AERC REPORT 154

Adoption of Recommended Doses of Fertilisers on Soil Test Basis by Farmers in Gujarat

Mrutyunjay Swain
S. S. Kalamkar
Kalpana Kapadia

Agro-Economic Research Centre
For the states of Gujarat and Rajasthan
(Ministry of Agriculture, Govt. of India)
Sardar Patel University,
Vallabh Vidyanagar, Dist. Anand, Gujarat

2014

AERC REPORT 154

Adoption of Recommended Doses of Fertilisers on Soil Test basis by Farmers in Gujarat

Mrutyunjay Swain
S. S. Kalamkar
Kalpana Kapadia

Report submitted to the
Directorate of Economics and Statistics
Ministry of Agriculture, Government of India,
New Delhi

Agro-Economic Research Centre
For the states of Gujarat and Rajasthan
(Ministry of Agriculture, Govt. of India)
Sardar Patel University,
Vallabh Vidyanagar, Dist. Anand, Gujarat

December 2014

AERC Report No. 154

© Agro-Economic Research Centre, Vallabh Vidyanagar 388120,
Dist. Anand, Gujarat, India.

Prepared by

Dr. Mrutyunjay Swain, *Sr. Research Officer/Assistant Professor (SS)*
Dr. S.S. Kalamkar, *Director and Professor*
Ms. Kalpana Kapadia, Research Associate

Research Team
Shri T. B. Parihar, Research Associate
Shri Manish Makwana, Research Associate
Shri M. R. Ojha, Research Associate
Shri N. G. Chauhan, Research Fellow
Ms. Priyanka Patel, Research Assistant

Published by

The Director
Agro-Economic Research Centre
For the states of Gujarat and Rajasthan
(Ministry of Agriculture, Govt. of India)
H.M. Patel Institute of Rural Development, Opp. Nandalaya Temple,
Post Box No. 24, Sardar Patel University,
Vallabh Vidyanagar 388120, Dist. Anand, Gujarat.

Ph. No. +91-2692-230106, 230799;
Mobile- 09822437451; 7383554616
Fax- +91-2692-233106
Email: director.aerc@gmail.com; directoraercgujarat@gmail.com

Draft Submitted in December 2014

Printed at University Press, SPU, Vallabh Vidyanagar.

Foreword

Indian agriculture has set new milestones in its progress. Since independence, major strides have been made in production of food grains, not only due to increase in area but also due to technology. As a result, the food grains production increased from 50.82 million tonnes in 1950-51 to 264.77 million tonnes in 2013-14. The phenomenal growth in agricultural production since independence has been triggered by higher input use, particularly purchased inputs as well as technology induced productivity enhancement, massive extension efforts, improved farm practices and, above all, ingenuity and hard work of Indian farmers since the Green Revolution Period in late 1960s. Among the inputs, significant increase in use of fertiliser has helped to enhance crop output and farmers' income. The average consumption of fertilisers has increased from 6.9 kg per ha of gross cropped area in 1966-67 to 139.7 kg per ha in 2011-12. However, indiscriminate use of chemical fertilisers by farmers has led to deterioration of soil structure, wastage of nutrients, destruction of soil microorganisms and scorching of plants at the extreme cases. Various initiatives have been taken at national as well as regional level to encourage the farmers for balanced use of fertilisers. Gujarat has been a leading state in taking up such initiatives, among which Soil Health Card Programme was a major one. The Soil Health Card System in Gujarat is a unique on line program making transfer of technology more scientific, precise, easy, and need based between Scientist-Extension officer- Farmers and input output dealers effectively. With this background, the Ministry of Agriculture, Govt. of India had assigned us to study on '*Adoption of Recommended Doses on Soil Test Basis in Gujarat*' with an objective to evaluate the effectiveness of the programme on crop productivity, extent of soil testing for nutrient deficiency and adoption of recommended doses of fertilizers by different categories of farmers based on the soil tests. The Agricultural Development and Rural Transformation Centre, Institute for Social and Economic Change (ISEC), Bangalore has coordinated this all India study.

The study is based on both primary and secondary level data. The study results show that SHC scheme has benefited the farmers in many ways, however, there are some gray areas where more attention is required to be given. Importantly, training should be provided to the farmers in the State on scientific method of collection of soil sample, reading and application of recommendations given on SHC. On the basis of the findings, relevant policy suggestions have been made.

I am thankful to authors and their research team for putting in a lot of efforts to complete this excellent piece of work. I also thank the Ministry of Agriculture, Government of India for the unstinted cooperation and support. I hope this report will be useful for those who are interested in understanding the problems and prospects of oilseeds sector in Gujarat.

Agro-Economic Research Centre
For the states of Gujarat and Rajasthan
(Sponsored by Ministry of Agriculture, Govt. of India)
Sardar Patel University, **Vallabh Vidyanagar 388120**,
Dist. Anand, Gujarat, India

(Dr. S.S. Kalamkar)
Director

Acknowledgements

The study on *"Adoption of Recommended Doses of Fertilisers on Soil Test Basis by Farmers of Gujarat"* has been carried out at the Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar, as suggested and sponsored by the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

We have benefited immensely from various scholars and officials from different government departments while carrying out this study. At the outset, we would like to thank **Dr. Harish Padh**, Vice Chancellor of our University and Chairman, AERC Governing Body as well as **Dr. Mahesh Pathak**, Honorary Advisor of our Centre for their constant encouragement and support for undertaking such research activity at the Centre. We are grateful to the coordinator of the study, **Dr. Elumalai Kannan**, Agricultural Development and Rural Transformation Centre, Institute for Social and Economic Change, Bangalore, Karnataka for providing required support, study framework and necessary inputs in completing the study.

We are grateful to **Dr S. R. Chaudhary**, Director of Agriculture, Department of Agriculture and Cooperation, Government of Gujarat, Gandhinagar; **Shri Anil Patel,** Deputy Director Agriculture (Fertiliser), Department of Agriculture, GoG, Gandhinagar for providing the necessary data and support in data collection. We also thank **Dr. K.B. Katheria,** Director of Research and Director – IT, Anand Agricultural University, Anand for providing required data on Soil Health Card issue and related information. We would like to record our sincere thanks to all the officials GoG as well as AAU, Anand for their invaluable help. The study would not have reached to this stage without the active co-operation of the sample households, who provided all the required data for the study without any hesitation and expectation. We thank each one of them for their invaluable support.

We have also received support and encouragements from our colleagues in the Centre while carrying out the study. We would specifically thank the Dr. Rajeshree Dutta (former Deputy Director), Shri Vasant D. Shah (former Research Officer), and Dr. S. R. Bhaiya (Field Officer, CCS) of our Centre for their support. We are also thankful to Shri Thansingh B. Parihar, Shri Manish Makwana, Shri M. R. Ojha and Shri N. G. Chauhan for collecting data from field and other sources. Thanks to our staff at Computer Centre (Mr. J. N. Singh, Miss Bhumika S. Padhiyar, Mr. Faruk G. Vorha and Mr. Mihir Rana) for excellent data feeding work. We thank Miss Priyanka Patel, Research Assistant for her assistance in data

compilation, analysis and tabulation and Mr. Deep K. Patel, Research and Reference Assistant (Library) for his assistance in publication of the report.

We also thank the constructive comments/suggestion given by the Coordinator of the study as well as by the seminar participants on the draft report/presentation of the study.

Last but not least, we thank all other AERC staff for their direct and indirect support.

Agro-Economic Research Centre
For the states of Gujarat and Rajasthan
(Ministry of Agriculture, Govt. of India)
Sardar Patel University,
Vallabh Vidyanagar 388120, Anand, Gujarat.

Mrutyunjay Swain
S.S. Kalamkar
Kalpana Kapadia

Contents

List of Tables

List of Figures

List of Maps

List of Annexures

List of Abbreviations

AEZ	Agro-Ecological Zones
APC	Agricultural Prices Commission
APMC	Agricultural Produce Marketing Committee
ASMO	Area Sown More Than Once
Av.	Average
B	Boron
C.I.	Cropping Intensity
CACP	Commission for Agricultural Costs and Prices
CAGR	Compound Annual Growth Rate
CCS	Cost of Cultivation Scheme
CDAP	Comprehensive District Agricultural Plan
CGR	Compound Growth Rate
CMS	Cooperative Marketing Society
CoC	Cost of Cultivation
Cu	Copper
DAO	District Agriculture Officer
DAP	Diammonium Phosphate
DDO	District Development Officer
DES	Directorate of Economics and Statistics
DOC	Division of Cooperation
DOC	Division of Cooperation
DPAP	Drought Prone Area Programme
ECA	Essential Commodities Act
Fe	Iron
GCA	Gross Cropped Area
GIS	Geographic Information System
GDP	Gross Domestic Product
GIA	Gross Irrigated Area
GOG	Government of Gujarat
GOI	Government of India
GSDP	Gross State Domestic Product
GSFCL	Gujarat State Fertilizers Company Limited
GSLDB	Gujarat State Cooperative Land Development Bank

GVS	Gram Vikas Samitties
ha	Hectare
HYV	High Yielding Variety
HYVP	High Yielding Variety Programme
I.I.	Irrigation Intensity
kg	kilograms
mha	Million hectares
MIP	Market Intervention Price
MIS	Market Intervention Scheme
Mn	Manganese
MOA	Ministry of Agriculture
MOP	Muriate of Potash
MSP	Minimum Support Price
MSR	Marketed Surplus Output Ratio
mt	Metric Tonnes
NABARD	National Bank for Agriculture and Rural Development
NBS	Nutrient Based Subsidy
NCA	Net Cropped Area
NFSB	National Food Security Bill
NGO	Non Government Organization
NIA	Net Irrigated Area
NPK	Nitrogen (N), Phosphorus (P), and Potassium (K)
NPMSF)	National Project on Management of Soil Health& Fertility
NSA	Net Sown Area
PDS	Targeted Public Distribution System
PIM	Participatory Irrigation Management
PSS	Price Support Scheme
R & D	Research and Development
RRB	Regional Rural Banks
SRR	Seed Replacement Ratio
STLs	Soil Testing Laboratories
TE	Triennium Endings
Zn	Zinc

Chapter I

Introduction

1.1 Background

Fertilisers have been considered as an essential input to Indian agriculture for increasing agricultural production so as to meet the food grains requirements of growing population of the country. It is has been well established fact that chemical fertilisers bear a direct relationship with food grains production along with a number of supporting factors like High Yielding Variety seeds (HYVs), irrigation, access to credit, tenurial conditions, size of the product market and the prices they face in input and output markets, etc. A very close association is observed between growth in use of fertilisers and crop productivity in almost all the states of the country (Chand and Pandey, 2008). Therefore use of chemical fertiliser in India has tremendously grown since the advent of green revolution in late 1960s. With the improvement in production since green revolution period, India's position has turned from the state of net importer of agricultural products to exporter of certain agricultural commodities like rice, wheat and sugar. At farm household level also, the green revolution technology has helped to improve the livelihood pattern, nutrition and education of children. However, the technology has brought some negative aspects as well. Since it proved successful in irrigated areas, dry land regions and crops grown therein were left out of the process and hence had created regional disparity in rural income (Krishnaji 1975; Vaidyanathan, 1988; Rao 1996). Further, the technology has also altered traditionally followed cropping pattern, which comprised growing multiple crops every season to mono-cropping, for example cultivation of only rice in some parts of south India. This practice put the land and other resources under severe strain resulting in depletion of soil nutrients, decline in water table, build up of pest and diseases, and micro-nutrient deficiency (Murgai et al 2001; Pingali and Shah 2001).

Chemical fertilisers are the important source of nutrients for plant growth. With the advent of fertiliser responsive crop varieties, total consumption of nitrogenous (N), phosphatic (P) potassic (K) fertilisers have increased from about 1.1 million tonnes in 1966-67 to 24.48 million tonnes in 2013-14. It was estimated that urea accounts for 82 per cent of total nitrogen consumption and di-ammonium phosphate for 63 per cent of phosphate consumption (FAO, 2005). The all-India average consumption of fertilisers has increased from 6.9 kg per ha of gross cropped area to 125.39 kg per ha during corresponding period (FAI, 2013; GOI, 2015). However, the level of consumption of fertilisers was highly varied within as well as between states, i.e. from 216.73 kg/ha in Punjab to 49.69 kg/ha in Rajasthan to 14.22 kg/ha in Meghalaya in 2013-14. The variability in consumption of fertilisers can be attributed to different cultivation methods, type of crops and subsidy on fertilisers. Further, the consumption of fertilisers has also varied across farm size groups with the highest amount of consumption recorded among group of small farmers.

There are concerns about the indiscriminate use of chemical fertilisers by the farmers with a view to increase the crop yield. This has led to deterioration of soil structure, wastage of nutrients, destruction of soil micro-organisms and scorching of plants at the extreme cases. A combination of factors such as intensive cultivation of crops, differential pricing of fertilisers and subsidy might have contributed to excessive use of fertilisers by the farmers. Due to lack of awareness among the farmers about balanced use of fertiliser, there are wide spread problems related to the indiscriminate use of chemical fertilisers, mismanagement of surface water and over exploitation of ground water. The over use of chemical fertilisers in most parts of India in the last few decades led to several problems affecting soil health, nutrient flow and natural environment. There is a need for promoting, among others, balanced use of fertilisers for increasing productivity of crops and for better absorption of nutrients from the applied fertilizers. The adoption of recommended doses of fertiliser either as per the

State Agricultural Universities (SAU) norms or as given in the Soil Health Card (SHC) is essential.

1.2 Brief Review of Literature

Most of the studies revealed that the fertiliser consumption and food grains production have shown an upward trend since 1950s in India. Sharma and Sharma (2000) stated that the fertiliser use in India increased from 69 thousand tonnes in 1950-51 to 16.2 million tonnes in 1997-98, at an annual growth rate of over 12 per cent and the food grains production increased from about 51 million tonnes to 192.2 million tonnes in the same period, indicating a direct relationship between fertiliser use and food grains production. A study by Randhawa (1992) found that around 60 per cent increase in agricultural production could be attributed to fertilisers. Kanwar (1997) noted that increase in food production in India due to increased input of fertilisers has been between 50-60 per cent.

Prasad (2000) has studied the impact of fertiliser consumption on rice and wheat productivity (tonnes per ha) in the northern states where rice-wheat cropping system has emerged as the dominant cropping system. The study clearly brought out that the five northern states (Punjab, Haryana, J&K, Uttar Pradesh and Himachal Pradesh) share the same status in productivity of rice and wheat as in consumption of fertiliser. Many other studies (Pingali, 2004; Sharma and Sharma, 2000) have established the direct relationship between fertiliser consumption and yield enhancement. Since fertiliser plays a vital role in increasing the production and productivity, per hectare consumption has substantially increased over the decades. Fertiliser Association of India (FAI, 1974) Survey on fertiliser use on specific crops in India has identified that the most important reason for increased fertiliser use was the expected increase in yields and outputs. Another major reason for the growth of fertiliser consumption is the wide adoption of high yielding variety seeds (HYVs). Until the period of Green Revolution in 1960s, commercial use of fertiliser was very low. The traditional varieties were not very responsive to high fertilisation. However, with the introduction of HYV

seeds, the use of fertiliser increased dramatically (McGuirk and Mundlak 1991).

Irrigation expansion has been another important factor for increased application of fertiliser. FAI (1974) studied the fertiliser use on different crops under irrigated and un-irrigated conditions. The study found that a higher per cent of irrigated area was fertilised as compared to un-irrigated area. Menon and Rao (1983) noted that over 85 per cent of the fertiliser consumption is still confined to irrigated areas which accounts for approximately 27 per cent of cropped area. The level of economic development has a bearing on the increased consumption of fertiliser. Whereas FAO (2005) noted that irrigated lands accounted for 40 per cent of total agricultural area, received 60 per cent of the fertilizer applied. Five crops (rice, wheat, cotton, sugarcane, rapeseed mustard) consume about two thirds of the fertiliser applied. Bhattacharya (2000) compared the consumption of fertilisers between the advanced and the backward regions and observed that the advanced regions have a lead over the backward regions in terms of consumption of inputs. The effects of fertiliser demonstration programmes, availability of credit and development in infrastructural facilities including the supply of fertiliser have also contributed to growth in fertiliser use in various parts of the country.

Among various major factors, expected increase in yield has been the major driving force for substantial increase in fertiliser application. This has also resulted in overdoses of fertilisers and imbalances in soil nutrients. The application of recommended doses of fertiliser, therefore, assumes prime importance so as to maintain a good soil health.

Pingali (2004) stated that the NPK ratio at all-India level was never close to the ideal NPK ratio of 4:2:1. The variation was very high during the pre-green revolution period and post liberalization era. During the pre-green revolution era, the consumption was mainly confined to nitrogen and the ratio was on an average 10:1.6:1. After the introduction of high yielding varieties, the ratio inched towards the ideal, reaching a 5.1:1.8:1 in 1973-74. The price rise in 1974 increased the consumption of nitrogen at the expense

of phosphorus, distorting the ratio to 7.7: 2:1. The ratio improved to a ratio of 6:2:1 in the seventies and the eighties after the reduction in prices. After decontrol of phosphatic and potassic fertilisers in August 1992, the ratio worsened to 9.5:3.2:1 in 1992-93 and to 9.68:2.94:1 in 1993-94. Thus the imbalance in prices of N, P and K were mainly responsible for the imbalance in their use. Generally, the farmers substitute one fertiliser for the other in order to maximise their revenue.

Among states, Punjab took a very big and early lean in fertiliser application. Inter-state variation in per hectare application of fertliser declined after early 1980s, but large difference still exists (Chand and Pandey, 2008). Among different parts of the country, the distortion of NPK ratio was the worst in North India where the application of nitrogen was much higher than phosphorus and potash. Punjab, UP and Rajasthan had deviated significantly from the recommended NPK ratio of 4:2:1 while West Bengal, Tamil Nadu, Karnataka have been hovering around the recommended NPK ratio (Pingali, 2004). The fertliser consumption intensity varies greatly between the regions, from 40.5 kg/ha of total nutrient in Rajasthan to 184 kg/ha in Punjab. In Gujarat, the NPK use ratio was heavily tilted in favour of N during 1960-61 and 1970-71 due to price hike of phosphatic and potassic fertilizers and reduction of price of urea by 10 per cent (Pathak et al, 1993). The study further revealed that, as an immediate reaction to fertilizers price hike, notable decline in per hectare consumption of nutrients was also observed for various irrigated crops in the state. Since the marginal and small farmers were exempted from price hike, per hectare consumption of fertilizer in case of marginal farmers increased as usual. However, small farmers did not report normal growth in fertilizer consumption. While per hectare consumption of NPK for medium (2 to 4 ha) and big/large farms (6 ha & above) was stagnant, it declined significantly for large famers (4 to 6 ha) in the state.

Based on the data from a field study in Haryana pertaining to two years 1990-91 and 1991-92 (rabi season), Rao and Jayasree (2000) found that fertiliser use was more in case of the small farmers too, considering all

crops. In case of fertiliser application per hectare of cotton, the small farmers have been applying more fertiliser as compared to the other groups.

The deficiency in micronutrients in soils of various parts of the country has been aptly analysed by Prasad (2000) and Singh (2001), among others. Based on 1.48 lakh soil samples from different agro-ecological zones (AEZ), Singh (2001) indicated the existence of 45, 8.3, 4.5, 3.3 and 33 per cent mean deficiency of Zinc (Zn), Iron (Fe), Manganese (Mn), Copper (Cu) and Boron (B), respectively in India. However, the level of deficiency varies widely among various AEZs. Prasad (2000) states that the mean percentage samples deficient in Zinc (Zn), Iron (Fe), Copper (Cu), Boron (B) and Manganese (Mn) in Gujarat was 24 per cent, 8 per cent, 5 per cent, 2 per cent and 1 per cent, respectively.

There is a need to restore a balance in soil nutrients so as to maintain a good soil health. The application of recommended doses of fertiliser, therefore, assumes prime importance. However, there are several factors that force the farmers not to adopt the recommended doses of fertiliser. Rastogi and Annamalai (1981) studied the adoption of recommended practices in dryland area and found that shortage of capital and fear of losses were the main reasons for not adopting these practices. Among other factors, high prices of fertiliser, lack of knowledge about the recommended doses and their benefits, and non-availability of irrigation water and desired fertilisers were the major ones.

A study on 'Soil Testing Services in Rajasthan' was carried out by Sevak (1982). The study has examined the organizational set up and working of soil testing service in Rajasthan on the basis of available secondary data and a field survey covering 60 beneficiary households and 40 non-beneficiary households for the reference year 1979-80. The study revealed that the fertilizers had not been used on any of the soil tested plots as per the recommendations. Similarly, the yield rates were found to be higher on farms using less than the recommended doses of NPK nutrients. This study had suggested that these results deserve to be looked into more carefully for

making this service more effective. This study had provided several specific recommendations for improving the working of this service in Rajasthan.

1.3 Need for the Study

Soils in many parts of India showed deficiency of not only primary nutrients (N, P, K) but also secondary (Sulphur, Calcium and Magnesium) and micro nutrients (Boron, Zinc, Copper and Iron). Government of India had undertaken initiatives to ameliorate the situation and encourage the farmers for balanced use of fertilisers. These initiatives among others, included promotion of integrated nutrient management (INM), production and promotion of organic manures and bio-fertilisers, National Project on Management of Soil Health and Fertility (NPMSF) and nutrient based subsidy (NBS) policy. Attempts have also been made to strengthen and revamp soil testing laboratories in various districts under NPMSF. Farmers are encouraged to test their soil periodically and apply fertilisers based on the deficiency of nutrients in soil. This is intended to ensure balanced supply of nutrients for maintaining soil health and improving crop productivity. The NPMSF, which is in operation in India since 2008-09, has three components viz., strengthening of soil testing laboratories (STLs), promoting use of integrated nutrient management and strengthening of fertiliser quality control laboratories.

There is no systematic study undertaken so far for evaluating the effectiveness of the programme on crop productivity, extent of soil testing for nutrient deficiency and adoption of recommended doses of fertilisers by different categories of farmers based on the soil tests. Among different farmer categories, except some progressive farmers, the level of adoption of recommended doses of fertiliser is expected to be low among small and marginal farmers due to several constraints. Therefore, the present study examines the level of adoption and constraints in the application of recommended doses of fertilisers by small and marginal farmers, impact on crop productivity and relevant institutional problems faced by these farmers in the state of Gujarat, India.

1.4 Objectives of the Study

The objectives of the study are as follows:

1. To examine the level of adoption and its constraints in the application of recommended doses of fertilisers based on soil test reports by the farmers in Gujarat.
2. To analyse the impact of adoption of recommended doses of fertilisers on crop productivity and income of farmers in the state.

1.5 Data and Methodology

The present study[1] is based on both secondary and primary level data. The secondary data on year wise/state-wise consumption of fertiliser use and related parameters were collected from the publications of Fertilization Association of India (FAI), various publications of Ministry of Agriculture, Government of India, related websites, research reports, papers, presentations as well as office of Director of Agriculture, Government of Gujarat, Gandhinagar.

The primary data were collected from the four selected districts of Gujarat in India for the reference year 2013-14. The farmers who got their soil tested during the last three years (2010-11 to 2012-13) were included for the detailed analysis. The two major crops grown in the state (groundnut and cotton) were selected for the detailed study. The household survey was administered on 400 farmers from 8 talukas of four districts. The selected districts of Gujarat were Surendranagar and Rajkot for cotton and Jamnagar and Junagadh for groundnut (see Map 1.1). For each study crop, the data were collected following a cluster approach on a sample of 80 control farmers (no soil test) and 120 soil test farmers for assessing the extent of adoption of recommended dose of fertilisers and its impact on crop production. So the total sample size of the study was 400 (Table 1.1).

[1] The present study is a part of all-India level coordinated project that covered the major crops grown in 9 states, viz., Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal. The study was sponsored by Ministry of Agriculture, Government of India and was coordinated by The Agricultural Development and Rural Transformation Centre (ADRTC), Institute for Social and Economic Change, Bangalore.

The cluster approach was followed to ensure that adequate number of soil test farmers is available for the survey. Further, adequate measures were taken to ensure that the selected villages fall under the same agro-climatic conditions of sample districts and that the selected villages have certain common characteristics such as soil type, irrigation and crop variety.

Table 1.1: District-wise Distribution of Sample Farmers

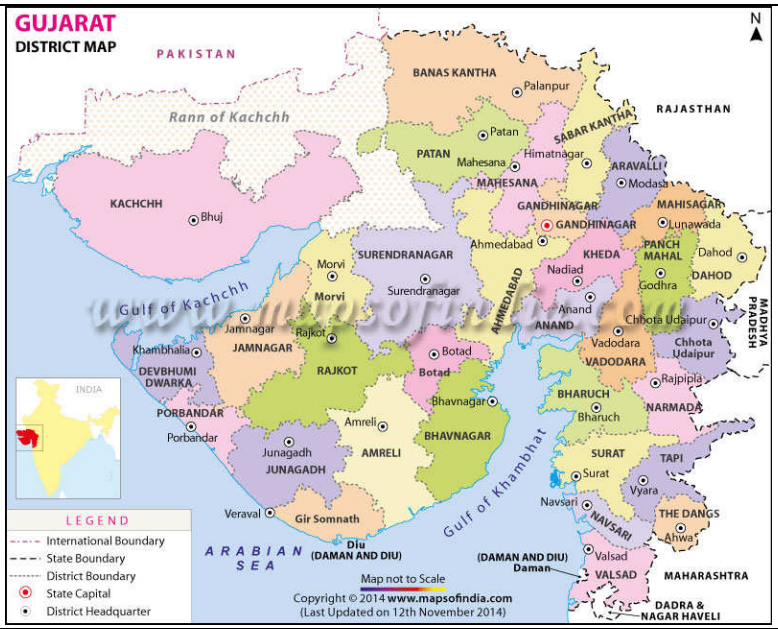
(Number of farmers)

Districts	MF	SF	MDF	LF	Total
Soil Test Farmers					
Surendranagar	3	7	17	33	60
	(5.0)	(11.7)	(28.3)	(55.0)	(100.0)
Rajkot	4	20	24	12	60
	(6.7)	(33.3)	(40.0)	(20.0)	(100.0)
Cotton total	7	27	41	45	120
	(5.8)	(22.5)	(34.2)	(83.3)	(100.0)
Junagadh	8	27	17	8	60
	(13.3)	(45.0)	(28.3)	(13.3)	(100.0)
Jamnagar	4	18	26	12	60
	(6.7)	(30.0)	(43.3)	(20.0)	(100.0)
Groundnut total	12	45	43	20	120
	(10.0)	(37.5)	(35.8)	(27.8)	(100.0)
Total (Soil Test)	19	72	84	65	240
	(7.9)	(30.0)	(35.0)	(55.6)	(100.0)
Non-Soil Test Farmers					
Surendranagar	0	6	9	25.0	40
	(0.0)	(15.0)	(22.5)	(62.5)	(100.0)
Rajkot	7	12	10	11.0	40
	17.50	30.00	25.00	27.5	(100.0)
Cotton total	7	18	19	36	80
	(8.8)	(22.5)	(23.8)	(123.1)	(100.0)
Junagadh	10	9	14	7.0	40
	(25.0)	(22.5)	(35.0)	(17.5)	(100.0)
Jamnagar	1	6	14	19.0	40
	(2.5)	(15.0)	(35.0)	(47.5)	(100.0)
Groundnut total	11	15	28	26	80
	(13.8)	(18.8)	(35.0)	(54.4)	(100.0)
Total (Non-Soil Test)	18	33	47	62	160
	(11.3)	(20.6)	(29.4)	(88.8)	(100.0)
Grand Total (Soil test+ Non soil test)	**37 (9.3)**	**105 (26.3)**	**131 (32.8)**	**127 (31.8)**	**400 (100.0)**

Notes: Figures in parentheses are the percentages of total; MF: Marginal farmers (0-2.5 acre); SF: Small farmers (2.5 – 5.0 acre); MDF: Medium farmers (5.0 – 10.0 acre); LF: Large farmers (>10.0 acre).

Source: Field survey data.

