use of the fertilizers. For this soil testing and obtaining SHC by the peasants is pre-requisite for judicious use of fertilizers resulting in decreasing the cost and at the same time increasing the yield of their crops.

6.2 Socio-economic characteristics of sample households

The general characteristics of sample households were quite young with overall average age of 44.78 years and it was 45.43 years for control and 44.12 for soil-tested farmers. All the respondents were males having agriculture as their main occupation. The average family size was 6.17 in overall scenario with 5.78 for control and 6.55 for soil-tested farmers category. It was observed that more than one (1.29) people were engaged in farming with average age of experience of farming being nearly 23 years in both the farmer categories. Majority of the respondents i.e. 61 per cent belonged to general caste category followed by OBC (38%) and SC (1%). Although the respondents were not highly educated but their experience of farming was significant enough to go for new farm technology.

The operational landholdings of the respondent farmers revealed that in overall net operated land was 12.55 acres while it was 11.55 acres for control farmers and 13.55 acres for soil-tested farmer's category. In overall scenario, about 35 per cent of net operated area was leased-in and leased out land was almost negligible. Rental value of lease-in land was about Rs. 40000 per acre and it was Rs. 39362 in case of control farmers and Rs. 40731 in soil-tested farmer's category. The entire net operated area was irrigated on both farmer categories. The cropping pattern during *kharif*, 2015 on the sample households in Punjab showed that paddy was major crop which occupied 79.62 per cent of the total sown area on control farmers and 82.11 per cent on soil-tested farmers category. Other crops grown by control farmers category was basmati (6.78%), sugarcane (4.40%), maize (2.16%) and fodder (7.04%). Similarly, on soil-tested farmers category other crops grown were; basmati (3.81%),

maize (2.77%), sugarcane (4.55%), fodder (6.61%) and vegetables (0.15%). Thus, paddy crop dominated the cropping pattern on the sample farms.

Gross income realized by the sample households revealed that on control farmer's farms, average quantity of paddy sold was 266.52 quintals and gross income obtained was Rs.386454 while from basmati it was Rs. 29806, from sugarcane Rs. 52597 and Rs.5517 from maize crop. On soil-tested farmers category, average quantity of paddy sold was 324.68 quintals with gross income obtained being Rs.470786 followed by sugarcane (Rs.64818), basmati (Rs.19440), maize (Rs.8306) and vegetables (Rs.2214). Thus, on both the farm categories; paddy, sugarcane and basmati were the major source of income.

In nutshell it can be concluded that the farmers in soil-tested farmer's category were younger having large family size, better educated and there were more number of OBC and SC in this category. Also, soil-tested farmers were having larger holding size with more owned and leased-in land but there were fewer sources of irrigation on soil-tested farmer's category as compared to control farmers. Paddy dominated the cropping pattern on the sample farms with higher relative area on soil-tested farmer's category as compared to control farmers and it was major source of income for almost all the farmers on both the farm categories followed by sugarcane, basmati and maize for few of them.

6.3 Awareness on SHC scheme

The awareness of sample households on soil testing revealed that 51.67 per cent soil-tested and 46.67 per cent control farmers were aware about the integrated nutrient management (INM) i.e. awareness about other nutrient sources such as farm yard manure (FYM), green manuring etc. Also, 48 per cent soil-tested and 47 per cent control farmers experienced reduction in chemical fertilizers due to INM. Awareness about the imbalanced use of fertilizers was widespread among soil-tested farmers (80%) as compared to control farmers (46.67%). Also, 68.33 per cent soil-tested farmers were having knowledge about ongoing programmes on Soil Health Mission and all were aware about Soil Health Cards. Besides, 53.33 per cent control farmers were also aware about Soil Health Cards. However, only 11.67 per cent soil-tested farmers were aware about grid system under SHC scheme.

It was observed that 96.67 per cent of the soil-tested farmers got information about soil testing from Krishi Vigyan Kendras (KVKs) while 3.33 per cent from State Agriculture Department. Information about training programmes attended by sampling households revealed that only 26.66 per cent of the soil-tested, 18.33 per cent of control farmers and 22.50 per cent in overall scenario attended training programmes on application of chemical fertilizers of one day duration. The method of application of fertilizers on crops by sample

households during *kharif*, 2015 season revealed that almost all the fertilizers were applied by broadcasting method except micro-nutrients by some of the farmers.

It can be summarized that about 34 to 77 per cent of the farmers were aware about various aspects related to soil testing and SAUs/KVKs were the major source of information about soil testing among soil-tested farmers and neighbours in case of control farmers category. It was observed during the course of the study that although majority of the farmers did not attend any training programme regarding application of chemical fertilizers but they were well aware about the method of application of chemical fertilizers. It was also found that soil testing laboratory was not much far away from the farmer's fields and average area covered under soil testing was 5.83 acres on the sample households. Also, it was seen that co-operative societies followed by private fertilizer shops/ dealers were the major source of fertilizer purchase as revealed by the sample households.