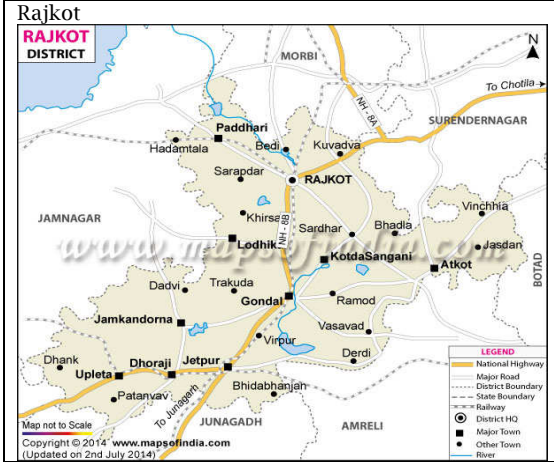
Map 1.1: Location Map of Study Area in Gujarat



Crop: Cotton

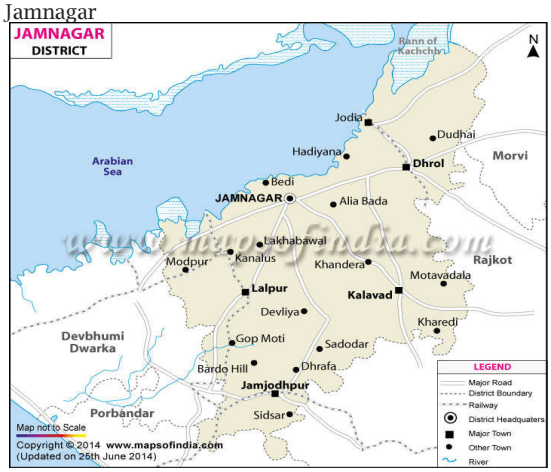
Surendranagar

Rajkot



Crop: Groundnut

Jamnagar



Junagadh

The multi-stage sampling method was used to select the districts, blocks and farm households. At first stage, four districts Surendranagar and Rajkot for Cotton and Jamnagar and Junagadh for groundnut) of Gujarat were selected on the basis of the average area under crops during the last three years (TE 2011-12). At second stage, 16 villages from 8 blocks of four study districts were selected. At third stage, desired number of sample households (400) representing different farm categories (Marginal 0-1 ha, Small 1-2 ha, Medium 2-4 ha; Large >4 ha) were covered for the study. The sample farmers were classified into different farm size groups post-survey as per the size of net operated area.

1.6 Limitation of the Study

The main limitation of the study was that as per the study design, it was not possible to get copy of soil health card from each selected farmer as they did not have same with them. Second, most of soil tested farmers were not aware about their soil test results. Third, for most of soil test results, same recommendations were made. Some types of recommendations (such as recommended split doses of fertilisers) are not available in the Soil Health Cards issued in Gujarat.

1.7 Organization of the Report

The present report is organized in seven chapters. The first chapter discusses the rationale, objectives of the study and methodology used for data collection and data analysis. The coverage, sampling design and conceptual framework of the study have been discussed in this chapter followed by the chapter scheme of the report.

The second chapter presents the trend in fertiliser consumption in the state. The overview of socio-economic profile of sample households/farmers, main features of the sample households including land ownership pattern, cropping pattern, sources of irrigation, area under HYV and value of output, farm assets holdings and the details of agricultural credit availed have been analyzed in Chapter III. The fourth chapter discusses the details of soil

testing and recommended doses of fertilisers adopted by the sample farmers. The source of information about soil testing by soil test farmers, reasons for soil testing by soil test farmers, reasons for not testing soil by control farmers, status of soil health on the sample soil test farms, and recommended doses of fertilisers applied by the sample farmers on soil test basis have been discussed in this chapter.

The next chapter (i.e., Chapter V) examines the extent of adoption of recommended doses of fertilisers and its constraints. The sources of information about recommended doses of fertilisers by control farmers, application of actual quantity of fertilisers by sample households, method of application of chemical fertilisers by sample farmers, and the extent of use of organic fertilisers by the sample households have been discussed in this chapter. The impacts of adoption of recommended doses of fertilisers have been discussed in Chapter VI. The last chapter (i.e., Chapter VII) presents the summary, concluding observations and policy implications of the study.

Chapter II

Trends in Fertiliser Consumption in Gujarat

2.1 Trends in Fertiliser Consumption by Nutrients

The increase in use of fertiliser was one of the major factors that changed the complexion of agriculture since Green Revolution period. More adoption of HYV seeds was supported by increased application of chemical fertilisers to raise agricultural output substantially across the country. As Shah (1989) pointed out, Gujarat has experienced the substantial increase in fertiliser use during the period of post green revolution (1966-1985). Similar trend was also observed to continue during the period of wider technology dissemination (1985-2000) (Swain, 2013). The per hectare consumption of fertiliser was the highest in western India compared to other parts of the country (Sharma and Sharma, 2000). It may be noted from Table 2.1 and Figure 2.1 that consumption of NPK in Gujarat state has increased from 3.57 lakh metric tonnes in 1980-81 to 19.39 lakh metric tonnes in 2010-11, implying an increase by 5.4 times. The NPK consumption per hectare of gross cropped area (GCA) has also increased by 16.5 per cent, from 32.6 kg in 1980-81 to 138.1 kg in 2010-11. But it has declined thereafter to 109.0 kg/ha in 2012-13. The total consumption of NPK in the state has also decreased from 19.39 lakh metric tonnes in 2010-11 to 13.42 lakh metric tonnes in 2012-13.

The decline in fertiliser consumption during the later period may be partly due to increased awareness generated by the Soil Health Card (SHC) programme in the state about the negative consequences of application of overdoses of fertiliser and positive effects of balanced fertiliser application on soil health. However, it is estimated that per hectare use of fertiliser has increased to about 127.7 kg/ha in 2013-14, indicating the reversal of trend in fertiliser use in the state.

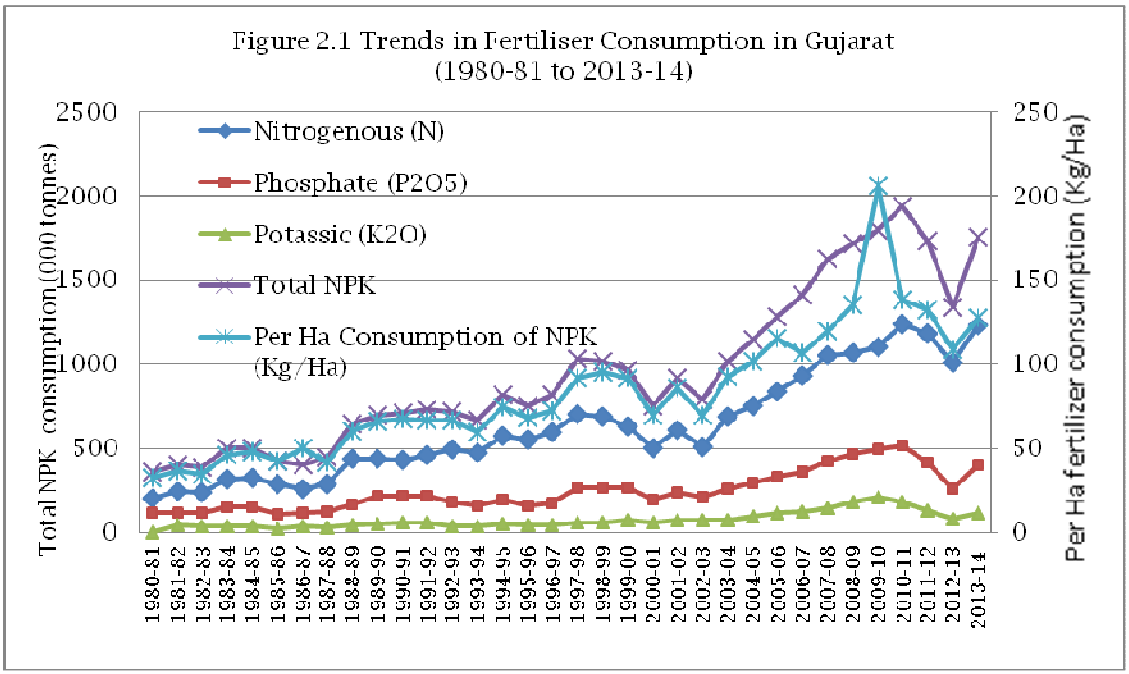


Table 2.1: Fertiliser Consumption in Gujarat State Year 1980-81 to 2013-14

(In 000' tonnes)

Sr. No	Year	Nitrogenous (N)	Phosphate (P2O5)	Potassic (K2O)	Total NPK	Per Ha Consumption of NPK (Kg/Ha)
1	1980-81	204.12	117.22	-	356.86	32.58
		(57.2)	(32.8)		(100.0)	
2	1990-91	430.75	217.15	58.49	706.39	67.26
		(61.0)	(30.7)	(8.3)	(100.0)	
3	2000-01	498.96	195.67	56.01	750.64	69.56
		(66.5)	(26.1)	(7.5)	(100.0)	
4	2010-11	1241.22	518.00	179.94	1939.16	138.08
		(64.0)	(26.7)	(9.3)	(100.0)	
5	2011-12	1183.30	417.02	132.74	1733.06	132.59
		(68.3)	(24.1)	(7.7)	(100.0)	
6	2012-13	1007.70	257.82	76.46	1341.97	108.99
		(75.1)	(19.2)	(5.7)	(100.0)	
7	2013-14 (est.)	1234.17	403.03	114.89	1752.08	127.65
		(70.4)	(23.0)	(6.6)	(100.0)	
CAGR (1980-81 to 1990-91)		7.75	6.36	-	7.07	7.52
CAGR (1990-91 to 2000-01)		1.48	-1.04	-0.43	0.61	0.34
CAGR (2000-01 to 2010-11)		9.54	10.23	12.38	9.96	7.10
CAGR (1980-81 to 2013-14)		5.78	3.93	3.12*	5.10	4.36

Notes: Figures in parentheses are the percentages of total; * CAGR is for a period of 1990-91 to 2013-14.
Sources: (1)Statistical Outline of Gujarat (1980-81 to 1990-91); (2)Statistical Abstract 2009, Directorate of Economics and Statistics, Government of Gujarat, Gandhinagar; (3) unpublished data, Department of Agriculture, Government of Gujarat.

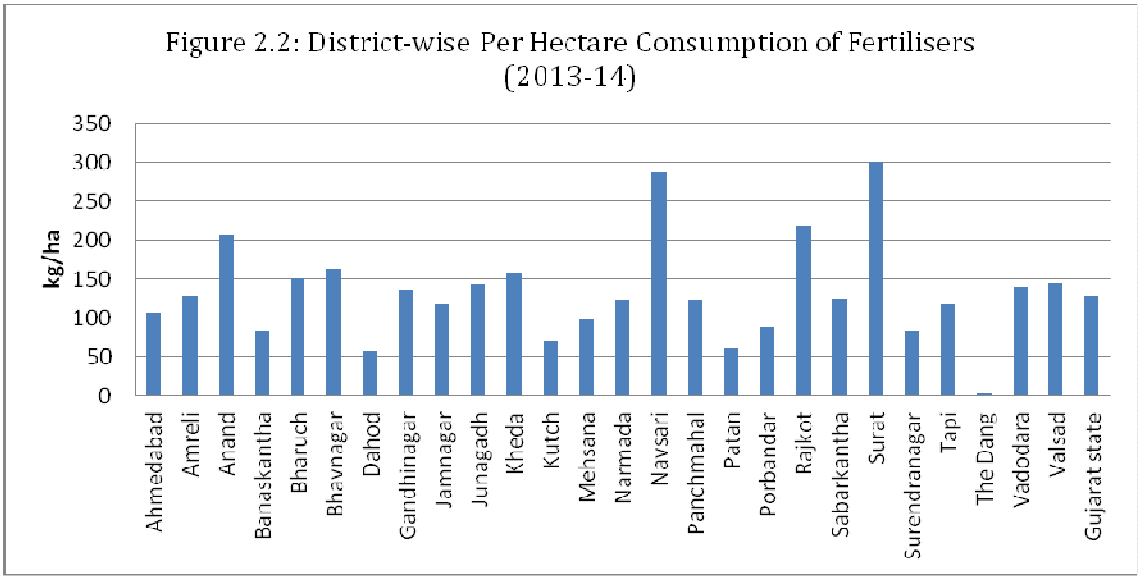
The district wise analysis of fertiliser use in Gujarat has been presented in Table 2.2. A wide variation is observed across districts with regard to per hectare consumption of NPK during 2013-14. The top five districts with high consumption of fertilisers were Surat (300.6 kg/ha), Navsari (287.8 kg/ha), Rajkot (218.5 kg/ha), Anand (207.5 kg/ha) and Bhavnagar (163.3 kg/ha). The bottom five districts with very low level of consumption of fertilisers were Dangs (4.9 kg/ha), Dahod (57.4kg/ha), Patan (61.9 kg/ha), Kutch (70.1 kg/ha) and Surendranagar (85.1 kg/ha). Almost half of the districts (16 districts, viz. Surat, Navsari, Rajkot, Anand, Bhavnagar, Kheda, Bharuch, Valsad, Junagadh, Vadodara, Gandhinagar, Amreli) have recorded higher use of fertiliser than state average of 127.7 kg/ha. It indicates the large variation in use of fertliser across the districts in the state.

Table 2.2: District-wise Per Hectare Consumption of Fertilisers (2013-14)

(in Kg/ha.)

Sl. No.	District	N	P	K	NPK
1	Ahmedabad	82.29	20.26	4.62	107.17
2	Amreli	82.62	40.40	5.31	128.33
3	Anand	170.74	25.19	11.53	207.46
4	Banaskantha	63.41	18.08	3.66	85.14
5	Bharuch	106.81	28.78	15.10	150.69
6	Bhavnagar	104.76	51.01	7.48	163.25
7	Dahod	41.35	12.62	3.07	57.04
8	Gandhinagar	101.54	25.18	9.51	136.23
9	Jamnagar	78.94	35.22	5.76	119.92
10	Junagadh	95.20	41.49	6.59	143.28
11	Kheda	129.46	21.51	6.64	157.61
12	Kutch	53.75	15.52	0.84	70.12
13	Mehsana	75.27	19.95	2.83	98.05
14	Narmada	89.28	20.78	13.52	123.58
15	Navsari	169.89	66.14	51.79	287.83
16	Panchmahal	102.73	18.19	3.20	124.13
17	Patan	48.55	12.70	0.73	61.98
18	Porbandar	55.49	29.92	4.29	89.70
19	Rajkot	145.11	59.03	14.36	218.50
20	Sabarkantha	86.64	27.32	12.07	126.04
21	Surat	167.64	81.74	51.18	300.57
22	Surendranagar	63.82	19.67	1.60	85.09
23	Tapi	74.48	26.29	18.51	119.28
24	Dang	3.44	0.67	0.80	4.91
25	Vadodara	102.69	22.54	15.63	140.86
26	Valsad	88.42	34.41	22.46	145.29
27	Gujarat state	89.91	29.36	8.37	127.65

Source: Department of Agriculture, Government of Gujarat, Gandhinagar.



The district wise soil fertility status in Gujarat has been presented in Table 2.3 (also see Maps 2.1 to 2.3). About 15 districts out of 26 districts in the state were found to have low soil fertility in terms of nitrogenous fertilisers. Only three districts (Rajkot, Porbandar and Junagadh) were having high nitrogen status. The phosphorous status was found to be low in 11 districts and medium in the rest of the districts. The potassium status was found be very high in the state. It was found to be high in about 22 districts. The medium status of potassium was found in only 4 districts. No districts in the state recorded low fertility status in terms of potassium.

Table 2.3: District wise Fertility Status in Gujarat

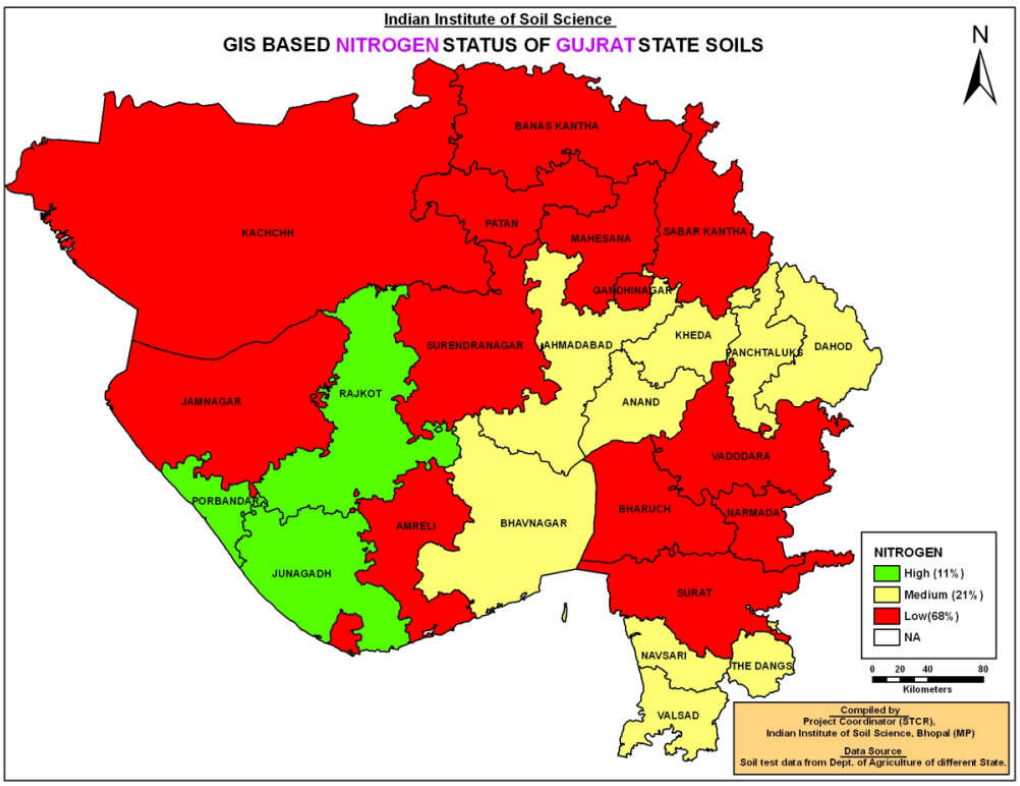
Sr. No.	Name of the districts	N	P	K
1	Ahmedabad	M	M	H
2	Amreli	L	M	H
3	Anand	M	M	H
4	Banaskantha	L	L	M
5	Bharuch	L	L	H
6	Bhavnagar	M	L	H
7	Dahod	M	L	H
8	Dang	M	M	H
9	Gandhinagar	L	M	H
10	Jamnagar	L	M	H
11	Junagadh	H	M	H
12	Kheda	M	M	H
13	Kutch	L	M	M

Table 2.3 continued…

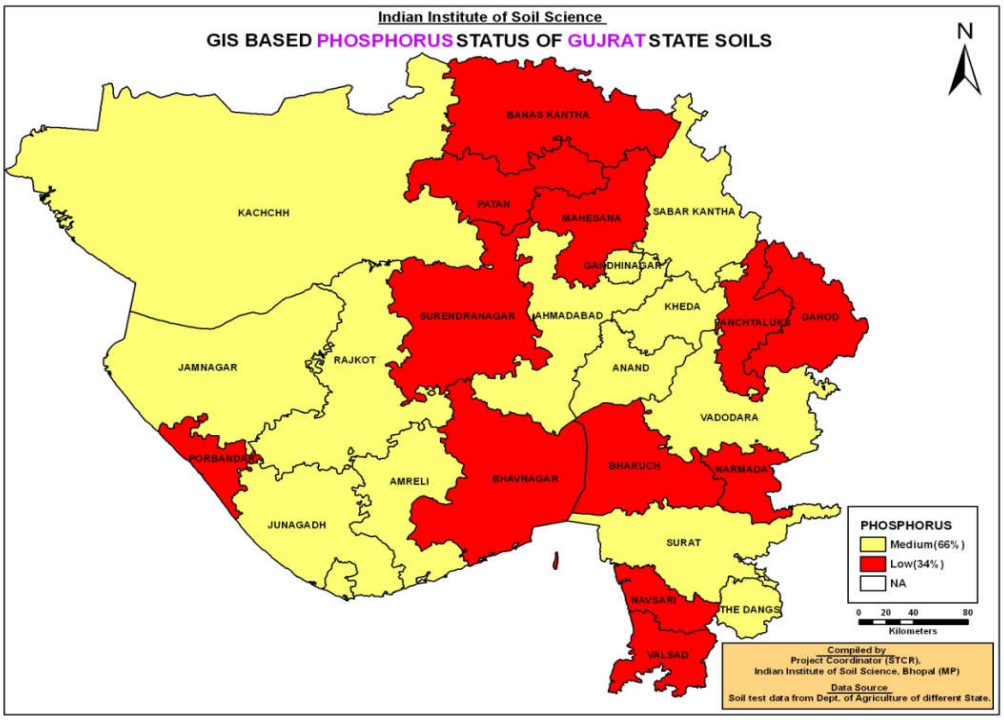
Sr. No.	Name of the districts	N	P	K
14	Mahesana	L	L	H
15	Narmada	L	L	H
16	Navsari	M	L	H
17	Panchmahal	M	L	H
18	Patan	L	L	H
19	Porbandar	H	L	H
20	Rajkot	H	M	H
21	Sabarkantha	L	M	M
22	Surat	L	M	H
23	Surendranagar	L	L	H
24	Vadodara	L	M	M
25	Valsad	M	L	H

Note: 'N' denotes Normal, 'H' denotes High and 'L' denotes Low level of nutrients
Source: http://www.iiss.nic.in/showmapD.asp?state=Gujarat&level=District

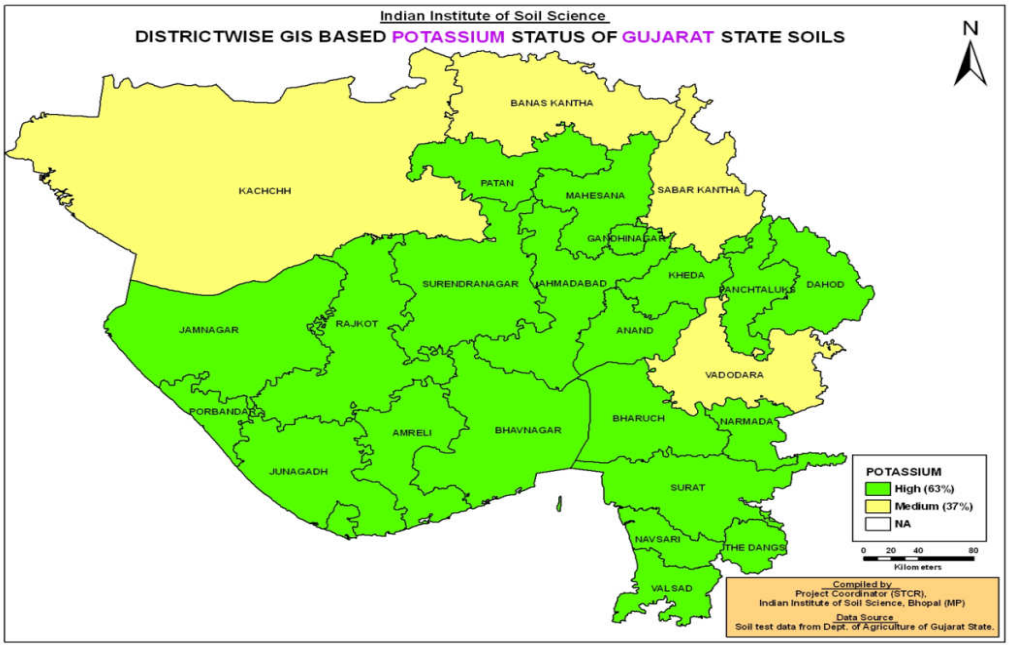
Map 2.1: Nitrogen Status of Soils in Gujarat



Map 2.2: Phosphorous Status of Soils in Gujarat



Map 2.3: Potassium Status of Soils in Gujarat



2.2 Trends in Fertiliser Consumption by Product

The trend in fertiliser consumption by product in the state in recent years is presented in Table 2.4. Among various fertilisers, per hectare consumption of Urea and Single Super Phosphate (SSP) has increased by a compound annual growth rate (CAGR) of 4.5 per cent and 6.4 per cent respectively, during a period of 2006-07 to 2013-14. Per hectare consumption of Urea and SSP has increased from 119.4 kg/ha and 7.2 kg/ha in 2006-07 to 162.7 kg/ha and 11.2 kg/ha in 2013-14, respectively. On the other hand, the per hectare consumption of Di-Ammonium Phosphate (DAP), Muriate of Potash (MOP) and Ammonium Sulphate (AS) has been reduced in the state, at the rate of 0.2 per cent, 2.69 per cent and 4.1 per cent respectively during the corresponding period. It is worth-mentioning here that the use of complex fertilisers has increased by 3.6 per cent annually. The per hectare consumption of complex fertilisers has increased from 26.5 kg/ha in 2006-07 to 33.8 kg/ha in 2013-14.

During last eight years (2006-07 to 2013-14), the share of Urea has varied from 51.0 per cent in 2010-11 to as high as 60.6 per cent in 2013-14. The share of DAP in total fertiliser consumption has varied from as low as 15.5 per cent in 2013-14 to as high as 22.6 per cent in 2008-09. The share of MOP in total fertiliser consumption has varied from as low as 3.5 per cent in 2013-14 to as high as 6.1 per cent in 2008-09. The share of complex fertilisers has hovered around 11.0 per cent during last eight years period. Because of comparatively lower price of Urea, it has been overused by the farmers. The analysis of season-wise pattern of fertiliser consumption reveals that, Kharif being the major crop growing season was expected to consume higher part of the total fertiliser consumption. However, the fertiliser consumption during Rabi season was found to be at par (around 50% in 2013-14) with that during Kharif season since the proportion of cash crops requiring more fertiliser has been grown during Rabi.

Table 2.4: Product-wise consumption of fertiliser in terms of material (2006-07 to 2013-14)

(In Metric Tonnes)

Year	Season	Urea	DAP	MOP	SSP	AS	Others	Total complex	Total product
2006-07	Kharif	774639	276296	58755	42517	84688	27231	200041	1464167
	Rabi	800124	281015	90802	52957	87843	21110	148917	1482768
	Total	1574763	557311	149557	95474	172531	48341	348958	2946935
	Per Ha	119.4 (53.4)	42.2 (18.9)	11.3 (5.1)	7.2 (3.2)	13.1 (5.9)	3.7 (1.6)	26.5 (11.8)	223.4 (100.0)
2007-08	Kharif	855605	289149	71257	46139	72752	17614	222598	1575114
	Rabi	85000	20000	13000	3000	3800	7000	27800	159600
	Total	940605	309149	84257	49139	76552	24614	250398	1734714
	Per Ha	69.4 (54.2)	22.8 (17.8)	6.2 (4.9)	3.6 (2.8)	5.6 (4.4)	1.8 (1.4)	18.5 (14.4)	128.0 (100.0)
2008-09	Kharif	925106	412597	108210	38278	33435	15047	212270	1744943
	Rabi	1000000	400000	100000	50000	75000	25000	202000	1852000
	Total	1925106	812597	208210	88278	108435	40047	414270	3596943
	Per Ha	151.5 (53.5)	63.9 (22.6)	16.4 (5.8)	6.9 (2.5)	8.5 (3.0)	3.2 (1.1)	32.6 (11.5)	283.0 (100.0)
2009-10	Kharif	1000000	425000	110000	50000	70000	16000	240500	1911500
	Rabi	950000	375000	120000	60000	70000	20000	239500	1834500
	Total	1950000	800000	230000	110000	140000	36000	480000	3746000
	Per Ha	223.1 (52.1)	91.5 (21.4)	26.3 (6.1)	12.6 (2.9)	16.0 (3.7)	4.1 (1.0)	54.9 (12.8)	428.5 (100.0)
2010-11	Kharif	1025000	500000	125000	60000	75000	19000	238000	2042000
	Rabi	1020000	390000	120000	60000	100000	20000	259500	1969500
	Total	2045000	890000	245000	120000	175000	39000	497500	4011500
	Per Ha	145.6 (51.0)	63.4 (22.2)	17.4 (6.1)	8.5 (3.0)	12.5 (4.4)	2.8 (1.0)	35.4 (12.4)	285.6 (100.0)
2011-12	Kharif	1250000	500000	115000	65000	90000	22000	277000	2319000
	Rabi	1250000	425000	125000	100000	70000	21000	250000	2241000
	Total	2500000	925000	240000	165000	160000	43000	527000	4560000
	Per Ha	191.3 (54.8)	70.8 (20.3)	18.4 (5.3)	12.6 (3.6)	12.2 (3.5)	3.3 (0.9)	40.3 (11.6)	348.9 (100.0)
2012-13	Kharif	1108282	291934	58596	73214.75	54806	55	234334	1108282
	Rabi	1250000	400000	100000	120000	100000	25000	280000	1250000
	Total	2358282	691934	158596	193214.75	154806	25055	514334	2358282
	Per Ha	191.5 (57.6)	56.2 (16.9)	12.9 (3.9)	15.7 (4.7)	12.6 (3.8)	2.0 (0.6)	41.8 (12.6)	191.5 (57.6)
2013-14 (provisional)	Kharif	1108282	291934	58596	73214.75	54806	55	234334	1822066
	Rabi	1125000	280000	70000	80000	80000	0	230000	1865000
	Total	2233282	571934	128596	153214.75	134806	55	464334	3687066
	Per Ha	162.7 (60.6)	41.7 (15.5)	9.4 (3.5)	11.2 (4.2)	9.8 (3.7)	0.0 (0.0)	33.8 (12.6)	268.6 (100.0)
CAGR (2006-07 to 2013-14)	Kharif	5.25	0.79	-0.04	8.07	-6.03	-58.79	2.29	3.17
	Rabi	4.99	-0.05	-3.65	6.07	-1.33	-100.00	6.41	3.33
	Total	5.12	0.37	-2.13	6.99	-3.46	-62.03	4.17	3.25
	Per Ha	4.52	-0.20	-2.69	6.39	-4.01	-62.24	3.58	2.67

Notes: Others include CAN, MAP or TSP; Figures in parentheses are the percentages of total fertiliser products used. DAP: Di-Ammonium Phosphate, MAP: Mono-Ammonium Phosphate, MOP: Muriate of Potash, SSP: Single Superphosphate, CAN: Calcium Ammonium Nitrate, AS: Ammonium Sulphate.

Source: Department of Agriculture, Government of Gujarat, Gandhinagar

2.3 Soil Health Card Programme in the State

Gujarat is the leading state in India in streamlining the Soil Health Card (SHC) Programme. This is an only one of its kind information project prepared and initiated by the Government of Gujarat for the benefit of farmers at the grass-root level. The programme was implemented in two phases. During the first phase (2004-05 to 2011-12), 38.43 lakhs farmers (out of total of 46.61 lakhs in Gujarat) were provided Soil Health Cards (SHCs), covering about 85.5 per cent of total farmers in Gujarat. The Second phase was started from 2012-13, aiming to cover 25% farm holding (11.50 Lakh) every year. During last two years (2012-13 and 2013-14), about 15.26 lakh farmers have been provided the SHCs. Thus, since the inception, a total of 53.69 lakh soil health cards have been given to farmers by the end of 2013-14 (Table 2.5 & Figure 2.3). The programme has generated alternative crop planning and recommendations for 229 talukas and 24324 villages and generated all Taluka and Village Model Action Plans (GoG, 2013).

Figure 2.3: Progress in Soil Health Card Programme in Gujarat, India

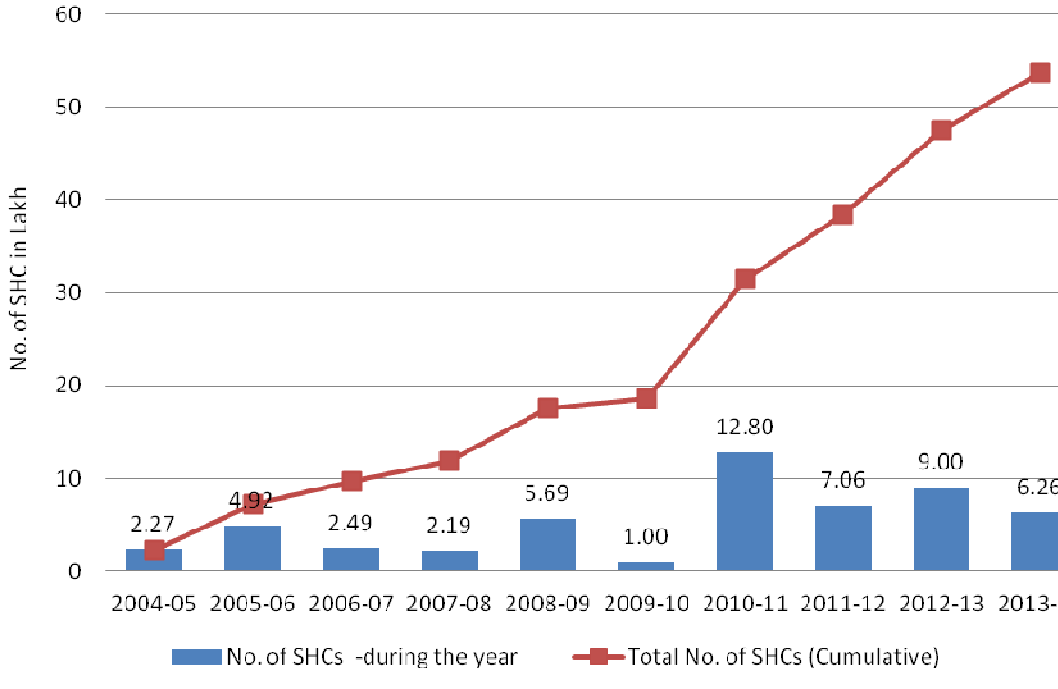


Table 2.5: Progress in Soil Health Card Programme in Gujarat, India

Year	Soil Testing Laboratories under	Number of soil testing laboratories			Annual analyzing capacity	No. of sample analyzed	Capacity Utilized (%)	No. of dist. having STL	No. of SHCs made available to farmers	
		Static	Mobile	Total					During the year	Cumulative Total
1	2	3	4	5	6	7	8	9	10	11
2004-05	(i) State Government	16	4	20	184000	184893	100.5	18	227425	
	(ii) Public Sector Undertaking	3	1	4	50000	138089	276.2	0		
	(iii) Private Sector	0	0	0	0	0	0.0	0		
	(iv) Total	19	5	24	234000	322982	138.0	18	227425	227425
2005-06	(i) State Government	16	4	20	184000	188596	102.5	18	492200	
	(ii) Public Sector Undertaking	3	1	4	60000	125583	209.3	0		
	(iii) Private Sector	0	0	0	0	0	0.0	0		
	(iv) Total	19	5	24	244000	314179	128.8	18	492200	719625
2006-07	(i) State Government	18	2	20	190000	211691	111.4	18	249186	
	(ii) Public Sector Undertaking	3	1	4	50000	99677	199.4	3		
	(iii) Private Sector						0.0			
	(iv) Total	21	3	24	240000	311368	129.7	21	249186	968811
2007-08	(i) State Government	18	2	20	190000	142692	75.1	18	219000	
	(ii) Public Sector Undertaking	3	1	4	50000	84789	169.6	3		
	(iii) Private Sector						0.0			
	(iv) Total	21	3	24	240000	227481	94.8	21	219000	1187811
2008-09	(i) State Government	18	2	20	190000	158224	83.3	18	568614	
	(ii) Public Sector Undertaking	3	1	4	50000	83819	167.6	3		
	(iii) Private Sector						0.0			
	(iv) Total	21	3	24	240000	242043	100.9	21	568614	1756425
2009-10	(i) State Government	18	2	20	190000	307348	161.8	19	100000	
	(ii) Public Sector Undertaking	3		3	50000	104733	209.5	3		
	(iii) Private Sector						0.0			
	(iv) Total	21	2	23	240000	412081	171.7	22	100000	1856425
2010-11*	(i) State Government	18	2	20	210000	650000	309.5	19	1279968	
	(ii) Public Sector Undertaking	70	0	70	1430223	1401646	98.0	24		
	(iii) Private Sector	0	0	0	0	0	0.0	0		
	(iv) Total	88	2	90	1640223	2051646	125.1	26	1279968	3136393
2011-12	(i) State Government	20	2	22	220000	136408	62.0	21	706241	
	(ii) Public Sector Undertaking	81	0	81	810000	353625	43.7	24		
	(iii) Private Sector	0	0	0	0	0	0.0	0		
	(iv) Total	101	2	103	1030000	490033	47.6	24	706241	3842634

Table 2.5 Continued…

1	2	3	4	5	6	7	8	9	10	11
2012-13	(i) State Government	20	2	22	220000	278931	126.8	21	900095	
	(ii) Public Sector Undertaking	81	0	81	810000	607421	75.0	24		
	(iii) Private Sector	0	0	0	0	0	0.0	0		
	(iv) Total	101	2	103	1030000	886352	86.1	26	900095	4742729
2013-14	(i) State Government	20	2	22	220000	203725	92.6	21	626362	
	(ii) Public Sector Undertaking	112	0	112	810000	560099	69.1	24		
	(iii) Private Sector	0	0	0	0	0	0.0	0		
	(iv) Total	132	2	134	1030000	763824	74.2	26	626362	5369091
CAGR (2004-05 to 2013-14)	(i) State Government	2.5	-7.4	1.1	2.0	1.1	-0.9	1.7	11.9	
	(ii) Public Sector Undertaking	49.5	-100.0	44.8	36.3	16.8	-14.3			
	(iii) Private Sector									
	(iv) Total	24.0	-9.7	21.1	17.9	10.0	-6.7	4.2	11.9	42.1

Notes: *During 2010-11, other than 70 PSU, analysis work done in 55 science colleges to meet the Golden Goal 739431 samples were analysed by science colleges. Analysis work was outsourced to private agencies by State Government STLs to meet the Golden Goal and work was done in two shifts. Soil samples were analysed by Public Sector Undertakings such as APMCs, Govt. supported Corporation Labs, Govt supported Sugar cooperatives labs) and Science Colleges.

Source: Department of Agriculture, Government of Gujarat

Along with increase in cumulative number of SHCs distributed to farmers from 2.27 lakh in 2004-05 to 53.69 lakh in 2013-14, the number of soil testing labs (STL) has also increased from 20 in 2004-05 to 134 in 2013-14 at the rate of 17.9 per cent per annum. Similarly, the annual soil sample analysing capacity has increased from 2.34 lakh in 2004-05 to 10.3 lakh in 2013-14. The actual soil sample analyzed has increased at the rate of 10.0 per cent per annum, i.e. from 3.23 lakh in 2004-05 to 7.64 lakh in 2013-14.

2.4 Summary of the Chapter

Gujarat has experienced the substantial increase in fertiliser use during the period of post green revolution (1966-1985) and also observed during the period of wider technology dissemination (1985-2000). The consumption of NPK in Gujarat state has increased from 3.57 lakh metric tonnes in 1980-81 to 19.39 lakh metric tonnes in 2010-11, implying an increase by 5.4 times. The NPK consumption per hectare of GCA has also

increased by 16.5 per cent, from 32.6 kg in 1980-81 to 138.1 kg in 2010-11. However, it has declined to 109.0 kg/ha in 2012-13. The decline in fertiliser consumption during the later period may be partly due to increased awareness generated by the Soil Health Card (SHC) programme in the state about the negative consequences of application of overdoses of fertiliser and positive effects of balanced fertiliser application on soil health.

A wide variation is observed across districts with regard to per hectare consumption of NPK during 2013-14. The top five districts with high consumption of fertilisers are Surat (300.6 kg/ha), Navsari (287.8 kg/ha), Rajkot (218.5 kg/ha), Anand (207.5 kg/ha) and Bhavnagar (163.3 kg/ha). The bottom five districts with low level of consumption of fertilisers are Dangs (4.9 kg/ha), Dahod (57.4kg/ha), Patan (61.9 kg/ha), Kutch (70.1 kg/ha) and Surendranagar (85.1 kg/ha). Almost half of the districts (16 districts, viz. Surat, Navsari, Rajkot, Anand, Bhavnagar, Kheda, Bharuch, Valsad, Junagadh, Vadodara, Gandhinagar, Amreli) have recorded higher use of fertiliser than state average of 127.65 kg/ha. It indicates the large variation in use of fertliser across the districts in the state.

Among various fertilisers, the per hectare consumption of Urea and SSP has increased by a compound annual growth rate (CAGR) of 4.5 per cent and 6.4 per cent respectively, during a period of 2006-07 to 2013-14. On the other hand, the per hectare consumption of DAP, MOP and AS has been reduced in the state, at the rate of 0.2 per cent, 2.69 per cent and 4.1 per cent respectively during the corresponding period. It is worth-mentioning here that the use of complex fertilisers has increased by 3.6 per cent annually.

Gujarat is the leading state in India in streamlining the Soil Health Card (SHC) Programme. So far, a total of 53.69 lakh soil health cards have been distributed to farmers by the end of 2013-14. Out of which, 6.26 lakh soil health cards have been distributed in the year 2013-14 alone.

Chapter III

Socio-Economic Characteristics of Sample Households

3.1 Distribution of Sample Households by Farm Size

The household level analysis was conducted following a cluster approach on a sample of 160 control farmers (non-soil test) and 240 soil test farmers for two study crops (cotton and groundnut) for assessing the extent of adoption of recommended doses of fertilisers and their impacts on crop production and productivity. The distribution of sample households is presented in Table 3.1. Among the farmers, the marginal and small farmers together constitute about 37.9 per cent of total soil test farmers and 31.9 per cent of total control farmers. Thus, the majority of the sample households are the medium and large farmers.

Table 3.1: Distribution of Sample Households by Farm Size Category

(% of households)

Particulars	Cotton		Groundnut	
	Soil test farmers	Control farmers	Soil test farmers	Control farmers
Marginal	5.8	8.75	10.0	13.75
Small	22.5	22.5	37.5	18.75
Medium	34.2	23.75	35.8	35
Large	37.5	45	16.7	32.5
Total	100.0	100	100	100

Note: MF: Marginal farmers (0-2.5 Ac); SF: Small farmers (2.5-5.0 Ac); MDF: Medium farmers (5.0- 10 Ac); LF: Large farmers (>10 Ac).

Source: Field survey

3.2 Socio-Economic Characteristics of Households

The socio-economic characteristics of sample households are presented in Table 3.2 and Table 3.3. It can be seen from the tables that the average age of respondent of selected farmer households was 48.4 years

with education of 7.3 years in case of the cotton growers. For the groundnut growers, the average age of respondent of selected farmer households was 47.8 years with education of 6.6 years. Thus, cotton growers were more educated than the groundnut growers. General caste households were more in case of cotton group (72.5%) compared to groundnut group (47.5%). The level of literacy was much better for cotton group of farmers (91.5%) compared to 72.5% in case of groundnut group of farmers.

The average family size for cotton farmers and groundnut farmers was 5.9 and 6.2 respectively. The agriculture formed the main source of occupation for the sample households of both crop groups. The average number of people engaged in agriculture was around 3.0 per household for both groups of farmers. The average year of experience in farming was around 26 years for both cotton farmers and groundnut farmers.

Table 3.2: Socio-economic Characteristics of Sample Households (Cotton)

Particulars	Cotton-Soil Test Farmers	Cotton-Control Farmers	Overall
Number of sample farmer households	120	80	200
Average age of respondent (years)	49.9	46.1	48.4
Average years of respondent education	7.3	7.3	7.3
Agriculture as main occupation (% of respondents)	100.0	97.5	99.0
Gender (% of respondents):			
Male	95.8	98.8	97.0
Female	4.2	1.3	3.0
Average family size (No.)	5.9	6.0	5.9
Average number of people engaged in agriculture	2.8	3.2	3.0
Average years of experience in farming	27.0	23.1	25.5
% of farmers being a member of any association	31.7	30.0	31.0
Caste (% of households):			
SC	5.0	6.3	5.5
ST	0.0	0.0	0.0
OBC	21.7	22.5	22.0
General	73.3	71.3	72.5

Source: Field survey data.

Table 3.3: Socio-economic Characteristics of Sample Households (Groundnut)

Particulars	Groundnut-Soil Test Farmers	Groundnut-Control Farmers	Overall
Number of sample farmer households	120	80	200
Average age of respondent (years)	48.8	46.3	47.8
Average years of respondent education	6.3	6.9	6.6
Agriculture as main occupation (% of respondents)	100.0	100.0	100.0
Gender (% of respondents):			
Male	95.8	100.0	97.5
Female	4.2	0.0	2.5
Average family size (No.)	6.2	6.1	6.2
Average number of people engaged in agriculture	2.7	3.6	3.0
Average years of experience in farming	26.7	25.1	26.0
% of farmers being a member of any association	15.8	21.3	18.0
Caste (% of households):			
SC	1.7	1.3	1.5
ST	0.0	0.0	0.0
OBC	43.3	62.5	51.0
General	55.0	36.3	47.5

Source: Field survey data.

However, for all farmers taken together (cotton +groundnut), the average age of respondent of selected farmer households was found to be 47.3 years with education 7.1 years (Table 3.4). The average family size for soil test farmers and control farmers was 5.6 and 5.9 respectively. The agriculture formed the main source of occupation for about 99.5 per cent of sample households. The average number of people engaged in agriculture was 2.9 per household and the average years of experience in farming has been 26.8 years among soil test farmers and 23.5 years among control farmers. The majority of sample households belonged to general caste (60%) and other backward caste (36.5%). The average level of literacy among the sample farmers was observed much better (about 82 per cent).

Table 3.4: Socio-Economic Characteristics of Sample Households
(All Farmers- cotton and groundnut)

Particulars	Soil Test Farmers (All)	Control Farmers (All)	Grand total
Number of sample farmer households	240	160	400
Average age of respondent (years)	49.3	44.3	47.3
Average years of respondent education	6.8	7.6	7.1
Agriculture as main occupation (% of respondents)	100.0	98.8	99.5
Gender (% of respondents)			
Male	95.8	99.4	22.8
Female	4.2	0.6	0.6
Average family size (No.)			
Male	3.1	3.0	3.0
Female	3.0	2.6	2.8
Total	6.1	5.6	5.9
Average number of people engaged in agriculture	2.7	3.1	2.9
Average years of experience in farming	26.8	23.5	25.5
% of farmers being a member of any association	23.8	25.6	24.5
Caste (% of households)			
SC	3.3	3.8	3.5
ST	0.0	0.0	0.0
OBC	32.5	42.5	36.5
General	64.2	53.8	60.0
Education level (% of respondents)			
Illiterate	19.6	15.6	18.0
Primary (1-5)	20.0	23.8	21.5
Secondary(6-10)	29.2	46.9	36.3
Higher secondary (11-12)	22.5	8.1	16.8
Graduate & above - 4	8.8	5.6	7.5

Source: Field survey data.

3.3 Details of Operational Land Holdings

The details of land holding pattern of the sample households have been presented in Table 3.5 and Table 3.6. In case of cotton group of farmers, average size of land holding was found to be 10.25 acres per household, out of which 6.23 acres of land was irrigated and 4.03 acre was un-irrigated. In the case of soil test farmers (cotton group), the average size of land holding was 10.43 acre per household, out of which 6.43 acre was irrigated and 4.0 acre was un-irrigated. The gross cropped area for soil test farmers and control farmers was 12.20 acre and 12.18 acre respectively. The cropping intensity for soil test farmers and control farmers of cotton group was estimated to be 141.97 per cent and 158.5 per cent respectively. Thus, cropping intensity for control farmer was higher than soil test group. The land leased-in tendency was found significant in case of soil test farmers than control group farmers for both cotton and groundnut farmers.

Table 3.5: Operational Landholding of the Sample Households (Cotton)

(Acre/household)

Particulars	Soil Test Farmers	Control Farmers	Overall
Owned land	9.98	9.88	9.95
Leased-in	0.58	0.23	0.43
Leased-out	0.13	0.10	0.13
Uncultivated/Fallow	0.08	0.05	0.05
Net operated area (NOA)	10.43	10.00	10.25
Net irrigated area	6.43	5.95	6.23
Net unirrigated area	4.00	4.05	4.03
Gross cropped area (GCA)	14.80	15.85	15.33
Cropping intensity (%)	141.97	158.50	149.51

Source: Field survey data.

Table 3.6: Operational Landholding of the Sample Households (Groundnut)

(Acre/household)

Particulars	Soil Test Farmers	Control Farmers	Overall
Owned land	6.03	7.60	6.65
Leased-in	0.53	0.35	0.45
Leased-out	0.00	0.05	0.03
Uncultivated/Fallow	0.03	0.00	0.03
Net operated area (NOA)	6.55	7.90	7.10
Net irrigated area	5.38	6.65	5.88
Net unirrigated area	1.18	1.25	1.20
Gross cropped area (GCA)	9.60	8.75	9.18
Cropping intensity (%)	146.56	110.76	129.23

Source: Field survey data.

Contrary to cotton farmers, the average size of operational land holding was more (7.9 acre per household) for control farmers than the soil test farmers (6.55 are per household) of groundnut crop group. The opposite situation was also observed in case of groundnut farmers compared with cotton farmers with respect to GCA and cropping intensity. Unlike cotton crop group, the gross cropped area and cropping intensity was more for soil test farmers than the control farmers in case of groundnut crop group.

In case of all farmers (cotton + groundnut), the average size of land holding was 8.7 acre per household, out of which about 70 per cent land was irrigated (6.1 acre) and remaining 30 per cent land (2.6 acre) was un-irrigated (Table 3.7). In the case of soil test farmers, the average size of land holding was found to be 8.5 acre per household, out of which 5.9 acre was irrigated and 2.6 acre was un-irrigated. The ratio of area irrigated in soil test farmers was almost same as found in all sample households. In the case of control farmers, the average size of land holding was 8.95 acre per household, out of which 6.3 acre was irrigated and 2.65 acre was un-irrigated.

Table 3.7: Operational Landholding of the Sample Households
(All farmers -cotton and groundnut)

(Acre/household)

Particulars	All farmers (cotton+ groundnut)		
	Soil Test Farmers	Control Farmers	Overall
Owned land	8.00	8.75	8.30
Leased-in	0.55	0.28	0.45
Leased-out	0.05	0.08	0.08
Uncultivated/Fallow	0.05	0.03	0.05
Net irrigated area	5.90	6.30	6.05
Net unirrigated area	2.58	2.65	2.63
Size of operational holding (NOA)	8.48	8.95	8.68
Gross cropped area (GCA)	12.20	12.18	12.25
Cropping intensity (%)	143.78	136.03	136.03

Source: Field survey data.

3.4 Sources of Irrigation

Among the sources of irrigation, open wells and dug wells were the major sources of irrigation for the sample households (Table 3.8, Table 3.9 and Table 3.10). For groundnut group of farmers, open wells and dug wells were found to be the major sources contributing about 58.2 per cent of total irrigated area; whereas, for cotton group of farmers, bore wells were found to be the major sources contributing about 54.9 per cent of total irrigated area. Thus, groundwater was the main source of irrigation for the selected sample households. The canal, tank, river/pond and other water sources accounts meager share in irrigating crops of sample farmers.

Table 3.8: Sources of Irrigation (Cotton)

(% of net irrigated area)

Particulars	Soil Test Farmers	Control Farmers	Overall
Open/ dug well	42.2	34.5	39.2
Bore well	53.5	57.0	54.9
Canal	3.7	2.6	3.3
Tank	0.3	0.0	0.2
River/Ponds and Others	0.3	5.9	2.5
Total	100.0	100.0	100.0

Source: Field survey data.

Table 3.9: Sources of Irrigation (Groundnut)

(% of net irrigated area)

Particulars	Soil Test Farmers	Control Farmers	Overall
Open/ dug well	73.0	47.7	58.2
Bore well	23.7	21.4	22.4
Canal	0.8	30.8	18.3
Tank	2.5	0.0	1.0
River/Ponds and Others	0.0	0.0	0.0
Total	100.0	100.0	100.0

Source: Field survey data.

Table 3.10: Sources of Irrigation (All farmers -cotton and groundnut)

(% of net irrigated area)

Particulars	Soil Test Farmers	Control Farmers	Overall
Open/ dug well	56.8	58.7	57.6
Bore well	39.4	37.4	38.6
Canal	2.3	1.2	1.8
Tank	1.4	0.0	0.8
River/Ponds and Others	0.2	2.7	1.2
Total	100.0	100.0	100.0

Source: Field survey data.

3.5 Cropping Pattern and Area under HYV

As mentioned earlier, among the selected crops, the average size of GCA was much higher in cotton growers as compared to groundnut farmers. The GCA of cotton group of farmers was almost one and half time higher than that of groundnut group of farmers. The proportion of area under more remunerative Rabi crops was also found to be higher (31.4% of GCA) in case of cotton growers as compared to groundnut farmers (20.7% of GCA) (Tables 3.8 and 3.9). Thus the proportion of area under Kharif was more among groundnut growers (76.7%) over cotton growers (60.4%).

Among the Kharif crops grown by cotton farmers, cotton (41.7%), kharif oilseeds such as castor (5.1%) and groundnut (3.8%), jowar (3.5%) were the major crops. Among the Rabi crops grown by cotton farmers, wheat (11.7%), cumin (12.3%) were the major crops. Total summer crops contributed about 8.1 per cent of GCA of cotton growers (Table 3.11).

Among the Kharif crops grown by groundnut farmers, groundnut (56.8%) and cotton (16.8) were the major crops. Among the Rabi crops grown by groundnut farmers, wheat (5.7%), cumin (5.3%) and gram (4.1%) were the major crops. Total summer crops contributed only about 2.3 per cent of GCA of groundnut growers (Table 3.12).

The area under HYV crops under both crops category was found to be much less as evident from Table 3.13. The HYV area under kharif groundnut, kharif cotton and wheat was relatively better for both soil test and control farmers. The HYV area under kharif groundnut, kharif cotton and wheat for soil test farmers (groundnut) was 36.3 per cent, 21.3 per cent and 10 per cent, respectively. Thus, it was very surprisingly to note here that despite of very low seed replacement rate in groundnut crop recorded at state level (10 percent) during 2013-14, more than 45 percent of selected groundnut farmers (control group) had replaced seed of groundnut. It may be because of progressive nature of selected groundnut farmers (control group).

Table 3.10: Cropping Pattern of the Sample Households (Cotton)

(% of GCA)

Sl. No.	Season/ crop	Soil Test Farmers	Control Farmers	Overall
A	Kharif crops			
	Bajra	0.2	0.1	0.1
	Jowar	3.3	3.6	3.5
	Other Cereals	0.0	0.0	0.0
1	Total cereals	3.5	3.7	3.6
2	Total Kharif Pulses	0.0	0.0	0.0
	Groundnut	4.4	3.2	3.8
	Sesamum	0.3	0.1	0.2
	Castor	5.1	5.1	5.1
3	Total Kharif oilseeds	10.2	8.4	9.2
	Cotton	44.5	39.0	41.7
4	Kharif Vegetables	0.0	0.0	0.0
	Kharif Fodder	2.8	3.7	3.3
	Kharif Guar	2.5	2.3	2.4
5	Other Kharif Crops	5.7	6.1	5.9
6	Total Kharif Crops	63.9	57.2	60.4
B	Rabi crops			
	Wheat	5.0	18.0	11.7
	Maize	0.0	0.1	0.1
	Jowar	0.3	1.8	1.0
7	Total Rabi Cereals	5.3	19.9	12.8
	Gram	4.9	1.6	3.2
8	Total Rabi Pulses	4.9	1.6	3.2
9	Total Rabi Oilseeds	0.0	0.3	0.1
	Cumin	10.2	14.3	12.3
	Other spices	1.4	0.5	0.9
10	Total Spices	11.6	14.8	13.2
	Onion	1.7	1.2	1.4
11	Total Vegetable	1.7	1.2	1.4
12	Fodder	0.7	0.4	0.5
13	Total Rabi Crops	24.2	38.1	31.4
C	Summer crops			
	Jowar	0.7	0.0	0.3
14	Total Summer Cereals	0.7	0.0	0.3
	Sesamum	1.7	1.7	1.7
15	Total Oilseeds	1.7	1.7	1.7
	Other summer crops	1.4	0.5	0.9
16	Total Summer Crops	11.9	4.6	8.1
D	Gross cropped area	100.0	100.0	100.0

Source: Field Survey data.