6.4 Adoption of recommended doses of fertilizers on soil test basis

It was seen that recommended quantity of fertilizers for paddy crop was 114 kg. urea, 25 kg. di-ammonium phosphate (DAP) or 75 Kg. single super phosphate (SSP) and 20kg. muriate of potash (MOP). Similarly, for basmati crop only 30 kg. urea was recommended per acre. In case of maize crop recommendation level of urea was 123 kg per acre besides 50 kg. DAP or 140 kg. SSP and 20 kg. MOP. According to farmers opinion requirement of urea was higher for paddy and basmati and lower for maize crop as compared to SHC report. Also, as per farmers opinion, requirement of DAP and MOP in paddy and DAP in maize was also lower vis-a-vis based on SHC recommendations. Thus, farmers mostly preferred higher urea but lower DAP and MOP use as compared to SHC recommendations.

The application of organic fertilizers revealed that only 52 per cent of the selected farmers applied farm yard manure (FYM) to the reference crops and average area covered under FYM was 2.74 acre. On an average 1285.58 kg. FYM valued at Rs 0.275 per kg was applied to the reference crop on the sample farms.

It was observed that recommendations about fertilizer use provided in SHC showed that these have been given only for macro-nutrients use in paddy, basmati and maize crops. As far as application of organic fertilizers is concerned, only FYM was applied by some of the farmers in their fields. Major problem revealed by the respondents about implementation of SHC scheme was organising lesser number of farmers training camps about soil testing and suggested for organizing more camps for spreading awareness about SHC scheme.

6.5 Impact of SHC scheme

The impact of application of recommended dose of fertilizers on yield of major *khariif* crops revealed that there was slightly higher yield in case of paddy, basmati and maize crops on soil-tested farms as compared to control farms. Although there can be numerous reasons associated with increase or decline in the yield of crops but application of recommended dose of fertilizers can be an important factor associated with higher crop yield on soil-tested farms.

Visible changes found after the application of recommended doses of fertilizers revealed that there was increase in crop yield as most important reason revealed by 31.67 per cent soil - tested households and 3.33 per cent depicting it as important. Similarly, improvement in crop growth was revealed by 18.33 per cent farmers as most important, 10 per cent as important and 6.67 per cent as least important reason. Also, improvement in grain filling was noticed by 3.33 per cent farmers as most important reason, 15 per cent as important and least important as visible change due to the application of recommended doses of fertilizers.

Analysis brought out that in case of paddy crop, total cost per acre on control farms was lower by Rs.562 vis-a-vis soil-tested farms. There was slightly higher yield of paddy i.e. 0.14 quintal per acre on soil-tested farms valued at Rs. 203 and net income difference from control farms was worked out at Rs. 359 per acre. In case of basmati crop, there was higher yield on soil-tested farms by 0.18 quintal per acre valued at Rs. 499 and net income was higher by Rs. 430 as compared to control farms. In maize crop also yield was higher by 0.23 quintals valued at Rs.578 per acre on soil-tested farms as compared to control farms while net income was negative due to higher total cost.

Thus, in case of paddy, basmati and maize crops there was judicious use of fertilizers on soil- tested farms which was quite evident from slightly higher yield recorded for these crops on these farms as compared to control farms and there was minor decline in fertilizer use in paddy and maize crops. Although, there are numerous associated factors determining crop yield besides efficient input use. Besides this, net income was higher in paddy and basmati crops on soil-tested farms as compared to control farms.

6.6 Policy suggestions

The foregone analysis brought out that about 34 to 77 per cent of the farmers were aware about various aspects related to soil testing and majority of the farmers did not attend any training programme regarding application of chemical fertilizers. Therefore, to make farmers aware about the benefits of soil testing, more farmers training camps be organised along with

soil testing campaigns. As far as impact of SHC scheme is concerned, in case of paddy and maize crops, there was slight decline in chemical fertilizer usage especially N and P and increase in K usage in case of paddy and increase in N usage in basmati on soil-tested farms which shows the balanced usage of chemical fertilizers as per recommendation. Also, there was slight increase in the yield in case of paddy, basmati and maize crops on soil-tested farms. The implication is that SHC scheme is a win-win situation for the farmers in terms of decline in fertilizer usage along with increase in crop productivity.

References

Babu M.V.S., Reddy C.M. and Balaguravaiah D. (2007) -Effect of integrated use of organic and inorganic fertilizers on soil properties and yield of sugarcaneø *Journal of the Indian Society of Soil Science*, 55: 161-66.

Grover D. K., Singh J. M., Singh J. and Kumar S. (2016) -Soil-test based fertilizer usage: A step towards sustainable agriculture in Punjabø *Indian Journal of Econ Dev* 12: 493-500.