Table 3.12: Cropping Pattern of the Sample Households (Groundnut)

(% of GCA)

Sl. No.	Season/ crop	Soil Test Farmers	Control Farmers	Overall
A	Kharif crops			
	Bajra	0.2	0.4	0.3
	Jowar	0.0	1.7	0.8
	Other Cereals	0.1	0.6	0.3
1	Total cereals	0.3	2.6	1.4
	Tur	0.6	0.6	0.6
2	Total Kharif Pulses	0.6	0.6	0.6
	Groundnut	55.1	58.8	56.8
	Castor	0.0	0.4	0.2
3	Total Kharif oilseeds	55.1	59.1	57.0
	Cotton	9.1	25.2	16.8
4	Kharif Vegetables	0.0	0.0	0.0
	Kharif Fodder	0.0	0.8	0.4
	Kharif Guar	0.0	0.4	0.2
	Kharif Chilli	0.7	0.0	0.4
5	Other Kharif Crops	0.7	1.2	0.9
6	Total Kharif Crops	65.8	88.7	76.7
B	Rabi crops			
	Wheat	10.9	0.0	5.7
	Bajra	0.7	0.0	0.4
	Jowar	2.4	0.0	1.3
	Other Cereals	0.0	0.0	0.0
7	Total Rabi Cereals	14.0	0.0	7.3
	Gram	2.2	6.3	4.1
	Tur	1.3	0.0	0.7
8	Total Rabi Pulses	3.5	0.0	3.6
	Rapeseed mustard	1.2	0.0	0.6
9	Total Rabi Oilseeds	1.8	0.0	1.0
	Cumin	4.1	6.6	5.3
	Other spices	6.4	0.9	3.8
10	Total Spices	10.4	7.5	9.0
	Other Vegetable	1.5	0.2	0.9
11	Total Vegetable	1.8	0.2	1.0
12	Fodder	0.8	0.2	0.5
13	Total Rabi Crops	32.4	7.8	20.7
C	Summer crops			
14	Summer cereals	0.3	0.2	0.3
	Sesamum	1.4	1.5	1.5
15	Summer oilseeds	1.4	1.5	1.5
16	Total Summer Crops	1.9	2.8	2.3
D	Gross cropped area	100.0	100.0	100.0

Source: Field Survey data.

Table 3.13. Area Under HYV of Major Crops

(% of cropped area)

Crop name	Cotton Farmers	Groundnut Farmers
Soil Test Farmers		
Kharif Jowar	2.50	0.00
Kharif Groundnut	6.25	36.25
Kharif Castor	9.58	0.00
Kharif Cotton	35.00	21.25
Rabi Wheat	7.50	10.00
Rabi Cumin	14.17	0.83
Rabi Other Spices	3.75	1.67
Summer Jowar	2.92	0.00
Control Farmers		
Kharif Jowar	25.71	3.57
Kharif Groundnut	5.63	45.63
Kharif Cotton	6.25	1.25
Rabi Wheat	6.88	11.25
Rabi Cumin	10.00	5.63
Rabi Onion	1.25	0.00
Summer Jowar	1.25	0.00

Source: Field Survey

3.6 Gross Value of Output

It was surprising to note that the control farmers under cotton crop category had received higher returns per acre (Rs. 41006.2) than soil test farmers (Rs. 33122) (Table 3.14). It may be because of relatively better prices realized by control group farmers of cotton. However, the reverse trend was found in the case of groundnut farmers (Table 3.15). The value of output per acre for groundnut farmers was Rs. 30524.9 for soil test group and Rs. 24665.1 for control group.

Table 3.14. Aggregate Value of Crop Output- Cotton

Particulars	Value of Output		Value of Output Sold	
	Rs/household	Rs/Acre	Rs/household	Rs/Acre
Soil Test Farmers:				
Marginal	125782.1	38355.7	125782.1	38355.7
Small	237505.6	46931.9	214253.7	42300.8
Medium	367619.9	35868.9	343505.7	33207.4
Large	750074.9	27606.4	721221.4	26722.6
Total	467657.6	35404.7	443366.9	33122.0
Control Farmers:				
Marginal	131835.7	51242.3	118228.6	45912.8
Small	184572.2	85068.4	169700.0	83027.4
Medium	363733.4	31393.1	334692.1	28950.0
Large	514163.3	23615.2	494730.6	25404.6
Total	370824.6	41706.8	350645.6	41006.2

Source: Field Survey data.

Table 3.15. Aggregate Value of Crop Output (Groundnut farmers)

Particulars	Value of Output		Value of Output Sold	
	Rs/household	Rs/Acre	Rs/household	Rs/Acre
Soil Test Farmers:				
Marginal	85005.8	30819.0	69133.3	25640.2
Small	181360.9	34291.0	172588.8	32659.3
Medium	430994.5	34660.0	388450.5	30462.9
Large	683968.0	30971.7	631907.5	28786.5
Total	344945.3	33522.8	316146.8	30524.9
Control Farmers:				
Marginal	39663.6	21333.7	30368.2	17483.4
Small	124329.3	21321.6	106957.7	18364.1
Medium	287214.6	27860.4	257547.5	25171.3
Large	597627.9	33207.5	547535.6	30793.6
Total	323519.7	27474.7	292320.9	24665.1

Source: Field Survey data.

3.7 Details of Farm Assets Holding

The details on distribution of farm assets by cotton and groundnut growers are presented in Table 3.16 and 3.17. It can be seen from the tables that the cotton growers were more mechanized as compared to groundnut growers. That to soil test farmers in cotton crop were more mechanized than control group farmers. It can be seen from Table 3.16 that the number of tractor with trolley, diesel engine, drip and sprinkler systems of irrigation was found higher for soil test farmers to their counterpart.

Table 3.16: Distribution of Farm Assets (Cotton farmers)

Particulars	Soil Test Farmers		Control Farmers	
	Number/ household	Value/household (Rs)	Number/ household	Value/Household (Rs)
Tractor, Trailer/trolley	0.8	180641.7	0.7	127363.8
Harrow and cultivator	0.5	10358.3	0.5	7088.6
Electric motor, Diesel engine	1.2	39402.5	1.0	30791.1
Thresher	0.1	5933.3	0.1	1088.6
Planker	0.0	23.3	0.0	0.0
Manual/power sprayer	1.2	2787.5	1.1	2131.5
Fodder chopper	0.1	62.1	0.1	29.1
Bullock cart	0.3	6795.0	0.3	8215.2
Drip /sprinkler system	0.8	24175.0	0.1	8068.2
Small tools (spade, hoe, sickle etc.)	5.2	2357.4	6.3	4310.8
Animal shed/Pump house	0.4	7129.2	0.8	12743.0
Any other	0.02	21541.7	0.01	1075.9

Source: Field Survey

However, in case of groundnut growers, except number of drip/sprinkler and diesel engines, fodder chopper and small tools, the control group farmers dominate the modernization of agriculture than the soil test farmers. Thus, totally opposite situation of cotton grower could be seen in case of groundnut growers.

Table 3.17: Distribution of Farm Assets (Groundnut farmers)

Particulars	Soil Test Farmers		Control Farmers	
	Number/ household	Value/household (Rs)	Number/ household	Value/Household (Rs)
Tractor, Trailer/trolley	0.3	51458.3	0.5	102625.0
Harrow and cultivator	0.1	2214.2	0.3	7287.5
Electric motor, Diesel engine	1.2	24364.2	1.2	26343.8
Thresher	0.03	1500.0	0.1	9425.0
Planker	0.0	0.0	0.0	0.0
Manual/power sprayer	1.0	2282.8	0.8	2434.4
Fodder chopper	0.02	8.3	0.0	0.0
Bullock cart	0.7	16429.2	0.7	17981.3
Drip /sprinkler system	0.8	8293.3	0.7	9893.8
Small tools (spade, hoe, sickle etc.)	5.8	2463.7	4.9	2010.0
Animal shed/Pump house	0.4	9551.7	0.4	12612.5
Any other	0.0	0.0	0.0	0.0

Source: Field Survey

3.8 Details of Agricultural Credit Availed

The details on agricultural credit availed by the selected farmer households is presented in Table 3.18 and Table 3.19. It can be seen from the tables that the institutional finance was the major source of credit for cotton as well groundnut growers and no amount was taken as credit from non-institutional sources. Among cotton farmers, the credit outstanding amount was found higher (Rs. 43956) for control farmers than the soil test farmers (Rs. 39338). Similarly, for the groundnut farmers, the credit outstanding was found higher (Rs. 38690) for control farmers than the soil test farmers (Rs. 4383). It may be noted that, in both crop categories, the control farmers had borrowed more and had more credit outstanding compared to soil test farmers. Thus, control farmers were more progressive in nature. Interesting fact which noticed during survey was that no farmer had revealed/shared information on credit taken from the informal sources.

Also it may be due to the fact that selected study areas were known to be well developed and thus there was adequate availability of credit by formal sources.

Table 3.18: Agricultural Credit Outstanding by the Sample Households (Cotton Farmers)

Sources	Soil Test Farmers	Control Farmers
Co-operative Credit Societies	35565.22	30604.17
Land development banks	0.00	0.00
Commercial banks	67081.40	80000.00
RRBs	200000.00	0.00
Money lenders	0.00	0.00
Fiends/Relatives	0.00	0.00
Traders/Commission agents	0.00	0.00
Others	0.00	0.00
Total	39337.50	43955.88

Note: About 36.7% soil test farmers and 42.5% of control farmers of cotton crop group availed loans from various sources.

Source: Field Survey data.

Table 3.19: Agricultural Credit Outstanding by the Sample Households (Groundnut Farmers)

Sources	Soil Test Farmers	Control Farmers
Co-operative Credit Societies	7333.33	19166.67
Land development banks	70000.00	0.00
Commercial banks	6393.44	47902.44
RRBs	0.00	10000.00
Money lenders	0.00	0.00
Fiends/Relatives	0.00	0.00
Traders/Commission agents	0.00	0.00
Others	0.00	0.00
Total	4383.33	38689.66

Note: About 41.3% soil test farmers and 36.3% of control farmers of groundnut crop group availed loans from various sources.

Source: Field Survey data.

The main purposes of borrowing/loan are presented in Table 3.20 & Table 3.21. The major purposes were found to be seasonal crop cultivation and purchase of tractor and other implements for both cotton farmers and groundnut farmers.

Table 3.20: Purpose of Agricultural Loan Availed (Cotton Farmers)

(% to total farmers)

Purpose	Soil Test Farmers	Control Farmers
Seasonal crop cultivation	94.3	95.6
Purchase of tractor and other implements	3.4	2.9
Purchase of livestock	1.1	0.0
Land development	1.1	0.0
Consumption expenditure	0.0	0.0
Marriage and social ceremonies	0.0	0.0
Non-farm activities	0.0	0.0
Other expenditures	0.0	1.5
Total Farmers	100.0	100.0

Source: Field Survey

Table 3.21: Purpose of Agricultural Loan Availed (Groundnut Farmers)

(% to total farmers)

Purpose	Soil Test Farmers	Control Farmers
Seasonal crop cultivation	99.0	100.0
Purchase of tractor and other implements	0.0	0.0
Purchase of livestock	0.0	0.0
Land development	1.0	0.0
Consumption expenditure	0.0	0.0
Marriage and social ceremonies	0.0	0.0
Non-farm activities	0.0	0.0
Other expenditures	0.0	0.0
Total Farmers	100.0	100.0

Source: Field Survey

3.9 Summary of the Chapter

The household level analysis was conducted following a cluster approach on a sample of 160 control farmers (non-soil test) and 240 soil test farmers for two study crops (cotton and groundnut) for assessing the extent of adoption of recommended doses of fertilisers and their impacts on crop production and productivity. Among the farmers, the marginal and small farmers together constitute about 37.9 per cent of total soil test farmers and 31.9 per cent of total control farmers. Thus, the majority of the sample households are the medium and large farmers.

The age of respondent selected farmer household was 47.3 years with education of 7.1 years. The average family size for soil test farmers and control farmers was 5.6 and 5.9 respectively. The agriculture formed the main source of occupation for about 99.5 per cent of sample households. The average number of people engaged in agriculture was 2.9 per household and the average years of experience in farming has been 26.8 years among soil test farmers and 23.5 years among control farmers. The average size of land holding of all sample households was 8.7 acre per household, out of which about 70 per cent land was irrigated (6.0 acre) and remaining 30 per cent land (2.7 acre) was un-irrigated.

The crop-wise data shows that the gross cropped area for soil test farmers and control farmers was 12.20 acre and 12.18 acre respectively. The cropping intensity for soil test farmers and control farmers was estimated to be 143.78 per cent and 136.03 per cent respectively. The gross cropped area was much higher (15.82 acre) for cotton compared to groundnut (9.18 acre). Therefore cropping intensity was much higher (149.5%) for the cotton farmers compared to groundnut farmers (139.2%). The open wells and dug wells were the major sources for all categories of sample households, which constituted about 57.6 per cent followed by bore wells (38.6 per cent). Thus, groundwater was the main source of irrigation for the selected sample households. For cotton farmers, around 60 per cent gross cropped area was in Kharif season and remaining area was covered under Rabi crops. The area

under Kharif crop for groundnut farmers was much higher (76.7%). The area under HYV crops under both crops category was found to be much less.

It is surprising to note that the control farmers under cotton crop category have received better returns per acre (Rs. 41006.2) over soil test farmers (Rs. 33122). However, the reverse is found to be true in the case of groundnut farmers. The cotton growers were found to be more mechanized as compared to groundnut growers. That to soil test farmers in cotton crop were more mechanized than control group farmers. The institutional finance was the major source of credit for cotton as well groundnut growers and no amount was taken as credit from non-institutional sources.

Chapter IV

Soil Testing & Recommended Doses of Fertilisers

4.1 Background

Soil testing helps in balanced and appropriate application of fertilizer. The success of these services depends on how scientifically the soil samples have been collected. Several factors such as technical expertise of the people engaged in collecting and testing soil samples, instruments used, depth of the soil collected and number of spots for soil collection are important for the efficiency of this service. Apart from scientific soil testing, optimum fertilizer application depends upon several other factors as follows: whether the reports of soil sample reach the farmers? If they reach to farmers, whether the farmers understand them? Again, whether the farmers adopt the fertilizer recommendations fully or not?

The Soil Health Cards (SHC) Programme in Gujarat was aimed at providing the soil testing facilities to the farmers in the most convenient way. The ultimate objective was to increase the level of adoption of recommended doses of fertiliser by the sample farmers. The programme facilitates the collection of soil samples from the farmers' field[2] and test the soil health in the nearest soil test laboratories (STLs). Different institutions such as Agriculture Department of the State government, Public Sector Undertakings (such as Government supported APMCs, Govt. corporation managed Soil Testing Labs, Government supported Sugar cooperatives labs) and Science Colleges were involved in testing the soil samples and

[2] The soil sample collection activity was out sourced by hiring farmers' friends (Gram Mitras) who collect the soil sample at the rate of Rs 15 per sample which includes collection charges, primary requirement like Sample bag, woven bag, Forms, Marker pens as well as transportation charges of samples. Village level workers (VLWs) supervise the work at village level and District Agriculture Officer and District Panchayat supervise the work at district level. The Samples collected from villages are aggregated at taluka level and sent to designate Soil Testing Laboratory (STL).

generating the soil health cards. The tests on major nutrients like N, P, K, Ph etc were done at all 101 STLs. However, the tests on micronutrients were done at only at designated 50 STLs and Agricultural Universities in the state. The test results were transferred to another organization Silver Touch Pvt. Ltd for generating SHCs. Anand Agricultural University was given the responsibility for uploading all these SHCs in its website through e-Krishi Kiran Programme. Thus, the results of soil test were digitized and communicated to farmers in the form of Soil Health Cards (SHC) for easy access by the farmers.

4.2 Details of Soil Testing

The details on the soil testing and related parameters are presented in Table 4.1 and Table 4.2. It can be seen from these tables that the cost of soil test was nil for all soil test farmers since it was provided free of cost by the Government. Some of the progressive farmers were also provided the detailed soil test analysis by the cooperatives through private soil testing labs. The cost of soil test through private soil testing labs varied from Rs 50 to Rs 250 per sample depending on nature of soil test undertaken. In case of our sample farmers, these charges were borne by the cooperatives.

Table 4.1: Details of Soil Testing by Sample Farmers (Cotton)

Particulars	Marginal	Small	Medium	Large	Total
% of farmers tested their soil in the last three years	100.0	100.0	100.0	100.0	100.0
Average cost of soil testing (Rs/sample)	0.0	0.0	0.0	0.0	0.0
Average distance from field to soil testing lab (kms)	33.9	19.8	42.1	62.8	44.4
Average number of soil samples taken per plot	4.9	4.7	4.8	5.0	4.9
Average no. of plots considered for soil testing	1.0	1.3	1.4	1.4	1.3
Area covered under soil test (Acre/HH)	2.4	3.1	4.5	9.4	5.9
Area covered as % of net operated area	97.6	82.3	62.2	50.2	56.6
% of farmers who collected samples themselves	42.9	37.0	48.8	35.6	40.8
% of soil sample collected by the department officials	57.1	63.0	51.2	64.4	59.2

Source: Field survey

Table 4.2: Details of Soil Testing by Sample Farmers (Groundnut)

Particulars	Marginal	Small	Medium	Large	Total
% of farmers tested their soil in the last three years	100.0	100.0	100.0	100.0	100.0
Average cost of soil testing (Rs/sample)	0.0	0.0	0.0	0.0	0.0
Average distance from field to soil testing lab (kms)	88.2	114.7	151.9	133.0	129.3
Average number of soil samples taken per plot	4.8	4.6	4.8	4.9	4.8
Av. no. of plots considered for soil testing	1.1	1.1	1.0	1.3	1.1
Area covered under soil test (Acre/HH)	1.5	3.2	5.8	5.7	4.4
Area covered as % of net operated area	83.4	88.6	79.8	39.5	66.8
% of farmers who collected samples themselves	25.0	44.4	37.2	25.0	36.7
% of soil sample collected by the department officials	75.0	55.6	62.8	75.0	63.3

Source: Field survey

The average distance travelled to soil test lab (STL) by the groundnut farm households (129.3 km) was more than doubled the distance travelled by cotton farm households (49.4 km). Among groundnut farmers, the distance to STL was highest (151.9 km) for the medium farmers. Per plot, 4 to 5 samples were taken for soil testing.

It is very surprising to note here is that about 40.8 per cent of cotton farmers and 36.7 per cent of groundnut farmers collected the soil samples by themselves. The collection of soil for soil sample is scientific and systematic process which requires the training of same. Thus, the trained staff should have been collected all soil samples in order to have correct results about soil health. The remaining around 60 per cent of total soil samples were taken by the department officials. The selected farmers opined that acute shortage of departmental staff forced them to collect the soil samples by themselves. They further opined that the inadequate number of soil testing labs (STLs) has severely affected the quality of testing service provided to them by these agencies.

4.3 Sources of Information about Soil Testing (Soil Test Farmers)

The major sources of information about the SHC programme were the government officials at grass root level (Gram Sevek, Gram Mitra and Extension Officers). About 95 per cent of all farmers were appraised by these government officials (Table 4.3). The friends, neighbours and fellow farmers were the next major sources of information for the sample farmers.

Table 4.3: Sources of Information about Soil Testing by Sample Households (Soil Test Farmers)

(% of farmers)

Sources	Marginal	Small	Medium	Large	Total
			Cotton		
SAUs	0.0	1.0	4.9	13.3	7.5
KVKs	0.0	0.0	2.4	4.4	2.5
State department	100.0	100.0	87.8	97.8	95.0
Private companies	0.0	0.0	0.0	0.0	0.0
Friends/neighbors	28.6	0.0	12.2	6.7	8.3
Total	128.6	103.7	107.3	122.2	113.3
			Groundnut		
SAUs	0.00	0.00	0.00	0.00	0.00
KVKs	0.00	0.00	0.00	0.00	0.00
State department	83.33	97.78	95.35	95.00	95.00
Private companies	0.00	0.00	0.00	0.00	0.00
Friends/neighbors	16.67	2.22	4.65	5.00	5.00
Total	100.00	100.00	100.00	100.00	100.00

Source: Field survey

4.4 Reasons for Testing the Soil by Soil Test Farmers

The farmers had shown keen interest in getting their soil tested for several reasons as presented in Table 4.4. The major motivating factors towards soil testing were expected to increase in crop yield (96.7%); adoption of new technological practices (59.2%); got motivated from village demonstration/training/exposure visits to places with best farming practices (40.8%). Both group farmers (cotton and groundnut) got motivated with the information they received about the benefit of testing of soil in crop production.

Table 4.4: Reasons for Soil Testing by Sample Households (Soil Test Farmers)

(% of farmers)

Reasons	Cotton				Groundnut			
	Most Important	Important	Least Important	Total	Most Important	Important	Least Important	Total
For availing benefits under subsidy schemes	6.7	1.7	1.7	10.0	0.8	0.0	0.8	1.7
For increasing crop yield	88.3	5.0	1.7	95.0	85.8	9.2	3.3	98.3
Motivation from village demonstration/ training/exposure visits to places with best farming practices	37.5	15.8	2.5	55.8	22.5	1.7	1.7	25.8
Peer farmers' group pressure	5.0	1.7	4.2	10.8	0.0	0.0	2.5	2.5
Adopt new technological practices	15.0	18.3	20.8	54.2	19.2	30.8	14.2	64.2

Source: Field Survey

4.5 Reasons for Not Testing Soil by Control Farmers

There are some farmers who had not tested their farm soil. It is because of the fact that spread of SHC programme was restricted due to lack of awareness among the farmers. Among non-soil test farmers, about 86.3 per cent groundnut farmers and 76.3 per cent cotton farmers expressed that they were not aware about how to draw soil sample; whereas 78.8 per cent groundnut farmers and 72.5 per cent cotton farmers mentioned that they were not aware about whom to contact for details on testing (Table 4.5). Thus, lack of awareness, interest and low level of education has kept away majority of sample control farmers from soil test. The larger distance of STL from villages was another de-motivating factor for about 60 per cent of farmers.

Table 4.5: Reasons for Not Testing Soil during the Last Three Years (Control Farmers)

(% of Farmers)

Reasons	Cotton				Groundnut			
	Most Important	Important	Least Important	Total	Most Important	Important	Least Important	Total
Do not know how to take soil samples	62.5	11.3	2.5	76.3	73.8	7.5	5.0	86.3
Do not know whom to contact for details on testing	36.3	36.3	0.0	72.5	43.8	30.0	5.0	78.8
Soil testing laboratories are located far away	30.0	16.3	15.0	61.3	33.8	10.0	16.3	60.0
Soil testing not required for my field as crop yield is good	25.0	13.8	8.8	47.5	31.3	6.3	5.0	42.5
Don't trust expert's recommendations	10.0	7.5	10.0	27.5	11.3	2.5	13.8	27.5
Poor education/awareness level	61.3	7.5	7.5	76.3	66.3	10.0	5.0	81.3
Trust on fellow farmers suggestion for not to go the soil test	7.5	5.0	10.0	22.5	13.8	8.8	10.0	32.5
Any other	3.8	0.0	0.0	3.8	11.3	0.0	0.0	11.3

Source: Field survey

4.6 Status of Soil Health of the Sample Soil Test Farms

The results of soil test are presented in Table 4.6. It can be seen from the table that average soil quality of farm plots of sample farmers was very poor in terms of nitrogen and phosphorus content. Only about 1.7 per cent farms of cotton growers and 2.8 per cent of groundnut growers were found to have normal nitrogen level. Only about 6.3 per cent of farm plots of cotton growers and 2.1 per cent of groundnut growers were found to have normal phosphorus level. About 11.4 per cent farm plots of cotton growers and 14.9 per cent of groundnut growers were found to have normal level of

potassium. The pH value was found to be normal in sufficient number of cases (90.8% for cotton and 100% for groundnut) in both crop groups.

Table 4.6: Status of Soil Health in terms of Nutrients on the Sample Soil Test Farms

(Percentage of farmers)

Fertilizers	Normal	High	Medium	Low
	Cotton			
Nitrogen	1.7	0.8	61.7	35.8
Phosphorus	6.3	9.2	48.6	35.9
Potassium	11.4	75.0	12.9	0.8
Sulphur (S)	53.8	3.8	42.3	0.0
Magnesium (Mg)	92.0	8.0	0.0	0.0
Calcium (Ca)	92.0	8.0	0.0	0.0
pH Value	90.8	7.5	0.0	1.7
	Groundnut			
Nitrogen	2.8	12.5	36.1	48.6
Phosphorus	2.1	10.4	21.5	66.0
Potassium	14.9	74.5	9.2	1.4
Sulphur (S)	75.0	25.0	0.0	0.0
Magnesium (Mg)	100.0	0.0	0.0	0.0
Calcium (Ca)	100.0	0.0	0.0	0.0
pH Value	98.6	1.4	0.0	0.0

Source: Field survey

4.7 Recommended Doses of Fertilisers on Soil Test Basis

The poor soil health has been mainly due to unbalanced use/doses of fertiliser application. Thus, it is necessary to adopt the recommended doses of fertiliser for maintaining better soil health. However, the recommended doses of fertiliser depend on many factors such as soil type, variety, sowing time of the crop and availability of irrigation provisions. The average quantities of recommended dose of fertilisers based on soil test (as reported in the farmers' SHC) for the two study crops have been presented in Table 4.7.

Table 4.7: Average Quantity of Recommended Dose of Fertilisers Based on Soil Test (as reported in the health card)-Soil Test Farmers

(Kg/acre)

Fertiliser	Cotton					Groundnut		
	HYV Irrigated	HYV Unirrigated	Local Unirrigated	Total unirrigated cotton	Total Cotton (Average)	Kharif Groundnut	Summer Groundnut	Total Groundnut (Avg)
Urea	153.7	69.8	34.9	52.3	86.1	3.5	7.0	5.3
DAP	0.0	0.0	0.0	0.0	0.0	17.6	37.1	27.1
MOP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FYM	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0

Notes: The recommended dose of SSP was not mentioned in the SHC in Gujarat. The split doses recommendations were also not mentioned in the SHCs in Gujarat
Source: Soil Health Cards of Sample Farmers (Field Survey)

For cotton, the major fertilisers recommended were Urea and FYM. The quantity of Urea recommended for HYV irrigated cotton, HYV unirrigated cotton and local cotton were 153.7kg/acre, 69.8kg/acre and 34.9kg/acre, respectively. The FYM recommended for all types of cotton was 4.0 tonne/acre. In the case of Groundnut, the major fertilisers recommended were Urea, DAP and FYM. The average quantities of Urea, DAP and FYM recommended for summer groundnut were much higher than that for kharif groundnut. The average quantities of Urea, DAP and FYM recommended for summer groundnut were 7.0kg/ha, 37.1kg/acre and 4.0 tonne/acre, respectively. On the other hand, the average quantities of Urea, DAP and FYM recommended for kharif groundnut were only 3.5kg/acre, 17.6kg/acre and 4.0 tonne/acre, respectively.

4.8 Summary of the Chapter

The Soil Health Cards (SHC) Programme in Gujarat was aimed at providing the soil testing facilities to the farmers in the most convenient way. The programme facilitates the collection of soil samples from the farmers' field and test the soil health in the nearest soil test laboratories (STLs). None of the soil test farmers had to incur the cost of soil testing since it was provided by the free of cost by the Government. Some of the progressive farmers were also provided the detailed soil test analysis by the cooperatives through private soil testing labs. However, the average distance

travelled to soil test lab (STL) by the groundnut farm households (129.3 km) was more than doubled the distance travelled by cotton farm households (49.4 km). It is very surprising to note here that about 40.8 per cent of cotton farmers and 36.7 per cent of groundnut farmers collected the soil samples by themselves.

The major sources of information about the SHC programme were the government officials at grass root level (Gram Sevek, Gram Mitra and Extension Officers). About 95 per cent of all farmers were appraised by these government officials. The major motivating factors towards soil testing were to increase crop yield; adoption of new technological practices; got motivated from village demonstration/training/exposure visits to places with best farming practices. Among non-soil test farmers, about 86.3 per cent farmers expressed that they are not aware about how to draw soil sample, about 79 per cent farmers mentioned that they do not know whom to contact for details on testing. The larger distance of STL from villages was another demotivating factor for about 60 per cent of farmers. Thus, lack of awareness, interest, low level of education and larger distance of STL have kept away majority of sample control farmers from soil test.

Only about 1.7 per cent of cotton growers and 2.8 per cent of groundnut growers were found to have normal nitrogen level in their soils. Only about 6.3 per cent of farm plots of cotton growers and 2.1 per cent of groundnut growers were found to have normal Phosphorus level. The pH value was found to be normal in sufficient number of cases in both crop groups.

The quantity of Urea recommended for HYV irrigated cotton, HYV unirrigated cotton and local cotton were 153.7kg/acre, 69.8kg/acre and 34.9kg/acre, respectively. The FYM recommended for all types of cotton and groundnut was 4.0 tonne/acre. In the case of Groundnut, the major fertilisers recommended were Urea, DAP and FYM. The average quantities of Urea, DAP and FYM recommended for summer groundnut were much higher than that for kharif groundnut.

Chapter V

Adoption of Recommended Doses of Fertilisers and Its Constraints

5.1 Background

To facilitate and promote Integrated Nutrient Management (INM) through judicious use of chemical fertilizers, including secondary and micro nutrients, in conjunction with organic manures and bio-fertilizers, the farmers' awareness and adoptability to recommended doses are necessary. The increase in level of adoptability will surely help in improving soil health and its productivity. The Government of Gujarat had therefore planned and implemented the Soil Health Card (SHC) Programme in a phased manner so as to provide Soil Health Card to all farmers. By the year 2013-14, more than 53 lakh farmers had been provided the SHC in the state. However, there are many farmers who got their soils tested and obtained the SHCs but didn't apply the recommended doses of fertiliser on field. There are number of reasons which are discussed in this Chapter. Before analyzing these constraints, let's first discuss the various aspects of adoptability of recommended doses especially after soil testing.

5.2 Application of Recommended Doses of Fertilisers by Soil Test Farmers

It may be noted that the level of adoption of recommended doses by the soil test farmers was found to be around 40 per cent for both cotton and groundnut farmers (Table 5.1). About 50.0 per cent of farmers of cotton and 72.5 per cent of soil test farmers of groundnut have expressed their willingness to continue the same practices to maintain the better soil health and to get the better yields. Among the Cotton growers, the maximum adoptability was found in the case of small farmers (45.7%) and minimum adoptability was observed in the case of marginal farmers (28.6%). In

contrast, in the case of groundnut crop, the maximum adoptability was found in the case of large farmers (45.0%) and minimum adoptability was observed in the case of small farmers (37.8%).

Table 5.1: Application of Recommended Doses of Fertilisers on Reference Crops-Soil Test Farmers

Particulars	Marginal	Small	Medium	Large	Total
			Cotton		
% of farmers applied recommended doses of fertilisers	28.6	45.7	35.8	42.2	40.0
Average area (acre)	1.8	2.4	3.0	6.4	4.1
Area covered as % of net operated area	14.7	5.6	7.0	16.6	3.5
Average number of seasons applied	2.0	2.0	2.0	2.0	2.0
% of farmers willing to continue applying recommended doses of fertilizers	42.9	55.6	36.6	60.0	50.0
			Groundnut		
% of farmers applied recommended doses of fertilisers	41.7	37.8	40.3	45.0	40.3
Average area (acre)	1.1	2.4	5.2	8.2	4.3
Area covered as % of net operated area	38.4	19.6	42.2	187.8	13.8
Average number of seasons applied	1.0	1.0	1.0	1.0	1.0
% of farmers willing to continue applying recommended doses of fertilisers	66.7	73.3	72.1	75.0	72.5

Source: Field Survey

5.3 Constraints in Application of Recommended Doses of Fertilisers (Soil Test Farmers)

The soil test farmers have faced several difficulties in applying recommended doses of fertiliser. Among these constraints, difficulty in understanding and following application of recommended doses, unavailability of technical advice on method and time of fertiliser application, high prices of fertilisers and unavailability of required fertilisers in adequate quantity were the major ones (Table 5.2). About 15.8 per cent farmers expressed that required fertilisers in adequate quantity were not available. Another 15.8 per cent farmers expressed that no technical advice on method and time of fertiliser application were given to them. About 15 per cent farmers stated higher price as their main constraints; while another 15 per cent farmers stated the difficulty in

understanding and following application of recommended doses as their major problem in applying recommended doses.

Table 5.2: Constraints in Applying Recommended Doses of Fertilisers (% of farmers)

Reasons	Cotton				Groundnut			
	Most Important	Important	Least Important	Total	Most Important	Important	Least Important	Total
Adequate quantity of fertilisers not available	3.3	7.5	3.3	14.2	9.2	4.2	2.5	15.8
Prices of fertilisers are high	3.3	6.7	3.3	13.3	5.0	8.3	1.7	15.0
Lack of money to purchase fertilisers	0.8	2.5	5.0	8.3	5.0	4.2	5.0	14.2
No technical advice on method and time of fertiliser application	10.8	2.5	2.5	15.8	10.8	5.0	0.0	15.8
Difficult to understand and follow the recommended doses	18.3	0.8	0.0	19.2	13.3	1.7	0.0	15.0
Any Other	2.5	0.0	0.0	2.5	2.5	0.0	0.0	2.5

Source: Field survey

5.4 Sources of Information about Recommended Doses of Fertilisers by Control Farmers

The soil test farmers had come to know about recommended doses of fertilizers from various reliable sources as discussed earlier. Therefore, it is important to know about the sources for same to control group farmers. It can be seen from the Table 5.3 that overall around 67 per cent cotton farmers and around 58 per cent groundnut farmers mentioned that they are aware about the recommended doses. Around 65 per cent of farmers had received information on recommended doses of fertliser from the officials of department of agriculture of the state. The other sources were fellow farmer and private input dealer. About one fourth cotton growers received information from fellow farmers whereas more than one fifth groundnut

growers were advised by input dealers. Importantly in both crop groups, two third farmers had received information from authentic source of state agriculture department. This may be due to the fact that this was one of the flagship programmes of state government which was started since 2006 and was made part of agricultural extension system in the state, i.e. Krishi Mahotsav[3]. This programme also includes the officials from four Agricultural Universities of the state. However, no support from NGO or cooperatives in creating awareness about the benefits of applying recommended doses of fertliser has been seen in selected study areas.

Table 5.3: Awareness and Sources of Information about Recommended Doses of Fertilisers by Sample Households (Control Farmers)

(% of farmers)

Sources	Marginal	Small	Medium	Large	Total
Crop I:			Cotton		
% farmers aware	77.78	66.67	48.72	80.00	66.67
Source of information:					
Department of agriculture	71.43	55.56	68.42	66.67	65.00
Agricultural University	0.00	0.00	0.00	0.00	0.00
Cooperatives/Growers' Association	0.00	0.00	0.00	0.00	0.00
Private input dealers	0.00	38.89	5.26	0.00	10.00
Fellow farmers	28.57	5.56	26.32	33.33	25.00
NGO/Others	0.00	0.00	0.00	0.00	0.00
Crop II:			Groundnut		
% farmers aware	91.67	33.33	65.12	80.00	58.33
Source of information:					
Department of agriculture	100.00	66.67	53.57	62.50	65.71
Agricultural University	0.00	0.00	0.00	0.00	0.00
Cooperatives/Growers' Association	0.00	0.00	0.00	0.00	0.00
Private input dealers	0.00	33.33	17.86	37.50	22.86
Fellow farmers	0.00	0.00	28.57	0.00	11.43
NGO/Others	0.00	0.00	0.00	0.00	0.00

Source: Field Survey

[3] The Krushi Mahotsav campaign which is being held since 2006, covered 18,600 villages in June 2009, with 230 'Krushi Raths' (vans) reaching to farmers with Researchers, Scientists, experts, Agriculture officers and Ministers, interacting and providing information and counselling on soil health, organic farming, technology and inputs, irrigation, etc., besides infusing a new spirit of change and mass mobilisation. Every year, during Krushi Mahotsav, the 'Krushi Raths' cover the entire state and visit villages in Gujarat. A multi-disciplinary team of scientists, horticulturists and agriculturists are present on each rath. The raths are a major vehicle for directly promoting scientific farming and improved agricultural practices to the individual farmers within their own villages. A mobile exhibition equipped with posters and pamphlets along with region-specific panels on farming, a drip irrigation system, audio-video system was very attractive for villagers.

5.5 Application of Actual Quantity of Fertilisers

The details on actual quantity of fertilisers applied by the sample farmers during the reference year are presented in Table 5.4 and Table 5.5. It can be seen from the tables that in case of cotton, the selected soil test farmers have applied more quantity of Urea and Potash than control group farmers. Whereas DAP use was much higher by the control farmers than the soil test farmers. The Urea application was more done by the small and medium farm size categories of soil test farmers than control group. It may be seen that the average actual quantity of fertilisers applied by the soil test farmers was more close to the recommended doses compared to that by the control farmers. For example, the average recommended dose of urea (the major fertiliser applied) for total cotton was 215.3 kg/ha or 86.12 kg/acre. The soil test farmers growing cotton have applied about 83.1 kg/acre compared to 71.2 kg/acre by the control farmers.

Table 5.4: Actual Quantity of Fertilisers Applied by the Sample Farmers during the Reference Year (Cotton farmers)

(Kg/Acre)

Fertilisers	Marginal	Small	Medium	Large	Total
Soil Test Farmers					
Urea	75.8	103.2	101.4	55.6	83.1
DAP	41.9	35.5	31.2	25.8	30.8
MOP	2.8	7.2	9.9	1.6	5.8
SSP	7.1	2.2	5.4	0.0	2.8
NPK Mixture	0.0	1.2	11.0	1.5	4.6
Others	0.0	6.6	14.7	14.2	11.8
Control Farmers					
Urea	77.0	100.6	66.8	57.8	71.2
DAP	45.2	79.3	37.9	33.1	45.7
MOP	0.0	2.8	4.3	3.4	3.2
SSP	6.5	1.4	4.5	0.9	2.4
NPK Mixture	6.0	4.9	1.8	0.7	2.4
Others	3.6	0.1	0.1	1.2	0.9

Source: Field survey

Table 5.5: Actual Quantity of Fertilisers Applied by the Sample Farmers during the Reference Year (Groundnut farmers)

(Kg/Acre)

Fertilisers	Marginal	Small	Medium	Large	Total
Soil Test Farmers					
Urea	0.0	9.0	5.4	4.5	6.1
DAP	52.6	32.7	24.0	22.7	29.9
MOP	0.0	2.1	3.5	0.6	2.1
SSP	17.3	29.9	7.5	0.0	15.6
NPK Mixture	5.8	19.1	16.3	20.4	17.0
Others	6.3	7.8	2.1	1.5	4.6
Control Farmers					
Urea	58.5	22.5	13.4	6.5	19.1
DAP	56.2	39.6	36.9	23.0	35.5
MOP	5.7	0.0	0.4	7.2	3.3
SSP	6.5	10.8	8.2	5.8	7.7
NPK Mixture	0.0	4.1	3.6	6.0	4.0
Others	0.0	0.0	3.9	3.2	2.4

Source: Field survey

In case of groundnut, use of DAP was the highest in both categories since this was the key fertiliser recommended for the groundnut. The recommended dose of DAP for total groundnut was 67.7 kg/ha or 27.1 kg/acre. It may be seen from Table 5.5 that the quantity of DAP applied by the soil test farmers (29.9 kg/acre) was more close to the recommended dose compared to that applied by the control farmers (35.5 kg/acre). The control farmers of groundnut was found to apply excess quantity of DAP than the soil test farmers which is harmful to the overall health of soils. Similarly, the use of Urea by the control farmers was also much higher than the recommended dose of Urea for groundnut (13.3kg/ha or 5.3kg/acre). The actual quantity of Urea applied by the soil test farmers and control farmers was 6.1kg/acre and 19.1kg/acre respectively. The control groundnut farmers had also used more quantity of MOP than the soil test farmers, whereas the soil test farmers used less MOP since the recommended dose of MOP was nil for the groundnut farmers. Overall, higher use of fertiliser was found in

control group than soil test farmer. This was mainly because of lack of awareness about benefits of application of recommended doses of fertiliser and harmful effects of overdoses of fertiliser on soil health. This was also due to the belief that application of more fertiliser would lead to more crop yield.

It is surprising to find that the marginal farmers of soil test group (groundnut) did not apply Urea at all, whereas the marginal farmers of control group applied 58.5kg/acre of Urea for groundnut against the recommendation of 5.3kg/acre. This shows the lack of proper knowledge may lead to farmers apply overdose of certain fertiliser that harm the soil health as well as increases the cost of cultivation.

The actual quantity of split doses of fertilisers applied by stages of crop growth during the reference year is presented in Table 5.6 and Table 5.7. It can be seen from the tables that Urea and Complex/NPK fertiliser were used more mostly after intercultural operations for better vegetative growth and flowering of the selected crops. DAP, Potash and other fertilisers were used as basal application, with very smaller quantity used during vegetative growth of the plant.

Table 5.6: Actual Quantity of Split Doses of Fertilizers Applied by Stage of Crop Growth during the Reference Year (Cotton)

(Kg/Acre)

Particulars	Basal application	After inter-cultivation (weeding, thinning etc)	Vegetative growth	Flowering	Grain formation	Total
Soil Test Farmers						
Urea	2.1	22.0	25.8	23.7	9.5	83.1
DAP	29.9	0.6	0.3	0.0	0.0	30.8
MOP	1.8	0.4	0.1	2.6	0.8	5.8
SSP	1.6	0.5	0.7	0.0	0.0	2.8
Complex/ NPK	3.1	0.8	0.0	0.7	0.0	4.6
Others total	6.5	1.3	1.3	2.6	0.1	11.8
Control Farmers						
Urea	4.2	44.5	62.9	49.7	16.7	178.1
DAP	101.9	4.2	4.4	3.7	0.0	114.2
MOP	6.3	0.0	0.0	0.9	0.8	8.0
SSP	2.9	0.0	2.0	0.6	0.5	6.0
Complex/ NPK	2.9	0.8	0.8	1.4	0.0	5.9
Others total	0.8	1.3	0.0	0.0	0.0	2.3

Source: Field Survey

Table 5.7: Actual Quantity of Split Doses of Fertilizers Applied by Stage of Crop Growth during the Reference Year (Groundnut)

(Kg/Acre)

Particulars	Basal application	After inter-cultivation (weeding, thinning etc)	Vegetative growth	Flowering	Grain formation	Total
Soil Test Farmers						
Urea	2.0	1.1	1.2	1.3	0.5	6.1
DAP	28.6	0.9	0.0	0.2	0.2	29.9
MOP	1.1	0.6	0.0	0.4	0.0	2.1
SSP	15.6	0.0	0.0	0.0	0.0	15.6
Complex/ NPK	12.9	2.0	0.1	1.7	0.3	17.0
Others total	4.0	0.3	0.0	0.0	0.2	4.6
Control Farmers						
Urea	3.3	6.8	4.6	4.0	0.3	19.1
DAP	35.5	0.0	0.1	0.0	0.0	35.5
MOP	2.6	0.3	0.3	0.0	0.0	3.3
SSP	7.7	0.0	0.0	0.0	0.0	7.7
Complex/ NPK	3.9	0.0	0.1	0.0	0.0	4.0
Others total	0.4	1.4	0.0	0.0	0.6	2.4

Source: Field Survey

5.6 Method of Application of Chemical Fertilisers by Sample Farmers

It has been observed that applying fertilizers causes many changes in the soil, including chemical changes that can positively or negatively influence its productivity. Only a fraction of the fertilizer applied to the soil is taken up by the crop, the rest either remains in the soil or is lost through leaching, physical wash-off, fixation by the soil, or release to the atmosphere through chemical and microbiological processes. The critical information on the relative merits of different methods of fertilizer application is essential. The methods of application of fertiliser adopted by the sample farmers are presented in Table 5.8 and Table 5.9. It can be seen from the tables that line application of fertiliser was adopted by most of the farmers, followed by broadcasting, dibbling as well as fertigation[4] method of fertiliser application. The application of fertiliser through foliar[5] spray was adopted by very few number of cotton farmers.

[4] Fertigation is a method of fertilizer application in which fertilizer is incorporated within the irrigation water by the drip system. In this system fertilizer solution is distributed evenly in irrigation. The availability of nutrients is very high; therefore, the efficiency is more. In this method liquid fertilizer as well as water soluble fertilizers are used. By this method, fertilizer use efficiency is increased from 80 to 90 per cent.

[5] This refers to the spraying on leaves of growing plants with suitable fertilizer solutions. These solutions may be prepared in a low concentration to supply any one plant nutrient or a combination of nutrients.

Table 5.8: Method of Application of Chemical Fertilizers (Cotton)

(% of farmers)

Method	Urea	DAP	SSP	Potash	Mixture/NPK	Any Other
Soil Test Farmers						
Percentage farmers applied fertiliser:	80.83	76.67	6.67	17.50	6.67	23.33
Methods followed:						
Broadcasting	11.00	0.91	0.00	0.00	6.67	0.00
Dibbling	6.00	41.82	7.14	5.88	6.67	6.67
Fertigation	5.00	0.00	28.57	17.65	6.67	33.33
Line application	78.00	57.27	64.29	76.47	80.00	46.67
Spraying	0.00	0.00	0.00	0.00	0.00	13.33
Total	100.00	100.00	100.00	100.00	100.00	100.00
Control Farmers						
Percentage farmers applied fertiliser:	86.25	87.50	13.75	12.50	6.25	6.25
Methods followed:						
Broadcasting	10.00	0.00	16.67	0.00	0.00	0.00
Dibbling	8.75	27.27	16.67	25.00	60.00	0.00
Fertigation	1.25	2.60	16.67	0.00	0.00	20.00
Line application	80.00	70.13	50.00	75.00	40.00	80.00
Spraying	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00

Source: Field Survey

Table 5.9: Method of Application of Chemical Fertilizers (Groundnut)

(% of farmers)

Method	Urea	DAP	SSP	Potash	Mixture/NPK	Any Other
Soil Test Farmers						
Percentage farmers applied fertiliser:	14.17	65.83	12.50	8.33	30.83	13.33
Methods followed:						
Broadcasting	27.27	0.00	0.00	20.00	0.00	0.00
Dibbling	18.18	36.36	33.33	0.00	50.00	16.67
Fertigation	0.00	1.30	0.00	0.00	2.94	16.67
Line application	54.55	62.34	66.67	80.00	47.06	66.67
Spraying	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00
Control Farmers						
Percentage farmers applied fertiliser:	31.25	73.75	8.75	10	11.25	1.25
Methods followed:						
Broadcasting	11.11	1.64	0.00	25.00	0.00	0.00
Dibbling	7.41	49.18	0.00	0.00	58.33	0.00
Fertigation	0.00	1.64	0.00	0.00	0.00	100.00
Line application	81.48	47.54	100.00	75.00	41.67	0.00
Spraying	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00

Source: Field Survey

5.7 Use of Organic Fertilisers

The use of organic fertilizers by sample farmers is presented in Table 5.10 and Table 5.11. It can be seen from the tables that as expected most of cotton as well as groundnut growers had used farm yard manure (FYM). Among cotton farmers, about 84.2 per cent of soil test farmers and 93.8 per cent of control farmers applied FYM on their soil. About 49.8 per cent of net cropped area of soil test farmers was covered with FYM. The use of other organic fertilisers was found very meager in total in both the crops. The easy availability and relatively low price of the FYM may be the reason behind high and dominant use of it in crop cultivation.

Table 5.10: Use of Organic Fertilizers by the Sample Farmers (Cotton)

Particulars	Farm yard manure	Vermi-compost/Biogas waste	Bio-fertilizer	Green manure	Other organic manure
Soil Test Farmers					
% farmers applied	84.2	0.0	7.5	5.0	0.0
Quantity applied (Kg/Ha)	6926.1	0.0	39.8	25.6	0.0
Price (Rs/kg)	2.5	0.0	223.3	17.0	0.0
Area covered (ha/household)	2.1	0.0	0.5	0.1	0.0
Area covered (% of net cropped area)	49.8	0.0	12.7	1.9	0.0
Control Farmers					
% farmers applied	93.8	0.036	0.032	0.0	7.5
Quantity applied (Kg/Ha)	5929.7	1730.0	625.0	0.0	29.9
Price (Rs/kg)	2.1	3.0	200.0	0.0	176.5
Area covered (ha/Household)	1.6	0.0	0.0	0.0	1.9
Area covered (% of net cropped area)	40.8	1.0	0.8	0.0	48.2

Source: Field Survey

Among groundnut farmers, about 80.8 per cent of soil test farmers and 85.0 per cent of control farmers applied FYM on their soil. About 57.2 per cent of net cropped area of soil test farmers growing groundnut was covered with FYM. It may be noted that other kind of organic fertiliser such as vermin compost/biogas waste, biofertiliser and green manure have not been promoted to the desirable extent. It is clear from the fact that none of the groundnut growers used vermin compost and only 0.8 per cent of soil test farmers and none of control farmers of groundnut group used green

manure. Similar was the case of cotton farmers. None of soil test farmers and only 0.04 per cent of control farmers of cotton group could use vermin-compost and only 5 per cent of soil test farmers and none of the control farmers used green manure.

Table 5.11: Use of Organic Fertilizers by the Sample Farmers (Groundnut)

Particulars	Farm yard manure	Vermi-compost/Biogas waste	Bio-fertilizer	Green manure	Other organic manure
Soil Test Farmers					
% farmers applied	80.8	0.0	2.5	0.8	0.8
Quantity applied (Kg/Ha)	7304.2	0.0	1.4	6.3	302.2
Price (Rs/kg)	2.8		288.0	500.0	180.0
Area covered (ha/household)	1.5	0.0	0.1	0.0	0.0
Area covered (% of net cropped area)	57.2	0.0	2.7	0.2	1.2
Control Farmers					
% farmers applied	85.0	0.0	1.3	0.0	0.0
Quantity applied (Kg/Ha)	5660.0	0.0	4.8	0.0	0.0
Price (Rs/kg)	3.0	0.0	91.0	0.0	0.0
Area covered (ha/household)	1.6	0.0	0.0	0.0	0.0
Area covered (% of net cropped area)	51.6	0.0	1.2	0.0	0.0

Source: Field Survey

5.8 Sources of Fertilisers Purchased

The details on fertilizers purchased by the sample households are presented in Table 5.12 and Table 5.13. The major sources of fertilisers purchased by the farmers were private fertilizer shops/dealers and co-operative societies for both categories of farmers. About 49.0 per cent of soil test farmers and 51.1 per cent of control farmers purchased fertiliser from private fertilizer shops/dealers. About 46.2 per cent of soil test farmers and 39.1 per cent of control farmers purchased fertiliser from co-operative societies.

Table 5.12: Sources of Purchase of Fertilizers

(% of farmers)

Sources	Marginal	Small	Medium	Large	Total
Soil Test Farmers					
Private fertilizer shops/dealers	68.18	42.77	45.85	55.56	48.98
Company authorized dealers	0.00	1.20	0.00	1.59	0.74
Co-operative societies	29.55	49.40	50.73	40.48	46.21
Government agency	2.27	10.24	4.39	3.97	5.91
Others	0.00	0.00	0.98	2.38	0.92
Total	100.00	103.61	101.95	103.97	102.77
Control Farmers					
Private fertilizer shops/dealers	51.35	50.00	50.49	52.11	51.14
Company authorized dealers	0.00	1.47	5.83	0.00	2.00
Co-operative societies	45.95	44.12	33.98	38.73	39.14
Government agency	0.00	4.41	27.18	9.86	12.86
Others	2.70	0.00	2.91	3.52	2.57
Total	100.00	100.00	120.39	104.23	107.71

Source: Field Survey

Table 5.13: Quantity of Fertilizer Purchased by the Sample Farmers

(Per cent of total quantity of respective fertiliser)

Sources	Urea	DAP	SSP	Potash	Complex /NPK	Bio-fertiliser	Micro nutrients
Soil Test Farmers							
Private fertilizer shops/dealers	47.3	55.9	53.1	62.6	9.4	58.1	94.9
Company authorized dealers	0.7	1.5	0.0	0.0	0.0	0.0	0.0
Co-operative societies	51.4	36.9	33.1	37.4	90.5	41.9	4.0
Government agency	0.4	5.5	13.1	0.0	0.0	0.0	0.7
Others	0.2	0.3	0.7	0.0	0.1	0.0	0.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Control Farmers							
Private fertilizer shops/dealers	57.1	48.8	12.8	61.4	34.0	69.0	93.7
Company authorized dealers	1.4	2.2	2.2	0.0	0.0	0.0	1.2
Co-operative societies	23.8	31.4	7.3	8.3	23.0	25.4	1.9
Government agency	13.1	13.7	77.7	25.2	13.1	5.6	3.1
Others	4.6	3.9	0.0	5.0	29.9	0.0	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Field Survey data.

The analysis on source-wise purchases of various fertiliser products reveals that about 47.3 per cent of Urea, 55.9 per cent of DAP, 62.6 per cent of SSP, 58.1 per cent of bio-fertilisers were purchased from the private fertilizer shops/dealers by the soil test farmers. The majority of soil test farmers also purchased micronutrients and magnesium from the private fertilizer shops/dealers. However, 90.5 per cent complex fertilisers including NPK mixtures were purchased from cooperative societies by the soil test farmers. On the other hand, about 57.1 per cent of Urea, 48.8 per cent of DAP, 12.8 per cent of SSP and 69.0 per cent of bio-fertilisers were purchased from the private fertilizer shops/dealers by the control farmers. About 77.7 per cent of SSP was purchased from government agencies by the control farmers.

The average price of fertilisers and the cost incurred in transportation of fertilisers are presented in Table 5.14. No much difference was observed between the soil test farmers and the control farmers with regard to prices and transport costs involved in fertiliser use. In the case of soil test farmers, the average transport cost varied from Rs 0.05 to 0.31 per kilogram of fertiliser bought from various places; whereas, in the case of control farmers, the average transport cost varied from Rs 0.09 to 0.35 per kilogram of fertiliser bought.

Table 5.14: Average Price of Fertilisers and Transport Cost Incurred

(Rs/kg)

Fertiliser type	Soil Test farmers		Control farmers	
	Average Price	Transport cost	Average Price	Transport cost
Urea	6.20	0.30	6.26	0.20
DAP	24.0	0.20	23.80	0.18
SSP	8.40	0.31	10.47	0.35
Potash	17.40	0.18	16.79	0.19
Complex/NPK	23.80	0.10	20.44	0.20
Bio-fertilisers (Rhizobium etc)	32.00	0.10	35.50	0.11
Micronutrients (sulphur, zinc, Magnesium)	41.14	0.08	46.50	0.21
Others	27.80	0.05	10.40	0.09

Source: Field Survey

5.9 Training Programmes Attended

The details on training programme attended on application of chemical fertilisers by the sample farmers are presented in Table 5.15. It can be seen from the table that about 6.5 per cent of soil test farmers had attended training programmes of around two days while the corresponding figure for control farmer group was about 4.1 per cent with duration of training programme of about three days.

Table 5.15: Training Programmes Attended on Application of Chemical Fertilisers by the Sample Farmers

Particulars	Marginal	Small	Medium	Large	Total
Soil Test Farmers (cotton+groundnut)					
Average number of trainings attended	1.00	1.25	1.05	1.06	1.02
% of farmers attended	2.92	6.67	9.17	7.08	6.46
Average number of days	4.14	1.65	2.17	1.82	2.16
Control Farmers(cotton+groundnut)					
Average number of trainings attended	1.25	1.25	1.00	1.00	1.04
% of farmers attended	3.13	2.50	5.00	5.63	4.06
Average number of days	1.00	0.00	0.00	5.00	3.00

Source: Field Survey

5.10 Summary of Chapter

The level of adoption of recommended doses by the soil test farmers was found to be around 40 per cent for both cotton and groundnut farmers. About 50.0 per cent of farmers of cotton and 72.5 per cent of soil test farmers of groundnut have expressed their willingness to continue the same practices to maintain the better soil health and to get the better yields. Among the Cotton growers, the maximum adoptability was found in the case of small farmers (45.7%) and minimum adoptability was observed in the case of marginal farmers (28.6%). In contrast, in the case of groundnut crop, the maximum adoptability was found in the case of large farmers (45.0%) and minimum adoptability was observed in the case of small farmers (37.8%).