Gopal Reddy B. and Suryanarayana Reddy M. (1998) -Available macronutrient status in soil as influenced by integrated nutrient management in maize-soybean cropping systemø *Journal of Research* 27: 55-62.

Kumar B., Gupta R.K. and Bhandari A.L. (2008) -Change after long-term application of organic manure and crop residues under rice-wheat systemø *Journal of the Indian Society of Soil Science*, 58: 80-85.

Kumar V. and Singh A.P. (2010) -Long-term effect of green manuring and farmyard manure on yield and soil fertility status in soil-wheat cropping systemø *Journal of the Indian Society of Soil Science*, 58: 409-12.

Mann K.K., Brar B.S. and Dhillon N.S. (2006) -Influence of long-term use of FYM and inorganic fertilizers on nutrient availability in a Typic Ustochreptø *Indian Journal of Agricultural Sciences*, 76: 477-80.

Mishra B., Khan U., Parchauri P. and Kumar Y. (2006) -Effect of nitrogen management on yield, and nitrogen nutrition of irrigation rice (*Oryza Sativa*)ø *Indian Journal of Agricultural Sciences*, 76: 176-80.

Prasad B. and Sinha S.K. (1995) -Nutrient regulating through crop residues management for sustainable rice and wheat production in calcareous soilø *Fertilizer News*, 40: 15-25.

Singh M. and Chahal S.S. (2009) -A Study on the extent of adoption of various recommended technologies in Wheat cultivation in Punjabø *Agricultural Economics Research Review (Conf. No.,)* 29: 349-54.

Sharma S.K. and Sharma S.N. (2002) -Integrated nutrient management for sustainability of rice-wheat cropping systemø *Journal of the Indian Society of Soil Science*, 72: 573-76.

Singh S., Singh R.N., Prasad J. and Singh B.P. (2006) -Effect of integrated nutrient management on yield and uptake of nutrients by rice and soil fertility in rainfed uplandsø *Journal of the Indian Society of Soil Science*, 54: 327-30.

Yaduvanshi N.P.S. (2001) -Effect of five years of ricer-wheat cropping and NPK fertilizers use with and without organic and green manures on soil properties and crop yields in a reclaimed sodic soilø *Journal of the Indian Society of Soil Science*, 49: 714-19.

Appendix I
Coordinator's Comments on the Draft Report

1. Title of the draft report examined:

Impact of Soil Health Card Scheme on Production, Productivity and Soil Health in Punjab.

2. Date of receipt of the Draft report: 3rd May, 2017

3. Date of dispatch of the comments: 16th June, 2017

4. Comments on the Objectives of the study:

All the objectives of the study have been addressed

5. Comments on the methodology

Common methodology proposed for the collection of field data and tabulation of results have been followed.

6. Comments on analysis, organization, presentation etc.

- (i) In Table 2, the irrigated land and Un-irrigated land can be given in % of GCA instead of total acres. At the same time, the rental value of leased-in land and leased-out land can be given separately, as there is a huge difference between these two.
- (ii) In Table 4 - Cropping pattern of sample households can be mentioned both in quantity as well as in % GCA.
- (iii) Chapter -III title can be given as "Status of Awareness on SHC Scheme" instead of Awareness of SHC Scheme.
- (iv) It is worth to mention the complete details of training programmes attended (Table 8) on application of chemical fertilizers.
- (v) The information in Table 9 and 11 should be bifurcated for soil tested farmers and control farmers.
- (vi) The average recommended quantity of fertilizers based on soil test results can also include 'the quantity as per the farmer's opinion' for better understanding the knowledge of the farmers on soil testing and its usefulness.
- (vii) Throughout the report, the percentages mentioned in Tables should be in two digits for better clarity on the information provided.

(viii) Chapter numbers can be included with the Tables like 1.1, 1.2, 2.1, 3.1 etc., for better identification of Tables along with their Chapters.

(ix) *It is suggested to **copy edit the report** before finalizing.*

7. Overall view on acceptability of report

Authors are requested to incorporate all the comments and submit the final report along with soft copy of the data for consolidation.

Appendix II

ACTION TAKEN ON THE COMMENTS BY AERC, LUDHIANA

Impact of Soil Health Card Scheme on Production, Productivity and Soil Health in Punjab.

The report has been revised in the light of the comments/ observations/ suggestions received from the coordinating centre. Point wise reply is as under:

- (i) Needful has been done
- (ii) Needful has been done.
- (iii) Title of Chapter changed as per suggestion.
- (iv) Complete details of training programmes attended by farmers have been added in Table 3.3.
- (v) Table 9 & 11 (Presently 3.4 &3.6) were already bifurcated for soil tested and control farmers.
- (vi) The average quantity of fertilizer use as per the farmers opinion has been added in Table 4.1
- (vii) Needful has been done.
- (viii) Needful has been done.
- (ix) *Report has been copy edited*

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