The soil test farmers have faced several difficulties in applying the recommended doses of fertiliser as well. Among these constraints, difficulty

in understanding and following application of recommended doses, unavailability of technical advice on method and time of fertiliser application, high prices of fertilisers and unavailability of required fertilisers in adequate quantity were the major ones.

The data on actual quantity of fertilisers applied by the sample farmers during the reference year shows that, in case of cotton, the selected soil test farmers have applied more quantity of Urea and Potash than control group farmers. Whereas DAP use was much higher by the control farmers than the soil test farmers. The Urea application was more done by the small and medium farm size categories of soil test farmers than control group.

The average actual quantity of fertilisers applied by the soil test farmers was more close to the recommended doses compared to that by the control farmers. For example, the average recommended dose of urea (the major fertiliser applied) for total cotton was 215.3 kg/ha or 86.12 kg/acre. The soil test farmers growing cotton have applied about 83.1 kg/acre compared to 71.2 kg/acre by the control farmers.

The use of organic fertilizers by sample farmers indicates that as expected most of cotton as well as groundnut growers had used farm yard manure. About 84.2 per cent of soil test farmers and 93.8 per cent of control farmers applied FYM on their soil. Among groundnut farmers, about 80.8 per cent of soil test farmers and 85.0 per cent of control farmers applied FYM on their soil. The use of other organic fertilisers was found very meager in total in both the crops.

The major sources of fertilisers purchased by the farmers were private fertilizer shops/dealers and co-operative societies for both categories of farmers. The majority of soil test farmers also purchased micronutrients and magnesium from the private fertilizer shops/dealers by the soil test farmers. No much difference was observed between the soil test farmers and the control farmers with regard to prices and transport costs involved in fertiliser use. As far as the training received by the farmers is concerned, about 6.5 per cent of soil test farmers had attended training programmes of

around two days while the corresponding figure for control farmer group was about 4.1 per cent with duration of training programme of about three days.

Chapter VI

Impact of Adoption of Recommended Doses of Fertilisers

6.1 Background

The adoption of recommended doses is believed to benefit the farmers in terms of improvement in yield, net returns and better soil health. In this chapter, an attempt has been made to examine these aspects. The changes observed after the application of recommended doses of fertilisers on reference crops have been analysed in detail.

6.2 Productivity of Reference Crops among the Sample Households

The adoption of recommended doses of fertiliser can be seen in terms of increase in crop yield in both the crops. The average yield of groundnut was found to be more in the case of soil test farmers by 13.3 per cent over control farmers (Table 6.1). Similarly, the soil test group of cotton farmers realized better average yield by 9.6 per cent compared to the control group. Thus, overall yield impact was better in case of groundnut farmers compared to cotton farmers.

As far as increase in average value of output per acre is concerned, cotton farmers recorded better increase, i.e., by about 25.4 per cent increase mainly because of the better price the realized; whereas the groundnut farmers have recorded an increase in average value of output by 13.5 per cent. Thus, overall returns on crop output realised was better in case of cotton farmers compared to groundnut farmers.

As such we cannot draw one to one relation between soil testing and increase in yield and net returns, it was expected that at least returns would be more in view reduction in cost of cultivation due to balance use of

fertiliser. However, the field data did not support the same. The picture is more confusing if we look at the land holding size-wise results.

Table 6.1: Productivity of the Sample Crops during the Reference Year

Particulars	Average Yield (Quintal/Acre)			Average value of output (Rs/Acre)		
	Soil test Farmers	Control farmers	% difference in yield	Soil test Farmers	Control farmers	% difference in yield
Cotton						
Marginal	7.9	9.5	-16.4	38805.1	45355.0	-14.4
Small	10.0	8.6	15.9	49601.1	43251.7	14.7
Medium	8.6	8.0	7.5	40986.2	31361.1	30.7
Large	7.8	7.0	11.2	33458.4	23827.3	40.4
Total	8.6	7.8	9.6	39974.4	31870.7	25.4
Groundnut						
Marginal	8.8	4.3	103.3	28188.0	13555.9	107.9
Small	8.7	7.2	20.7	28630.2	23135.6	23.7
Medium	7.7	7.8	-2.2	23677.5	24762.8	-4.4
Large	8.1	8.0	2.2	25173.5	25384.4	-0.8
Total	8.2	7.3	13.3	26235.2	23118.8	13.5

Source: Field Survey

6.3 Impact of Application of Recommended Doses of Fertilisers on Reference Crops (before and after)

It would be important to see the impact of application of recommended doses of fertiliser on yield of particular crop, i.e. change in crop yield after application of recommended doses of fertilizers. It was observed that the selected farmers had realized better crop may be because of adoption of recommended doses of fertiliser. As presented in Table 6.2, the yield level of groundnut and cotton has increased by 23.8 per cent and 22.9 per cent respectively. However, among the marginal cotton farmers, increase in yield level was lower compared to other farmers. Among groundnut farmers, the marginal and small farmers had realized better yield level over other categories of farmers. They have realized maximum of about 20.4 per cent

and 41.8 per cent increase in yield, respectively, after the adoption of recommended doses of fertiliser.

Table 6.2: Impact of Application of Recommended Doses of Fertilizers on Crop Yield (Soil Test Farmers)

Particulars	Average yield (Quintal/Acre)		% change in yield
	Before	After	
Cotton			
Marginal	7.3	7.9	9.3
Small	7.6	10.0	32.6
Medium	6.6	8.6	31.5
Large	6.6	7.8	18.3
Total	7.0	8.6	22.9
Groundnut			
Marginal	7.3	8.8	20.4
Small	6.1	8.7	41.8
Medium	6.6	7.7	15.4
Large	6.9	8.1	17.5
Total	6.7	8.2	23.8

Source: Field survey

In addition to increase in crop yield, several other changes have been observed after the application of recommended doses of fertilisers on reference crops by the sample farmers (Table 6.3). Improvement in soil texture, improvement in crop growth, improvement in grain filling, decrease in application of other inputs like seed, labour, pesticide etc. and fewer incidences of pest and diseases were the major benefits experienced by the sample farmers.

Table 6.3: Changes Observed after the Application of Recommended Doses of Fertilisers on Reference Crops (Soil Test Farmers)

(% of farmers)

Particulars	Cotton				Groundnut			
	Most Important	Important	Least Important	Total	Most Important	Important	Least Important	Total
Increase in crop yield	29.2	12.5	4.2	45.8	28.3	22.5	3.3	54.2
Improvement in soil texture	12.5	14.2	15.0	41.7	26.7	20.0	10.8	57.5
Improvement in crop growth	10.0	15.8	12.5	38.3	14.2	15.0	9.2	38.3
Improvement in grain filling	28.3	25.0	8.3	61.7	40.8	8.3	7.5	56.7
Less incidence of pest and diseases	11.7	5.0	3.3	20.0	14.2	4.2	6.7	25.0
Decrease in application of other inputs like seed, labour, pesticide etc.	29.2	12.5	4.2	45.8	28.3	22.5	3.3	54.2

Field survey data.

6.4 Summary of the Chapter

The adoption of recommended doses is believed to benefit the farmers in terms of improvement in yield, net returns and better soil health. As such we cannot draw one to one relation between soil testing and increase in yield and net returns. The soil test farmers were found to realize better yield over the control farmers. The average yield of groundnut was found to be more in the case of soil test farmers by 13.3 per cent over control farmers. Similarly, the soil test group of cotton farmers realized better average yield by 9.6 per cent compared to the control group.

The study finds that the farmers have realized better yield because of adoption of recommended doses of fertiliser. The analysis of crop yield before and after soil tests revealed that the yield level of groundnut was increased by 23.8 per cent and by 22.9 per cent in case of cotton. However, among the marginal cotton farmers, increase in yield level was lower compared to other farmers. However, among groundnut farmers, the marginal and small farmers had realized better yield level over other categories of farmers. They have realized maximum of about 20.4 per cent and 41.8 per cent increase in yield, respectively, after the adoption of recommended doses of fertiliser.

In addition to increase in crop yield, several other changes have been observed after the application of recommended doses of fertilisers on reference crops by the sample farmers. Improvement in soil texture, improvement in crop growth, improvement in grain filling, decrease in application of other inputs like seed, labour, pesticide etc. and fewer incidences of pest and diseases were the major benefits experienced by the sample farmers.

Chapter VII

Summary and Conclusions

7.1 Introduction

India's agricultural sector has undergone considerable changes since the introduction of high yielding varieties in the mid-1960s which has resulted in tremendously increase in fertiliser use so as to enhance crop output and farmers' income. The all-India average consumption of fertilisers increased from 6.9 kg per ha of gross cropped area in 1966-67 to 125.39 kg per ha in 2013-14. The indiscriminate use of chemical fertilisers by farmers has led to deterioration of soil structure, wastage of nutrients, destruction of soil microorganisms and scorching of plants at the extreme cases.

The Government of India has undertaken initiatives to encourage the farmers for balanced use of fertilisers. Among various states of India, Gujarat has been a leading state in streamlining these programmes, among which Soil Health Card Programme is a major one. However, there is no systematic study undertaken so far for evaluating the effectiveness of the programme on crop productivity, extent of soil testing for nutrient deficiency and adoption of recommended doses of fertilisers by different categories of farmers based on the soil tests. Among different farmer categories, except some progressive farmers, the level of adoption of recommended doses of fertiliser is expected to be low among small and marginal farmers due to several constraints. Therefore, the present study examines the level of adoption and constraints in the application of recommended doses of fertilisers by small and marginal farmers, impact on crop productivity and relevant institutional problems faced by these farmers in Gujarat, India.

The specific objectives of the study are as follows:

- To examine the level of adoption and its constraints in the application of recommended doses of fertilisers based on soil test reports by the farmers in Gujarat.
- To analyse the impact of adoption of recommended doses of fertilisers on crop productivity and income of farmers in the state.

The present study is based on both secondary and primary level data.

The primary data were collected from the four selected districts of Gujarat in India covering the reference year 2013-14. The farmers who got their soil tested during the last three years (2010-11 to 2012-13) were included for the detailed analysis. The two major crops grown in the state (groundnut and cotton) were selected for the detailed study. The household survey was administered on 400 farmers from 8 talukas of four districts. The selected districts of Gujarat were Surendranagar and Rajkot for cotton and Jamnagar and Junagadh for groundnut. For each study crop, the experiment was conducted following a cluster approach on a sample of 80 control farmers (no soil test) and 120 soil test farmers for assessing the extent of adoption of recommended dose of fertilisers and its impact on crop production. So that the total sample size of the study for two selected crops was 400. The cluster approach was followed to ensure that adequate number of soil test farmers is available for the survey. The multistate sampling method was used to select the districts, blocks and farm households. At first stage, four districts Surendranagar and Rajkot for Cotton and Jamnagar and Junagadh for groundnut) of Gujarat were selected on the basis of the average area under crops during the last three years (TE 2011-12). At second stage, 16 villages from 8 blocks of four study districts were selected. At third stage, 400 sample households representing different farm categories (MF: Marginal farmers (0-2.5 Ac); SF: Small farmers (2.5-5.0 Ac); MDF: Medium farmers (5.0- 10 Ac); LF: Large farmers (>10 Ac)) were selected for the survey. The sample farmers were classified into different farm size groups post-survey as per the size of net operated area.

7.2 Fertiliser Consumption in Gujarat

The increase in fertiliser use was one of the major factors that changed the complexion of agriculture since Green Revolution Period. More adoption of HYV seeds was supported by increased application of chemical fertilisers to raise agricultural output substantially across the country. The per hectare consumption of fertiliser is found to be highest in western states of country. Gujarat has experienced the substantial increase in fertiliser use during the period of post green revolution (1966-1985); and also during the period of wider technology dissemination (1985-2000). The consumption of NPK in the state has increased from 3.57 lakh metric tonnes in 1980-81 to 15.65 lakh metric tonnes in 2013-14, implying an increase by 4.4 times. The NPK consumption per hectare of GCA has also increased by about 4 times, from 32.6 kg in 1980-81 to 127.7 kg in 2013-14.

It is worth mentioning that per hectare consumption of fertiliser has declined since 2010-11, when it was 138.1 kg/ha. The decline in fertiliser consumption during the later period may be partly due to increased awareness generated by the Soil Health Card (SHC) programme in the state about the negative consequences of application of overdoses of fertiliser and positive effects of balanced fertiliser application on soil health.

A wide variation is observed across districts in Gujarat with regard to per hectare consumption of NPK during 2013-14. The top five districts with high consumption of fertilisers were Surat (300.6 kg/ha), Navsari (287.8 kg/ha), Rajkot (218.5 kg/ha) and Anand (207.5 kg/ha). Some of the districts with low level of consumption of fertilisers were Dangs (4.9 kg/ha), Patan (61.9 kg/ha), Kutch (70. 1 kg/ha), Surendranagar (85.1 kg/ha) and Banaskantha (85.15 kg/ha). Almost half of the districts (16 districts, viz. Surat, Navsari, Rajkot, Anand, Bhavnagar, Kheda, Bharuch, Valsad, Junagadh, Vadodara, Gandhinagar, Amreli) have recorded higher use of fertiliser than state average of 127.65 kg/ha. It indicates the variation in use of fertiliser across the districts in the state.

Among various fertilisers, per hectare consumption of Urea and SSP has increased by a compound annual growth rate (CAGR) of 4.5 per cent and

6.4 per cent respectively, during a period of 2006-07 to 2013-14. Per hectare consumption of Urea and SSP has increased from 119.4 kg/ha and 7.2 kg/ha in 2006-07 to 162.7 kg/ha and 11.2 kg/ha in 2013-14. On the other hand, the per hectare consumption of DAP, MOP and AS has been reduced in the state, at the rate of 0.2 per cent, 2.69 per cent and 4.1 per cent respectively during the corresponding period. It is worth-mentioning here is that the use of complex fertilisers has increased by 3.6 per cent annually. Per hectare consumption of complex fertilisers has increased from 26.5 kg/ha in 2006-07 to 33.8 kg/ha in 2013-14.

7.3 Soil Health Card Programme in Gujarat

Gujarat is the leading state in India in streamlining the Soil Health Card (SHC) Programme for the benefit of farmers at the grass-root level. So far, a total of 53.69 lakh soil health cards have been generated and given to farmers by the end of 2013-14. Out of which, 6.26 lakh soil health cards have been distributed in the year 2013-14 alone (Table 7.1). The programme has generated alternative crop planning and recommendations for 229 Talukas and 24324 villages and generated all Talukas and Villages Model Action Plans.

Table 7.1: No. of SHCs made available to farmers

Year	No. of SHCs made available to farmers (in lakh)	
	No. of SHCs -during the year	Total No. of SHCs (Cumulative)
2004-05	2.274	2.274
2005-06	4.922	7.196
2006-07	2.492	9.688
2007-08	2.190	11.878
2008-09	5.686	17.564
2009-10	1.000	18.564
2010-11	12.800	31.364
2011-12	7.062	38.426
2012-13	9.001	47.427
2013-14	6.264	53.691

Source: Department of Agriculture, Government of Gujarat, Gandhinagar

Along with increase in number of SHCs distributed to farmers from 2.27 lakh in 2004-05 to 53.69 lakh in 2013-14, the number of soil testing labs (STL) has also increased from 20 in 2004-05 to 134 in 2013-14 at the rate of 17.9 per cent per annum. Similarly, the annual soil sample analyzing capacity has increased from 2.34 lakh in 2004-05 to 10.3 lakh in 2013-14. The actual soil sample analyzed has increased at the rate of 10.0 per cent per annum, i.e. from 3.23 lakh in 2004-05 to 7.64 lakh in 2013-14.

7.4 Summary of Findings from Field Data

7.4.1 Socio-Economic Characteristics of Sample Households

- The household level analysis was conducted following a cluster approach on a sample of 160 control farmers (non-soil test) and 240 soil test farmers for two study crops (cotton and groundnut) for assessing the extent of adoption of recommended doses of fertilisers and their impacts on crop production and productivity. Among the farmers, the marginal and small farmers together constituted about 37.9 per cent of total soil test farmers and 31.9 per cent of total control farmers. Thus, the majority of the sample households were the medium and large farmers.

- The age of respondent selected farmer household was 47.3 years with education 7.1 years. The agriculture formed the main source of occupation for about 99.5 per cent of sample households. The average family size for soil test farmers and control farmers was 5.6 and 5.9 respectively. The average number of people engaged in agriculture was 2.9 per household and the average years of experience in farming was 26.8 years among soil test farmers and 23.5 years among control farmers. The majority of sample households belonged to general castes (60%) and other backward castes (36.5%). The average level of literacy among the sample farmers was much better (about 88 per cent).

- The average size of land holding of all sample households was 8.7 acre per household, out of which about 70 per cent land was irrigated (6.0

acre) and remaining 30 per cent land (2.7 acre) was un-irrigated. In the case of soil test farmers, the average size of land holding was found to be 8.5 acre per household, out of which 5.9 acre was irrigated and 2.6 acre was un-irrigated. The ratio of area irrigated in soil test farmers was almost same as found in all sample households. In the case of control farmers, the average size of land holding was 8.95 acre per household, out of which 6.3 acre was irrigated and 2.65 acre was un-irrigated. In case of cotton group of farmers, average size of land holding was found to be 10.25 acres per household, out of which 6.23 acres of land was irrigated and 4.03 acre was un-irrigated.

- The gross cropped area for soil test farmers and control farmers was 12.20 acre and 12.18 acre respectively. The cropping intensity for soil test farmers and control farmers was estimated to be 143.78 per cent and 136.03 per cent respectively. Thus, cropping intensity for soil test farmer was slightly higher than control group.
- The crop-wise data shows that the gross cropped area of cotton group of farmers was much higher (15.33 acre per HH) than the groundnut group of farmers (9.18 acre per HH). Therefore cropping intensity was much higher (149.5%) for the cotton farmers compared to groundnut farmers (129.2%). Among the selected farmers, the land leased-in tendency was found significant in case of soil test farmers than control group farmers.
- Among the sources of irrigation, open wells and dug wells were the major sources for all categories of sample households, which constituted about 57.6 per cent followed by bore wells (38.6 per cent). Thus, groundwater was the main source of irrigation for the selected sample households.
- Among the selected crops, the GCA of cotton group of farmers was almost one and half time higher than that of groundnut group of farmers. The proportion of area under more remunerative Rabi crops

was also found to be higher (31.4% of GCA) in case of cotton growers as compared to groundnut farmers (20.7% of GCA).

- For cotton farmers, around 60 per cent cropped area was in kharif season and remaining area was covered under rabi crops. The area under kharif crop for groundnut farmers was much higher (76.7%). Among the Kharif crops grown by cotton farmers, cotton (41.7%), kharif oilseeds such as castor (5.1%) and groundnut (3.8%), jowar (3.5%) were the major crops. Among the Rabi crops grown by cotton farmers, wheat (11.7%), cumin (12.3%) were the major crops. Total summer crops contributed about 8.1 per cent of GCA of cotton growers.
- Among the Kharif crops grown by groundnut farmers, groundnut (56.8%) and cotton (16.8) were the major crops. Among the Rabi crops grown by groundnut farmers, wheat (5.7%), cumin (5.3%) and gram (4.1%) were the major crops. Total summer crops contributed only about 2.3 per cent of GCA of groundnut growers.
- The area under HYV crops under both crops category was found to be much less. The HYV area under kharif groundnut, kharif cotton and wheat was relatively better for both soil test and control farmers. The HYV area under kharif groundnut, kharif cotton and wheat for soil test farmers was 36.3 per cent, 21.3 per cent and 10 per cent, respectively.
- It was surprising to note that the control farmers under cotton crop category had received better returns per acre (Rs. 41006) over soil test farmers (Rs. 33122). However, the reverse was found in the case of groundnut farmers. The value of output per acre for groundnut farmers was Rs. 30525 for soil test group and Rs. 24665 for control group.
- The cotton growers were more mechanized as compared to groundnut growers. That to soil test farmers in cotton crop were more mechanized than control group farmers. The tractor with trolley, diesel engine, drip and sprinkler systems of irrigation was found higher with significant than its counterpart. However, in case of

groundnut growers, except number of sprinkler and diesel engines, the control group farmers dominate the moderation of agriculture than soil test farmers. Thus, totally opposite situation of cotton grower could be seen in case of groundnut growers.

- The institutional finance was the major source of credit for cotton as well groundnut growers and no amount was taken as credit from non-institutional sources. The credit was taken to meet the seasonal crop cultivation expenditures.

7.4.2 Soil Testing and Recommended Doses of Fertilisers

- The cost of soil test was nil for all soil test farmers since it was provided by the free of cost by the Government (Table 7.2). Some of the progressive farmers were also provided the detailed soil test analysis by the cooperatives through private soil testing labs. However, the average distance travelled to soil test lab (STL) by the groundnut farm households (129.3 km) was more than doubled the distance travelled by cotton farm households (49.4 km). Among groundnut farmers, the distance to STL was highest (151.9 km) for the medium farmers.

Table 7.2: Details of Soil Testing by Sample Farmers

Particulars	Cotton	Groundnut
% of farmers tested their soil in the last three years	100.00	100.00
Average cost of soil testing (Rs/sample)	0.00	0.00
Average distance from field to soil testing lab (kms)	49.39	129.30
Average number of soil samples taken per plot	4.93	4.77
Average no. of plots considered for soil testing	1.27	1.14
Av area covered under soil test (Acre)	5.90	4.37
Area covered as % of net operated area	56.59	66.76
% of farmers who collected samples themselves	40.83	36.67
% of soil sample collected by the department officials	59.17	63.33

Source: Field survey

- It was very surprising to note that about 40.8 per cent of cotton farmers and 36.7 per cent of groundnut farmers collected the soil samples by themselves. The collection of soil sample is scientific and systematic process which requires the training of same. Thus, the trained staff should have been collected all soil sample to have correct results about soil health. The remaining around 60 per cent of total soil samples were taken by the department officials. The selected farmers opined that inadequate number of STLs has severely affected the quality of testing service provided to them by these agencies.
- The major sources of information about the SHC programme were the government officials at grass root level (Gram Sevek, Gram Mitra and Extension Officers). About 95 per cent of all farmers were appraised by these government officials. The friends, neighbours and fellow farmers were the next major sources of information for the sample farmers.
- The farmers had shown keen interest in getting their soil tested for several reasons. The major motivating factors towards soil testing were to increase crop yield, adoption of new technological practices, motivation from village demonstration/training/exposure visits to places with best farming practices. Thus both group farmers got motivated with the information they received about the benefit of testing of soil in crop production.
- There are some farmers who had not tested their farm soil. It is because of the fact that spread of SHC programme was restricted and thus due to lack of awareness among the farmers, some farmers left out. Among non-soil test farmers, about 86.3 per cent farmers expressed that they are not aware about how to draw soil sample, about 79 per cent farmers mentioned that they do not know whom to contact for details on testing. Thus, lack of awareness, interest and low level of education has kept away around 81 per cent sample control farmers from soil test.

- The results of soil test indicated that average soil quality of farm plots of sample farmers was very poor in terms of nitrogen and phosphorus content. Only about 1.7 per cent farms of cotton growers and 2.8 per cent of groundnut growers were found to have normal nitrogen level. Only about 6.3 per cent of farm plots of cotton growers and 2.1 per cent of groundnut growers were found to have normal Phosphorus level. About 11.4 per cent farm plots of cotton growers and 14.9 per cent of groundnut growers were found to have normal level of potassium. The pH value was found to be normal in sufficient number of cases (90.8% for cotton and 100% for groundnut).
- The poor soil health has been mainly due to unbalanced use/doses of fertiliser application. Thus, it is necessary to adopt the recommended doses of fertiliser for maintaining better soil health. However, the recommended doses of fertiliser depend on many factors such as soil type, variety and sowing time of the crop.
- The average quantities of recommended dose of fertilisers given based on soil test (as reported in the farmers' SHC) for the two study crops indicated that, for cotton, the major fertilisers recommended were Urea and FYM. The quantity of Urea recommended for HYV irrigated cotton, HYV unirrigated cotton and local cotton were 153.7kg/acre, 69.8kg/acre and 34.9kg/acre, respectively. The FYM recommended for all types of cotton was 4.0 tonne/acre. In the case of Groundnut, the major fertilisers recommended were Urea, DAP and FYM. The average quantities of Urea, DAP and FYM recommended for summer groundnut were much higher than that for kharif groundnut. The average quantities of Urea, DAP and FYM recommended for summer groundnut were 7.0kg/ha, 37.1kg/acre and 4.0 tonne/acre, respectively. On the other hand, the average quantities of Urea, DAP and FYM recommended for kharif groundnut were only 3.5kg/acre, 17.6kg/acre and 4.0 tonne/acre, respectively.

7.4.3 Adoption of Recommended Doses of Fertilisers and Its Constraints

- The level of adoption of recommended doses by the soil test farmers was found to be around 40 per cent for both cotton and groundnut farmers (Table 7.3). About 50.0 per cent of farmers of cotton and 72.5 per cent of soil test farmers of groundnut have expressed their willingness to continue the same practices to maintain the better soil health and to get the better yields.

Table 7.3: Application of Recommended Doses of Fertilisers on Reference Crops

Sr. No.	Particulars	Cotton	Groundnut
1	% of farmers applied recommended doses of fertilisers	40.0	40.3
2	Average area (acre)	4.0	4.3
3	Area covered as % of net operated area	3.5	13.8
4	Average number of seasons applied	2.0	1.0
5	% of farmers willing to continue applying recommended doses of fertilisers	50.0	72.5

Source: Field survey

- Among the Cotton growers, the maximum adoptability was found in the case of small farmers (45.7%) and minimum adoptability was observed in the case of marginal farmers (28.6%). In contrast, in the case of groundnut crop, the maximum adoptability was found in the case of large farmers (45.0%) and minimum adoptability was observed in the case of small farmers (37.8%).
- The soil test farmers had faced several difficulties in applying the recommended doses of fertiliser as well. Among these constraints, difficulty in understanding and following application of recommended doses as stated in Soil Health Cards, unavailability of technical advice on method and time of fertiliser application, high prices of fertilisers and unavailability of required fertilisers in adequate quantity were the major ones.

- In case of control farmers, around 66.7 per cent cotton farmers and around 58.3 per cent groundnut farmers mentioned that they were aware about the recommended doses. Around 65 per cent of farmers had received information on recommended doses of fertiliser from the officials of department of agriculture of the state. The other sources were fellow farmer and private input dealer. About one fourth cotton growers received information from fellow farmers whereas more than one fifth groundnut growers were advised by input dealers. Importantly in both crop growers, two third farmers had received information from authentic sources of state agriculture department since this was linked with a flagship programme like Krishi Mahotsav.
- The data on actual quantity of fertilisers applied by the sample farmers during the reference year shows that, in case of cotton, the selected soil test farmers had applied more quantity of Urea and Potash than control group farmers. On the other hand, DAP use was much higher by the control farmers than the soil test farmers. The Urea application was more done by the small and medium farm size categories of soil test farmers than control group.
- The average actual quantity of fertilisers applied by the soil test farmers was more close to the recommended doses compared to that by the control farmers. For example, the average recommended dose of Urea (the major fertiliser applied) for total cotton was 86.1 kg/acre. The soil test farmers growing cotton have applied about 83.1 kg/acre compared to 71.2 kg/acre by the control farmers.
- In case of groundnut, use of DAP was the highest in both categories since this was the key fertiliser recommended for the crop. The recommended dose of DAP for total groundnut was 27.1kg/acre. The quantity of DAP applied by the soil test farmers (29.9 kg/acre) was more close to the recommended dose compared to that applied by the control farmers (35.5 kg/acre). The control farmers of groundnut was

found to apply excess quantity of DAP than the soil test farmers which is harmful to the overall health of soils.

- The analysis on actual quantity of split doses of fertilisers applied by stage of crop growth during the reference year reveals that Urea was heavily used mostly after intercultural operations for better vegetative growth and flowering of the selected crops. DAP, Potash and other fertilisers were used as basal application with very smaller quantity use during vegetative growth of the plant.
- Among the method of application of fertiliser adopted by the sample farmers, the line application of fertiliser was found to be adopted by most of farmers, followed by broadcasting, dibbling as well as fertigation method of fertiliser application. The application of fertiliser through foliar spray was adopted by very few number of cotton farmers.
- As regards the use of organic fertilizers by sample farmers, as expected most of cotton as well as groundnut growers had used farm yard manure (FYM). About 84.2 per cent of soil test farmers and 93.8 per cent of control farmers applied FYM on their soil. About 49.8 per cent of net cropped area of soil test farmers was covered with FYM. Among groundnut farmers, about 80.8 per cent of soil test farmers and 85.0 per cent of control farmers applied FYM on their soil. The use of other organic fertilisers was found very meager in total in both the crops. The easy availability and relatively low price of the FYM may be the reason behind high and dominant use of it in crop cultivation.
- The major sources of fertilisers purchased by the farmers were private fertilizer shops/dealers and co-operative societies for both categories of farmers. About 49.0 per cent of soil test farmers and 51.1 per cent of control farmers purchased fertilisers from private fertilizer shops/dealers. About 46.2 per cent of soil test farmers and 39.1 per cent of control farmers purchased fertiliser from co-operative societies. About 44.1 per cent of Urea, 49.5 per cent of DAP, 54.3 per

cent of SSP, 66.7 per cent NPK mixtures were purchased from the private fertilizer shops/dealers by the soil test farmers. The majority of soil test farmers also purchased micronutrients and magnesium from the private fertilizer shops/dealers.

- No much difference was observed between the soil test farmers and the control farmers with regard to prices and transport costs involved in fertiliser use. In the case of soil test farmers, the average transport cost varied from Rs 0.05 to 0.31 per kilogram of fertiliser bought from various places; whereas, in the case of control farmers, the average transport cost varied from Rs 0.09 to 0.35 per kilogram of fertiliser bought.
- The details on training programme attended on application of chemical fertilisers by the sample farmers show that about 6.5 per cent of soil test farmers had attended training programmes of around two days while the corresponding figure for control farmer group was only 4.1 per cent with duration of training programme of about three days. Thus the training and awareness of the farmers need to be given more importance so as to increase the level of adoption of recommended doses of fertiliser.

7.4.4 Impacts of Adoption of Recommended Doses of Fertilisers

- The adoption of recommended doses is believed to benefit the farmers in terms of improvement in yield, net returns and better soil health. The soil test farmers were found to realize better yield over the control farmers. The average yield of groundnut was found to be more in the case of soil test farmers by 13.3 per cent over control farmers. Similarly, the soil test group of cotton farmers realized better average yield by 9.6 per cent compared to the control group. Thus, overall yield impact was better in case of groundnut farmers compared to cotton farmers. However, the increase in yield may not be exclusively attributed for adoption of recommended doses of fertiliser. It may be

due to some other favourable factors like better seeds, better availability of irrigation water, among others.

- The analysis of crop yield before and after soil tests revealed that the yield level of groundnut was increased by 23.8 per cent and 22.9 per cent in case of cotton. However, among the marginal cotton farmers, increase in yield level was lower compared to other farmers. However, among groundnut farmers, the marginal and small farmers had realized better yield level over other categories of farmers. They have realized about 20.4 per cent and 41.8 per cent increase in yield, respectively, after the adoption of recommended doses of fertiliser.
- As far as increase in average value of output per acre is concerned, cotton farmers recorded better increase, i.e., by about 25.4 per cent increase mainly because of the better price the realized; whereas the groundnut farmers have recorded an increase in average value of output by 13.5 per cent. Thus, overall returns on crop output realised was better in case of cotton farmers compared to groundnut farmers.
- Improvement in soil texture, improvement in crop growth, improvement in grain filling, decrease in application of other inputs like seed, labour, pesticide etc. and fewer incidences of pest and diseases were the major benefits experienced by the sample farmers.
- However, there have been a number of shortcomings in implementation of the programme which need to be taken care of for strengthening this farmer friendly programme. The inadequate number of STLs severely affected the quality of service provided to the farmers, as opined by the sample farmers.

7.5 Policy Implications

- The major impression which has emerged from the study is that the Soil Health Card (SHC) programme is an important and beneficial programme to the farmer; however, it was not implemented in proper manner in the State. In view to achieve the quantity targets fixed for

some period/s, quality norms were not given proper attention which defeated the main purpose of the programme.

- In majority of cases, it was found that the SHCs were not with farmer. Those were kept together somewhere with some official/s. Thus, it was no use to the farmer/s. Though huge amount of money has been spent on implementation of the scheme, the main objective of the programme was overlooked.
- Depending on nutrient availability in soils, the recommended doses of fertiliser are expected to vary from region to region and from agro-climatic zone to zone. However, same was not reflected in the SHCs provided to the farmers. Also, the recommended doses of fertilisers given on SHC were found to be invariant/same across eight study talukas covering four different districts.
- The qualitative improvements need to be made in implementation of SHC programme so as to improve the confidence of farmers on recommendations of SHC. It was observed that many farmers even failed to understand the content of the card. They failed to calculate the recommended doses of various fertilisers required for their pieces of lands. Thus, the information on SHC should be provided in simple format and understandable language.
- The level of adoption of recommended doses by the soil test farmers was reasonably less due to various constraints, viz. difficulty in understanding and following application of recommended doses as stated in Soil Health Cards, unavailability of technical advice on method and time of fertiliser application, high prices of fertilisers and unavailability of required fertilisers in adequate quantity. Adequate efforts should be made to eliminate such constraints in order to increase the adoption level of recommended doses of fertilizers.
- The spread of SHC programme was restricted due to lack of awareness among the farmers. Therefore, special Gram Sabha or training programmes should be organized to train/educate farmers or to raise the awareness level regarding importance of soil test, scientific

method of collection of soil sample, how to read and understand SHC and what are the benefits of applying recommended doses of fertiliser.

- The inadequate number of Soil Testing Lab (STLs) in the state has severely affected the quality of service provided to the farmers, as opined by the most of the sample farmers. Therefore, adequate STL facility should be created/made available in nearby areas, at least at the Taluka level.
- Since there were only two mobile STLs operating in the state and it was reported that both were virtually dysfunctional, thus benefit of Mobile Soil Testing Lab (STL) did not reach to most of the farmers in the state as well as farmers in selected study area. Therefore, State Government should increase the number of mobile STLs with effective plans of action, since these mobile labs can provide services at door steps and can help in increasing the awareness level in villages.
- Looking at existing situation of inadequate staff in implementation of scheme, the involvement of non-governmental organizations and public private partnership (PPP) mode of operation may be promoted for the benefits of the farmers. Alternatively, establishment of private STLs should be encouraged/ promoted with some government incentives/support.
- The inadequate staff strength along with inadequate infrastructures and equipments has severely affected the quality performance of this programme. More number of Gram Sevaks/Gram Mitras should be hired so as to complete the soil testing in time with assured quality and to hand over of SHC to farmers within a reasonable time limit.
- Staff strength at line departments should be raised, as existing staff are already overloaded with assignments/targets to be achieved under various programmes. Even the existing staff at grassroot level were not updated about the technical aspects of the schemes. The Gram Sevaks/Gram Mitras should be provided regular training on accurate implementation of schemes/programmes.

- The actual procedures followed for soil samples collection need to be monitored properly since it was found that near about 40 per cent of soil samples were collected by the farmers themselves which cannot be technically sound. Unless there is a systematic effort to address the bureaucratic lethargy and political interference in implementation of such a wonderful programme, achievement of desired outcomes and the set objectives of the programme would be difficult/delayed.
- Collection of Soil Samples may be organised in a particular village in campaign mode. All stakeholders [such as farmers, farmer friends (Gram Mitras), village level workers (VLWs), Block level officers fertilizer industries, Co-op Society, SAU students (as part of their internship of farmer's field /village for technical exposure), people representatives] should be brought to common platforms on some occasions so as to bring qualitative improvements and to raise the level of awareness in the villages.
- Drawing soil sample in field is a laborious job. Time required to draw one soil sample may take at least one hour or so (after reaching on the field). For obtaining better results, proper sampling implements need to be provided to the farmers' friend (Gram Mitras) and their remuneration may be increased. At present they get Rs 15 per sample which happens to be very less for the required job (since this token amount also includes collection charges, primary requirement like sample bag, woven bag, forms, marker pen as well as transportation charges of samples). Since the compensation rate is seems to be very low, it may have forced them adopting the wrong methods to achieve the targets, which may affect the success of entire programme in future.
- Furthermore, it was reported that not only the selection of Gram Mitras was biased due to political interference but also they were not been imparted proper training to perform their duty accurately. Besides, their work was not properly monitored on a regular basis, which resulted in collection of poor quality of soil samples and non-

submission of soil samples in time. Thus, appropriate care should be taken in appointing as well as necessary training should be provided to gram mitras.

- Some of the farmers during discussion reported that samples had been collected from a single plot but had been shown for a large number of plots. Therefore collected soil samples need to be handled more carefully so as to ensure that farmer get his SHC for his plot/s only.
- At present, different institutions such as Agriculture Department of the state government, Public Sector Undertakings (such as APMCs, Government supported Corporation Labs, Government supported Sugar cooperatives labs) and Science Colleges are involved in testing the soil samples and generating the soil health cards. For instance, the tests on major nutrients like N, P, K, Ph etc are done at all 134 STLs. However, the tests on micronutrients are done at only at designated 50 STLs and Agricultural Universities. The test results are transferred to another organization Silver Touch Pvt. Ltd for generating SHCs. Anand Agricultural University was given the responsibility for uploading all these SHCs on its website through e-Krishi Kiran Programme. Proper coordination among all these institutions is necessary for delivering reliable results and matching data sets. Collection of soil samples in the field, analysis of soil samples in the laboratory and delivery of SHC to the farmers must be performed in perfect harmony and entire process should be completed prior to sowing season.
- It was observed that information provided in SHC available with farmers as well as information uploaded on the AAU website differs. During the discussion, some of the farmers mentioned that they were not aware about soil samples taken from their field and how/when their SHCs were prepared. Such findings raises questions about the reliability of the soil test results and debilitating farmers' confidence on the recommendations given in the SHCs. Therefore, necessary steps

to be taken to ensure quality implementation so as to raise the confidence level of the farmers.

- One way to raise the level of confidence of the farmers is to demonstrate the usefulness of the recommendations by applying recommended doses of fertiliser on experimental plots at every village or at least at Gram Panchayat level. If the better results can be demonstrated on the experimental plots compared to farmers' field, farmers will be self-motivated to have SHCs.
- The quality of data/statistics on SHC programme as collected by various agencies needs improvement. For instance, the aggregate of district level number of SHCs (compiled by one agency) is found to be different from state level total in various years (as reported by the State Government) by huge margin. The coordination among agencies involved is essential for generating a reliable and quality database since such databases on various government programmes like SHC programme is required for undertaking regular evaluation and policy relevant research.
- Adoption level of organic fertiliser and green manure was found to be very low among sample farmers. It may be because of less production, consequent high prices and lack of availability of these manures at local levels. In order to lower down the excessive use of chemical fertilisers and to boost the health of soil, organic and green manure use needs to be promoted. Therefore, effective measures needs to be adopted to increase supply and use of organic manures. It is also necessary to reduce subsidy on chemical fertilisers and instead, subsidize more organic fertilisers so as to increase their adoption level.

REFERENCES

Chand, Ramesh and L. M. Pandey (2008), "Fertiliser Growth, Imbalances and Subsides: Trends and Implications", Discussion Paper (NPP 02/2008), National Centre for Agricultural Economics and Policy Research (Indian Council of Agricultural Research), New Delhi.

FAO (2005), *Fertiliser Use by Crop in India,* Land and Plan Nutrition Management Service, Land and Water Development Division, Food and Agriculture Organization of the United Nation, Rome.

FAI (Fertiliser Association of India) (1974), A Study on Fertiliser Demand and Marketing, Volume III, All India Summary Report, Fertiliser Association of India, New Delhi.

Government of India (2008), 'Eleventh Five Year Plan Volume III Agriculture, Rural development, Industry, Services, and Physical infrastructure', New Delhi: Oxford University Press.

Government of India (2013), 'State of Indian Agriculture, 2012-13', Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi.

Government of India (2015), 'Agricultural Statistics at a Glance 2014', Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi

Kanwar, J.S. (1997), 'Balanced Fertiliser Use and Food Security – Overview of Indian Scenario', Fertiliser News, 42 (7), 63, 65 & 67.

Krishnaji. N., (1975), 'Inter-Regional Disparities in Per Capita Production and Productivity of Food Grains: A Preliminary Note on Trends'. Economic and Political Weekly, 10 (33/35): 1377-85.

McGuirk and Mundlak (1991), 'McGuirk, A. and Y. Mundlak (1991), 'Incentives and Constraints in the Transformation of Punjab Agriculture', IFPRI Research Report 87, Washington, D.C.

Menon and Rao (1983) Menon, K.N.N. and H.K. Lakshman Rao (1983). "Is ECA Allocation Conducive to Stimulate Fertiliser Consumption?, Fertiliser News, July 1983, 1-69.

Murgai, R., M. Ali and D. Byerlee (2001), 'Productivity and Sustainability in Post-Green Revolution Agriculture: the Case of Indian and Pakistan Punjab'. The World Bank Research Observer, 16(2):199-218.

Pathak, Mahesh, V.D. Shah and M.L. Jhala (1993), Impacts of Fertiliser Price Hike on Gujarat Agriculture, AERC Report No. 89, Agro-Economic Research Centre, Vallabh Vidyanagar, Gujarat.

Pingali, P.L. and M. Shah, (2001), 'Policy Re-directions for Sustainable Resource Use: The Rice-Wheat Cropping System of The Indo-Gangetic Plains'. In The Rice-Whet Cropping System of South Asia: Trends, Constraints, Productivity and Policy, ed. P.K. Kataki, 103-18. New York: Food Products Press.

Pingali, Venugopal (2004), 'Input Management', "State of Indian Farmers: A Millennium Study (Volume 8)", Academic Foundation, New Delhi.

Prasad (2000) Prasad (2000), 'Nutrient Management Strategies for the Next Decade: Challenges Ahead', **Error! Hyperlink reference not valid.**

Randhawa, M.S. ((1992), 'Green Revolution in Punjab', Punjab Agricultural University, Ludhiana, India.

Rao, Hanumantha and K. Jayasree, (2000), 'Subsidies and Fertiliser Use Efficiency under the New Economic Policy Regime', Rural Prosperity and Agriculture Policies and Strategies, 197-239.

Rao, V. M., (1996), 'Agricultural Development with A Human Face: Experiences and Prospects'. Economic and Political Weekly, 31(26): A50-A62.

Rastogi, B.K., V. Annamalai (1981), 'A Study on the Adoption and Diffusion of Recommended Technology in Dryland Agriculture', AICRPDA, Hyderabad.

Sevak, R.D. (1982), 'Soil Testing Services in Rajasthan', AERC Report No. 60, Agro-Economic Research Centre, Vallabh Vidyanagar, Gujarat.

Shah, V.D. (1989), Fertiliser Consumption in Gujarat, AERC Report No. 80, Agro-Economic Research Centre, Vallabh Vidyanagar, Gujarat.

Singh, M.V. (2001), 'Evaluation of Current Micronutrient Stocks in Different Agro-Ecological Zones of India for Sustainable Crop Production', Fertiliser News, Vol. 46. Issue No.2. February, pp. 25-42.

Swain, M (2013), Problems and Prospects of Oilseeds Production in Gujarat', AERC Report 148, Agro-Economic Research Centre, S.P. University, Vallabh Vidyanagar.

Swain, M., R.H. Patel, and M. Ojha (2011), 'Impacts of National Horticulture Mission Scheme in Gujarat', Research Report No. 142, Agro-Economic Research Centre, S.P. University, Vallabh Vidyanagar.

Swain, M., S .S. Kalamkar and Kalpana Kapadia (2012), 'State of Gujarat Agriculture 2011-12', AERC Report No. 146, Agro-Economic Research Centre, S. P. University Vallabh Vidyanagar.

Vaidyanathan, A. (1988), 'India's Agricultural Development in a Regional Perspective', Orient Longman, Hyderabad.

Vijay P. Sharma and Pritee Sharma (2000). 'Environmental Effects of Agricultural Trade Liberalisation in Indian Agriculture', "Rural Prosperity and Agriculture Policies and Strategies", pp. 419-456.

ANNEXURE TABLES

Annexure I: Salient Features of Agro Climatic Zones of Gujarat State

Zone	Climate	Districts Covered	Rainfall (mm)	Major Crops	Soil
South Gujarat (Heavy Rain Area.)	Semi-arid to dry sub-humid	Navsari, Dang, Valsad and Valod, Vyara, songadh and Mahuva taluks of Surat.	1500 and more	Rice, Sorghum, Ragi, Kodra, Seasamum, Pigeonpea, Groundnut, Cotton, Sugarcane, Chilli, Wheat, Gram	Deep black with few patches of coastal alluvial, laterite and medium black
South Gujarat	Semi-arid to dry sub-humid	Surat and Amod, Ankleshwar, Broach, Dekdopada, Honsot, Jhagadia, Nanded, Sagbara and Valia talukas of Bharuch.	1000-1500	Rice, Wheat, Gram, Perlmillets,Sorghum, Maize, Kodra, Ragi, Pigeonpea, groundnut, Sesamum, Castor, Cotton, Sugarcane, Chillies,	Deep black clayey
Middle Gujarat	Semi-arid	Panchmahals, Baroda and Anand, Balasinor, Borsad, Kapadvanj, Kheda, Matar, Ahmedabad, Nadiad, Petlad and Thasara and taluks of Kheda.	800-1000	Rice, Wheat, Gram, Perlmillets,Sorghum, Maize, Kodra, Ragi, Pigeonpea, groundnut, Sesamum, Castor, Cotton, Sugarcane, Potato, Rapeseed & Mustard.	Deep black, medium black to loamy sand
North Gujarat	Arid to semi-arid	Sabarkantha, Gandhinagar, Dehgam, Daskroi, Sanand talukas of Ahmedabad, Deesa, Dhenera, Palanpur, Dandta, Wadgam taluks of Banaskantha and Chanasma, Kadi, Kalol, Kheralu, Mehsana, Patan, Sidhpur, Visnagar, Vijapur taluks and Mehsana.	625-875	Rice, Wheat, Gram, Perlmillet, Sorghum, Maize, groundnut, Sesamum, Castor, Cotton, Sugarcane, Cumin, Rapeseed & Mustard.	Sandy loam to sandy
Bhal & Coastal Area	Dry sub-humid	Bhavnagar (Vallabhipur, Bhavnagar talukas), Ahmedabad (Dholka, Dhanduka talukas), and Vagra, Jambusa talukas of Bharuch.	625-1000	Rice, Pearlmillet.	Medium black, poorly drained and saline

Annexure I Continued…

South Saurashtra	Dry sub-humid	Junagadh, Ghodhra, Talaja, Mahuva talukas of Bhavnagar Kodinar, Rajula and Jafrabad talukas of Amerli and Dhoraji, Jetpur, Upleta talukas of Rajkot.	625-750	Rice, Maize, Sugarcane Wheat, Gram Pearl millets ,Sorghum, Groundnut, Seasamum, Cotton, Pulses, rapeseed & mustard	Shallow medium black calcareous
North Saurashtra	Dry sub-humid	Jamnagar, Rajkot, Chotila, Limdi, Lakhtar, Muli, Sayla, Wadhwan talukas of Surendranagar and Gadheda, Umrala, Botad, Kundla, Dihor, Garidhar, Palitana talukas of Bhavnagar and Amreli, Babra, Lathi, Lalia, Kunkavav, Khamba, Dhari taluks of Amreli.	400-700	Pearlmillet, Sorghum, Groundnut, Seasamum, Castor, Cotton, Pulses.	Shallow medium black
North West Zone	Arid to semi-arid	Kutch, Rajkot, Malia Halvad, Dhrangdhra, Dasada taluks of Surendranagar, Sami and Harij taluks of Mahsana, Santhalpur, Radhanpur, Kankrej, Deodar, Vav, Tharad talukas of Banaskantha and Viramgam taluka of Ahmedabad.	250	Rice, Wheat, Gram, Perlmillet, Sorghum, Maize, Pigeon pea, groundnut, Sesamum, Castor, Cotton, Rapeseed & Mustard , barley.	Sandy and saline

Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Government of Gujarat, Gandhinagar

Annexure II: Fertilizer Consumption in Gujarat State Year 1980-81 to 2013-14

(In 000' tonnes)

Sr. No	Year	Nitrogenous (N)	Phosphate (P2O5)	Potassic (K2O)	Total NPK	Per Ha Consumption of NPK (Kg/Ha)
1	1980-81	204.12	117.22	0.00	356.86	32.58
2	1981-82	245.40	114.64	41.42	401.46	36.50
3	1982-83	236.39	115.73	34.31	386.43	34.66
4	1983-84	317.04	147.35	37.96	502.35	45.60
5	1984-85	320.31	148.78	35.47	504.56	48.33
6	1985-86	286.51	109.30	25.50	421.31	42.23
7	1986-87	255.61	111.77	34.91	402.29	50.05
8	1987-88	290.15	120.30	31.83	442.28	41.32
9	1988-89	434.74	164.46	44.27	643.47	60.23
10	1989-90	434.40	213.86	47.12	695.38	65.72
11	1990-91	430.75	217.15	58.49	706.39	67.26
12	1991-92	456.59	216.98	59.68	733.26	66.64
13	1992-93	496.17	181.14	39.29	716.60	66.79
14	1993-94	472.89	157.01	39.17	669.08	59.50
15	1994-95	572.27	195.64	50.38	818.29	74.42
16	1995-96	551.92	160.16	41.41	753.49	68.15
17	1996-97	596.65	175.62	41.27	813.54	72.55
18	1997-98	702.77	264.83	60.29	1027.89	91.78
19	1998-99	690.73	267.57	61.36	1019.66	95.28
20	1999-00	632.13	264.73	68.75	965.61	91.99
21	2000-01	498.96	195.67	56.01	750.64	69.56
22	2001-02	605.64	240.23	69.36	915.23	86.09
23	2002-03	510.80	207.04	71.59	789.43	69.12
24	2003-04	687.55	255.28	73.50	1016.33	92.32
25	2004-05	754.00	296.26	96.22	1146.48	101.42
26	2005-06	834.73	328.46	116.73	1279.92	114.99
27	2006-07	927.57	361.13	120.09	1408.79	106.78
28	2007-08	1052.63	424.52	146.11	1623.26	119.78
29	2008-09	1068.83	465.17	182.98	1716.98	135.09
30	2009-10	1101.60	491.67	206.45	1799.72	205.86
31	2010-11	1241.22	518.00	179.94	1939.16	138.08
32	2011-12	1183.30	417.02	132.74	1733.06	132.59
33	2012-13	1007.70	257.82	76.46	1341.97	108.99
34	2013-14	1234.17	403.03	114.89	1752.08	127.65

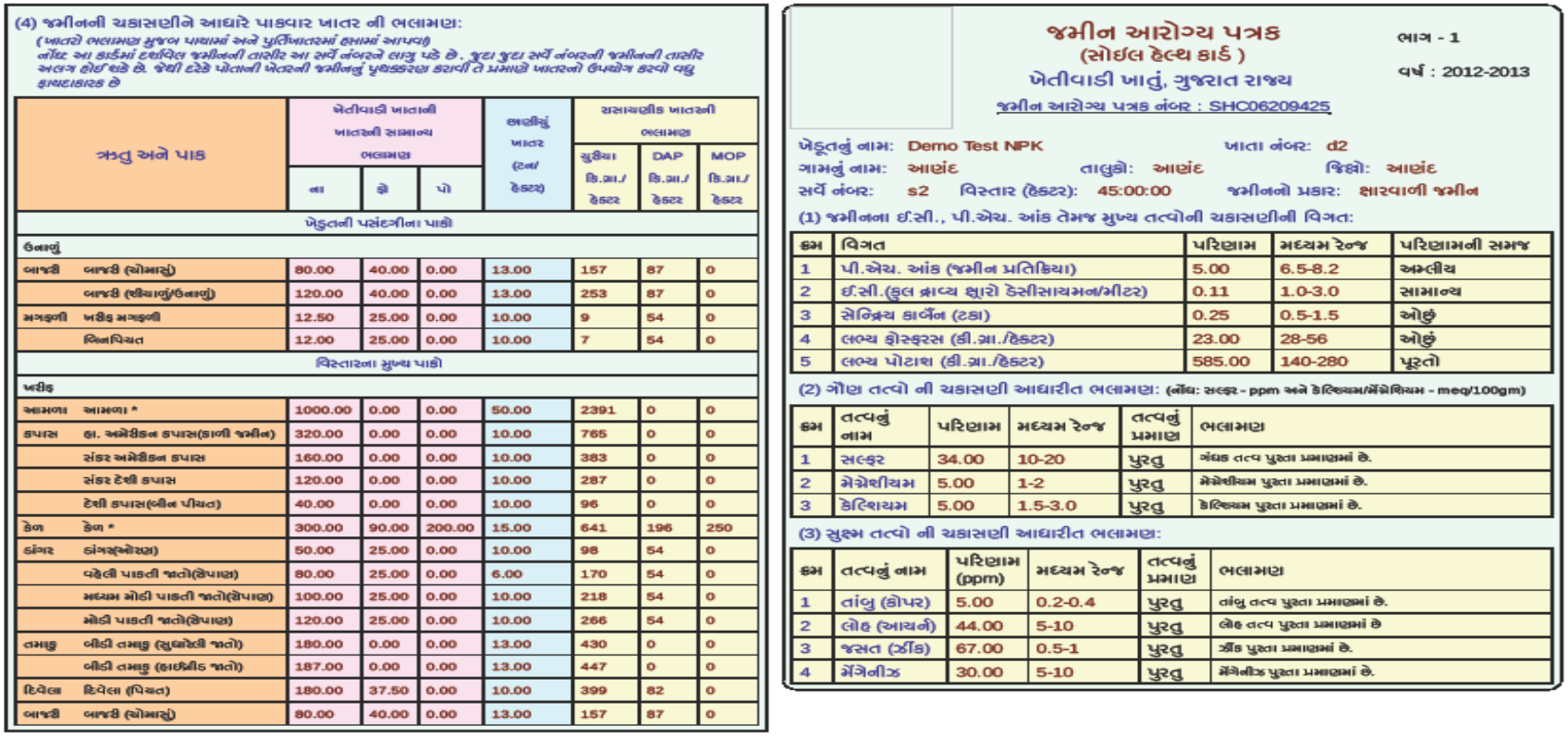
Sources: Statistical Outline of Gujarat (1980-81 to 1990-91) and Statistical Abstract 2009, Directorate of Economics and Statistics, Department of Gujarat, Gandhinagar

Annexure III: District-wise Availability of Soil Health Cards (SHCs) in Gujarat (2010-11 to 2012-13)

District Name	Total No. of SHCs		
	2010-11	2011-12	2012-13
Kutch	101092	48428	47711
Surendranagar	115458	50355	54047
Rajkot	170712	86947	87005
Jamnagar	156225	58572	76627
Jamnagar	124182	73723	66693
Amreli	133667	58324	55511
Bhavnagar	76270	48921	63965
Ahmedabad	59435	46293	50885
Gandhinagar	37291	26163	28820
Mehsana	138366	54753	53184
Banaskantha	52544	67815	74668
Sabarkantha	85199	40331	52145
Panchmahal	27095	73019	49427
Kheda	67264	69195	56991
Vadodara	117332	67098	59079
Bharuch	21670	31899	25867
Surat	30520	53890	35744
Valsad	17090	24754	27029
The Dang	6068	2791	2901
Porbandar	33284	13319	15214
Patan	58198	22798	40619
Dahod	19193	25953	21145
Anand	81087	67654	58965
Narmada	2522	12356	9955
Navsari	6321	28762	28308
Tapi			10249
State Total	**1738085**	**1154113**	**1152754**

Source: Information Technology Center, Anand Agricultural University, Anand, Gujarat

Annexure IV: A Copy of Soil Health Card (2012-13)



(4) જમીનની ચકાસણીને આધારે પાકવાર ખાતર ની ભલામણ:

(ખાતરો ભલામણ મુજબ પાયામાં અને પૂર્તિખાતરમાં હપ્તામાં આપવા)

નોંધ: આ કાર્ડમાં દર્શાવેલ જમીનની તારીખ આ સર્વે નંબરને લાગુ પડે છે , જુદા જુદા સર્વે નંબરની જમીનની તારીખ અલગ હોઈ શકે છે. જેથી દરેકે પોતાની ખેતરની જમીનનું પૃથક્કરણ કરાવી તે પ્રમાણે ખાતરનો ઉપયોગ કરવો વધુ ફાયદાકારક છે

ઋતુ અને પાક		ખેતીવાડી ખાતાની ખાતરની સામાન્ય ભલામણ			ગળતીયું ખાતર (ટન/ હેક્ટર)	રાસાયણીક ખાતરની ભલામણ		
		ના	કે	પો		યુરિયા કિ.ગ્રા./ હેક્ટર	DAP કિ.ગ્રા./ હેક્ટર	MOP કિ.ગ્રા./ હેક્ટર
ખેડુતની પસંદગીના પાકો								
ઉનાળું								
બાજરી	બાજરી (ચોમાસું)	80.00	40.00	0.00	13.00	157	87	0
	બાજરી (શિયાળું/ઉનાળું)	120.00	40.00	0.00	13.00	253	87	0
મગફળી	ખરીફ મગફળી	12.50	25.00	0.00	10.00	9	54	0
	બિનપિયત	12.00	25.00	0.00	10.00	7	54	0
વિસ્તારના મુખ્ય પાકો								
ખરીફ								
આમળા	આમળા *	1000.00	0.00	0.00	50.00	2391	0	0
કપાસ	હા. અમેરીકન કપાસ(કાળી જમીન)	320.00	0.00	0.00	10.00	765	0	0
	સંકર અમેરીકન કપાસ	160.00	0.00	0.00	10.00	383	0	0
	સંકર દેશી કપાસ	120.00	0.00	0.00	10.00	287	0	0
	દેશી કપાસ(બીન પીયત)	40.00	0.00	0.00	10.00	96	0	0
કેળ	કેળ *	300.00	90.00	200.00	15.00	641	196	250
ડાંગર	ડાંગર(ભોરણ)	50.00	25.00	0.00	10.00	98	54	0
	વહેલી પાકતી જાતો(રોપાણ)	80.00	25.00	0.00	6.00	170	54	0
	મધ્યમ મોડી પાકતી જાતો(રોપાણ)	100.00	25.00	0.00	10.00	218	54	0
	મોડી પાકતી જાતો(રોપાણ)	120.00	25.00	0.00	10.00	266	54	0
તમાકુ	બીડી તમાકુ (સુધારેલી જાતો)	180.00	0.00	0.00	13.00	430	0	0
	બીડી તમાકુ (હાઈબ્રીડ જાતો)	187.00	0.00	0.00	13.00	447	0	0
દિવેલા	દિવેલા (પિયત)	180.00	37.50	0.00	10.00	399	82	0
બાજરી	બાજરી (ચોમાસું)	80.00	40.00	0.00	13.00	157	87	0

જમીન આરોગ્ય પત્રક
(સોઇલ હેલ્થ કાર્ડ)
ખેતીવાડી ખાતું, ગુજરાત રાજ્ય

ભાગ - 1

વર્ષ : 2012-2013

જમીન આરોગ્ય પત્રક નંબર : SHC06209425

ખેડૂતનું નામ: Demo Test NPK ખાતા નંબર: d2

ગામનું નામ: આણંદ તાલુકો: આણંદ જિલ્લો: આણંદ

સર્વે નંબર: s2 વિસ્તાર (હેક્ટર): 45:00:00 જમીનનો પ્રકાર: ક્ષારવાળી જમીન

(1) જમીનના ઈ.સી., પી.એચ. આંક તેમજ મુખ્ય તત્વોની ચકાસણીની વિગત:

ક્રમ	વિગત	પરિણામ	મધ્યમ રેન્જ	પરિણામની સમજ
1	પી.એચ. આંક (જમીન પ્રતિક્રિયા)	5.00	6.5-8.2	અમ્લીય
2	ઈ.સી.(દ્રાવ્ય ક્ષારો ડેસીસાયમન/મીટર)	0.11	1.0-3.0	સામાન્ય
3	સેન્દ્રિય કાર્બન (ટકા)	0.25	0.5-1.5	ઓછું
4	લભ્ય ફોસ્ફરસ (કી.ગ્રા./હેક્ટર)	23.00	28-56	ઓછું
5	લભ્ય પોટાશ (કી.ગ્રા./હેક્ટર)	585.00	140-280	પૂરતો

(2) ગૌણ તત્વો ની ચકાસણી આધારીત ભલામણ: (નોંધ: સલ્ફર - ppm અને કેલ્શિયમ/મેગ્નેશિયમ - meq/100gm)

ક્રમ	તત્વનું નામ	પરિણામ	મધ્યમ રેન્જ	તત્વનું પ્રમાણ	ભલામણ
1	સલ્ફર	34.00	10-20	પુરતુ	ગંધક તત્વ પુરતા પ્રમાણમાં છે.
2	મેગ્નેશીયમ	5.00	1-2	પુરતુ	મેગ્નેશીયમ પુરતા પ્રમાણમાં છે.
3	કેલ્શિયમ	5.00	1.5-3.0	પુરતુ	કેલ્શિયમ પુરતા પ્રમાણમાં છે.

(3) સુક્ષ્મ તત્વો ની ચકાસણી આધારીત ભલામણ:

ક્રમ	તત્વનું નામ	પરિણામ (ppm)	મધ્યમ રેન્જ	તત્વનું પ્રમાણ	ભલામણ
1	તાંબુ (કોપર)	5.00	0.2-0.4	પુરતુ	તાંબુ તત્વ પુરતા પ્રમાણમાં છે.
2	લોહ (આયર્ન)	44.00	5-10	પુરતુ	લોહ તત્વ પુરતા પ્રમાણમાં છે
3	જસત (ઝીંક)	67.00	0.5-1	પુરતુ	ઝીંક પુરતા પ્રમાણમાં છે.
4	મેંગેનીઝ	30.00	5-10	પુરતુ	મેંગેનીઝ પુરતા પ્રમાણમાં છે.

@ Information Technology Center, Anand Agricultural University, Anand. http://aau.in, http://shc.aau.in, http://shc.gujarat.gov.in

Annexure V: A Table Printed on back side of SHC to calculate the fertiliser (2012-13)

Table for calculation of fertilizers

Recommended dose of nutrient for 1 hectare (kg)	Percentage of Nitrogen, Phosphorus and Potash described on the bag of chemical fertilizer (for basal dose of fertilizer)																				
	10%	11%	12%	14%	15%	16%	17%	18%	19%	20%	22%	25%	26%	28%	32%	35%	36%	45%	46%	50%	60%
1	10	9.1	8.3	7.1	6.7	6.3	5.9	5.6	5.3	5.0	4.5	4.0	3.8	3.6	3.1	2.9	2.8	2.2	2.2	2.0	1.7
2	20	18.2	16.7	14.3	13.3	12.5	11.8	11.1	10.5	10.0	9.1	8.0	7.7	7.1	6.3	5.7	5.6	4.4	4.4	4.0	3.3
5	50	46	42	36	33	31	29	28	26	25	23	20	19	18	16	14	14	11	11	10	8
10	100	91	83	71	67	63	59	56	53	50	45	40	38	36	31	29	28	22	22	20	17
15	150	136	125	107	100	94	88	83	79	75	68	60	58	54	47	43	42	33	33	30	25
20	200	182	167	143	133	125	118	111	105	100	91	80	77	71	63	57	56	44	44	40	33
30	300	273	250	214	200	188	176	167	158	150	136	120	115	107	94	86	83	67	65	60	50
50	500	455	417	357	333	313	294	278	263	250	227	200	192	179	156	143	139	111	109	100	83
60	600	546	500	429	400	375	353	333	316	300	273	240	231	214	188	171	167	133	130	120	100
75	750	682	625	536	500	469	441	417	395	375	341	300	288	268	234	214	208	167	163	150	125
80	800	727	667	571	533	500	471	444	421	400	364	320	308	286	250	229	222	178	174	160	133
100	1000	909	833	714	667	625	588	556	526	500	455	400	385	357	313	286	278	222	217	200	167

Table Explanation : The percentage of different nutrients printed on the bag of chemical fertilizer is given in the first horizontal row, while the recommended nutrients (in kg) are given in the first column. Now as per the percentage mentioned on the bag you have selected for chemical fertilizer move vertically and select the recommended quantity of fertilizer from the row and move horizontally. Where the horizontal and vertical lines are crossed, that will be your recommended quantity of fertilizer in kilogram. Apply that quantity per hectare.

Example:

1. Suppose the recommended dose of fertilizer is 100:50:50 N-P-K kg/ha. If the source of nitrogen is Urea, then urea contents 46 % Nitrogen. So, select 46% from the first row and select 100 kg from the first column. Where both are crossing shows 217 kg, that means for applying 100 kg nitrogen /ha through urea, one should apply 217 kg Urea/ha. Similarly, 313 kg Super Phosphate (16% P_2O_5) and 83 kg Muriate of Potash (60 % K_2O) is required for 50 kg of P_2O_5 and K_2O each, respectively.
2. Suppose the recommended dose of fertilizer is 100:50:00 N-P-K kg/ha and the sources of fertilizers are DAP and Urea. Then, first one has to calculate the dose of phosphorus from DAP (as it is a compound fertilizer). Select the first row at 46% and first column at 50 kg, the lines cross at 109. that means, for applying 50 kg P_2O_5 through DAP, one should apply 109 kg DAP. Now DAP is a compound fertilizer, contains 18 % N and 46 % P_2O_5. That means, 109 kg DAP will supply 109 x 18/100 = 19.62 ≈20 kg N /ha. In this example, one needs 100 kg N/ha. So, after applying 109 kg DAP, one requires 100 – 20 = 80 kg N/ha. Now, again select 46% from the first row and 80 kg from the first column and where these lines are crossing i.e.174 kg Urea/ha. should be applied .

Note : While calculating doses of fertilizers, first calculate potassic fertilizers, then phosphatic fertilizers and lastly, nitrogenous fertilizers. So that one can subtract phosphorus and nitrogen available from the potassic fertilizers and nitrogen from the phosphatic fertilizers.

Annexure VI: Soil Heath Card format- 2006-07

(7) Crop wise Fertilizer Recommendation on the basis of soil analysis.
(Supply recommended fertilizers as basal dose and in top dressing)

Note: Soil characteristics illustrated in this card is pertaining to this survey number only. Soil characteristics vary for different survey numbers. Use of fertilizers in accordance with soil analysis of individual field is more beneficial.

Season	Crop	General recommendation of fertilizers by Dept. of Agriculture (kg/ha) N	P_2O_5	K_2O	FYM (Tones/ha)	Recommendation on the basis of soil analysis (kg/ha) N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
Kharif	Banana					*(*FYM-kg/plant, NPK : gm/plant)*		
Banana*		180	90	180	15	200	90	180
Kharif	Paddy							
Paddy (Drilled)		80	20	0	6	90	20	0
Medium late (T.P.)		50	25	0	10	55	25	0
Early Maturing (T.P.)		100	25	0	10	110	25	0
Late Maturing (T.P.)		120	30	0	10	130	30	0
Kharif	Tobacco							
Bidi Tobacco (Hybrid)		220	0	0	13	240	0	0
Bidi Tobacco (Improved)		180	0	0	13	200	0	0
Kharif	Castor							
Irri. Castor		75	50	0	10	85	50	0
Kharif	Pearl millet							
Hy. Pearl millet (Rain fed)		80	40	0	13	90	40	0
Kharif	Chilly							
Chilly		100	50	50	10	110	50	50
Rabi	Culcutti Tobacco							
Guj. Culcutti-1		200	0	0	10	240	0	0
Guj. Culcutti-2		150	0	0	10	165	0	0
Rabi	Wheat							
Late sowing		80	40	0	13	90	40	0
Timely sowing		120	60	0	13	130	60	0
Rabi	Chickpea							
Chickpea		20	40	0	10	25	40	0
Rabi	Potato							
Potato		200	100	200	25	220	100	200
Summer	Paddy							
Summer Paddy		100	30	0	10	110	30	0

SOIL HEALTH CARD

DEPARTMENT OF AGRICULTURE
GUJARAT STATE

Year : 2008

SOIL HEALTH CARD NO.: SHC00027842

(1) Farmer's Name : Pursotambhai Hirabhai Patel

(2) Village : Zarolla **Taluka :** Borsad **District :** Anand

(3) Account No : 280

(4) Land / Soil detail as per account :

Serial	Survey No.	Area (Ha.)	Soil Type
1	1004-2	00 : 40 : 00	Sandy loam
2			
3			
4			
5			

(5) Fertility class as per soil analysis of the village :

Serial	Fertility Class	Nitrogen	Phosphorus	Potash
1	Low	✓		
2	Medium		✓	
3	High			✓

(6) Details of individual soil analysis : Survey No. : 1004-2

Sr.	Detail	Result	Interpretation of Result
1	pH (Soil Reaction)	7.20	Normal
2	E.C. (Total Dissolve Salts: dSm/m)	0.49	Normal
3	Organic Carbon (%)	0.26	Low
4	Available Phosphorus (kg/ha)	43.00	Medium
5	Available Potash (kg/ha)	254.00	Medium

pH		E.C. (Electric Conductivity)	
Acidity :	6.5 or less	Normal :	Less than 1.0
Normal :	6.5 - 8.2	Medium:	1.0 to 3.0
Alkaline:	8.2 or high	Harmful :	3.0 or high

Annexure VII: Back Side of Soil Heath Card format- 2006-07

Table for calculation of fertilizers

Recommended dose of nutrient for 1 hectare (kg)	Percentage of Nitrogen, Phosphorus and Potash described on the bag of chemical fertilizer (for basal dose of fertilizer)																			
	10%	11%	12%	14%	15%	16%	17%	18%	19%	20%	22%	25%	26%	28%	32%	35%	36%	45%	46%	50%	60%
1	10	9.1	8.3	7.1	6.7	6.3	5.9	5.6	5.3	5.0	4.5	4.0	3.8	3.6	3.1	2.9	2.8	2.2	2.2	2.0	1.7
2	20	18.2	16.7	14.3	13.3	12.5	11.8	11.1	10.5	10.0	9.1	8.0	7.7	7.1	6.3	5.7	5.6	4.4	4.4	4.0	3.3
5	50	46	42	36	33	31	29	28	26	25	23	20	19	18	16	14	14	11	11	10	8
10	100	91	83	71	67	63	59	56	53	50	45	40	38	36	31	29	28	22	22	20	17
15	150	136	125	107	100	94	88	83	79	75	68	60	58	54	47	43	42	33	33	30	25
20	200	182	167	143	133	125	118	111	105	100	91	80	77	71	63	57	56	44	44	40	33
30	300	273	250	214	200	188	176	167	158	150	136	120	115	107	94	86	83	67	65	60	50
50	500	455	417	357	333	313	294	278	263	250	227	200	192	179	156	143	139	111	109	100	83
60	600	546	500	429	400	375	353	333	316	300	273	240	231	214	188	171	167	133	130	120	100
75	750	682	625	536	500	469	441	417	395	375	341	300	288	268	234	214	208	167	163	150	125
80	800	727	667	571	533	500	471	444	421	400	364	320	308	286	250	229	222	178	174	160	133
100	1000	909	833	714	667	625	588	556	526	500	455	400	385	357	313	286	278	222	217	200	167

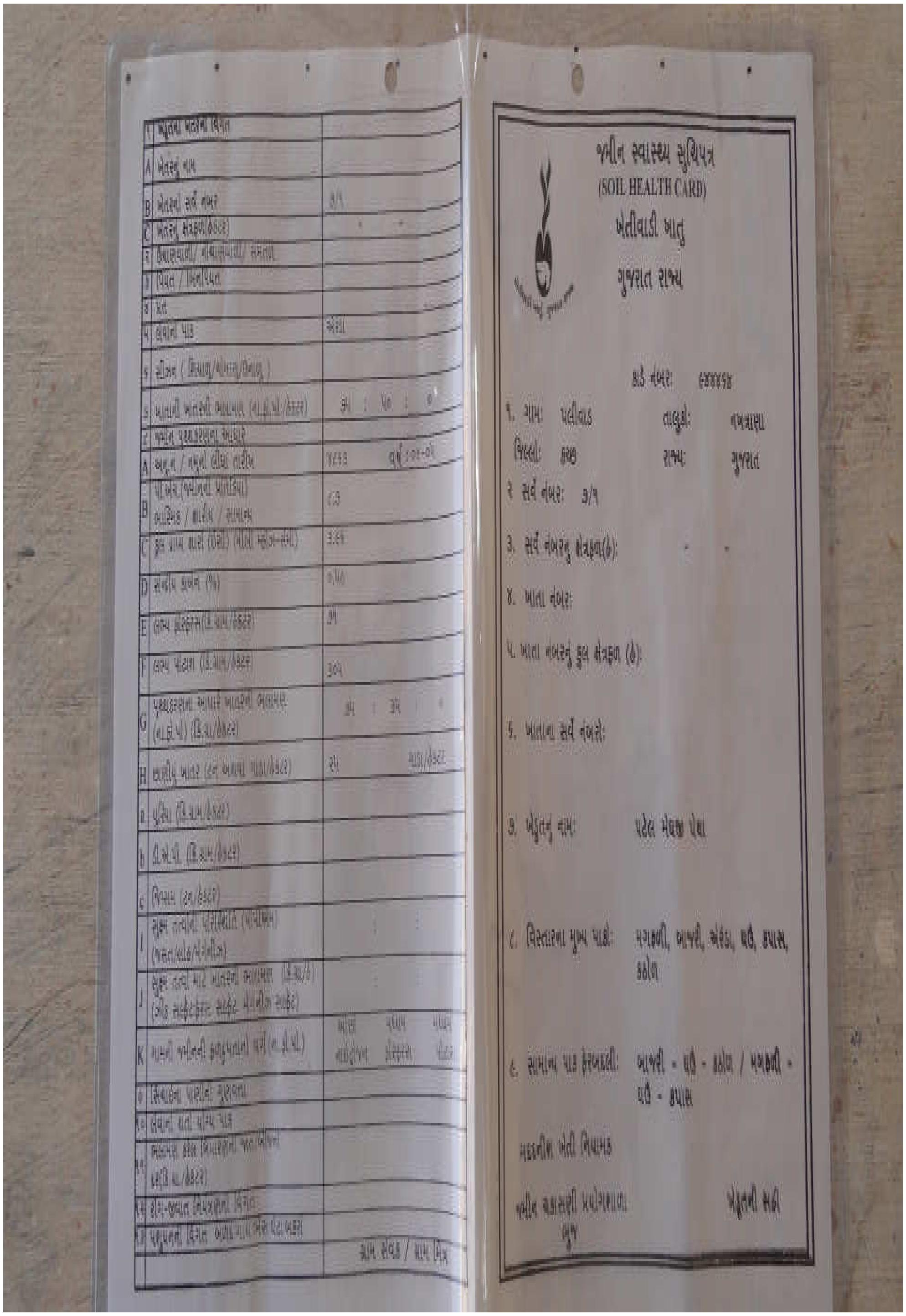
Table Explanation : The percentage of different nutrients printed on the bag of chemical fertilizer is given in the first horizontal row, while the recommended nutrients (in kg) are given in the first column. Now as per the percentage mentioned on the bag you have selected for chemical fertilizer move vertically and select the recommended quantity of fertilizer from the row and move horizontally. Where the horizontal and vertical lines are crossed, that will be your recommended quantity of fertilizer in kilogram. Apply that quantity per hectare.

Example:

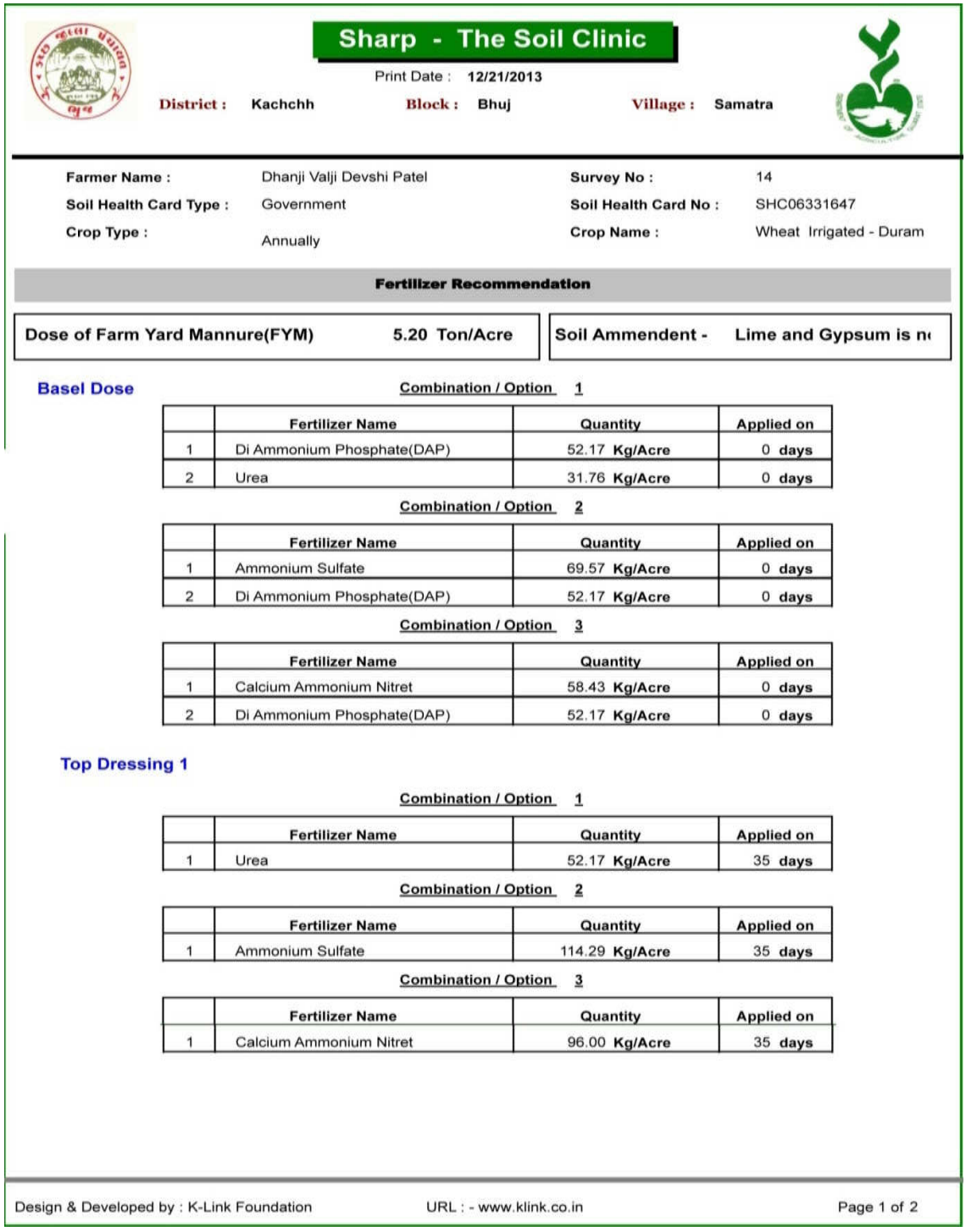
1. Suppose the recommended dose of fertilizer is 100:50:50 N-P-K kg/ha. If the source of nitrogen is Urea, then urea contents 46 % Nitrogen. So, select 46% from the first row and select 100 kg from the first column. Where both are crossing shows 217 kg, that means for applying 100 kg nitrogen /ha through urea, one should apply 217 kg Urea/ha. Similarly, 313 kg Super Phosphate (16% P_2O_5) and 83 kg Muriate of Potash (60 % K_2O) is required for 50 kg of P_2O_5 and K_2O each, respectively.
2. Suppose the recommended dose of fertilizer is 100:50:00 N-P-K kg/ha and the sources of fertilizers are DAP and Urea. Then, first one has to calculate the dose of phosphorus from DAP (as it is a compound fertilizer). Select the first row at 46% and first column at 50 kg, the lines cross at 109. that means, for applying 50 kg P_2O_5 through DAP, one should apply 109 kg DAP. Now DAP is a compound fertilizer, contains 18 % N and 46 % P_2O_5. That means, 109 kg DAP will supply 109 x 18/100 = 19.62 ≈20 kg N /ha. In this example, one needs 100 kg N/ha. So, after applying 109 kg DAP, one requires 100 – 20 = 80 kg N/ha. Now, again select 46% from the first row and 80 kg from the first column and where these lines are crossing i.e.174 kg Urea/ha. should be applied .

Note : While calculating doses of fertilizers, first calculate potassic fertilizers, then phosphatic fertilizers and lastly, nitrogenous fertilizers. So that one can subtract phosphorus and nitrogen available from the potassic fertilizers and nitrogen from the phosphatic fertilizers.

Annexure VIII: Soil Heath Card format- 2003-04



Annexure IX: SHARP- The Soil Clinic in Gujarat



Sharp - The Soil Clinic

Print Date : 12/21/2013

District : Kachchh Block : Bhuj Village : Samatra

Farmer Name :	Dhanji Valji Devshi Patel	Survey No :	14
Soil Health Card Type :	Government	Soil Health Card No :	SHC06331647
Crop Type :	Annually	Crop Name :	Wheat Irrigated - Duram

Fertilizer Recommendation

Dose of Farm Yard Mannure(FYM)	5.20 Ton/Acre	Soil Ammendent -	Lime and Gypsum is n

Basel Dose

Combination / Option 1

	Fertilizer Name	Quantity	Applied on
1	Di Ammonium Phosphate(DAP)	52.17 Kg/Acre	0 days
2	Urea	31.76 Kg/Acre	0 days

Combination / Option 2

	Fertilizer Name	Quantity	Applied on
1	Ammonium Sulfate	69.57 Kg/Acre	0 days
2	Di Ammonium Phosphate(DAP)	52.17 Kg/Acre	0 days

Combination / Option 3

	Fertilizer Name	Quantity	Applied on
1	Calcium Ammonium Nitret	58.43 Kg/Acre	0 days
2	Di Ammonium Phosphate(DAP)	52.17 Kg/Acre	0 days

Top Dressing 1

Combination / Option 1

	Fertilizer Name	Quantity	Applied on
1	Urea	52.17 Kg/Acre	35 days

Combination / Option 2

	Fertilizer Name	Quantity	Applied on
1	Ammonium Sulfate	114.29 Kg/Acre	35 days

Combination / Option 3

	Fertilizer Name	Quantity	Applied on
1	Calcium Ammonium Nitret	96.00 Kg/Acre	35 days

Design & Developed by : K-Link Foundation URL : - www.klink.co.in Page 1 of 2

Annexure X: Farm Size wise Cropping Pattern of the Sample Households (Soil Test Farmers)

(Area in acre per HH.)

Sr. No.	Season/ Crop	IRRI/ UNIRRI	Marginal		Small		Medium		Large		All Farms	
1	**Kharif crops**											
	Paddy	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Maize	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Bajra	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.01	(0.2)	0.00	(0.0)	0.00	(0.1)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.02	(0.2)	0.01	(0.1)
	Jowar	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.02	(0.4)	0.16	(1.6)	0.05	(1.0)
		UNIRRI	0.00	(0.0)	0.02	(0.9)	0.06	(1.5)	0.07	(0.7)	0.05	(1.0)
	Ragi	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Other Cereals	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.01	(0.2)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(i)	Total cereals	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.04	(0.9)	0.16	(1.6)	0.05	(1.1)
		UNIRRI	0.00	(0.0)	0.02	(0.9)	0.06	(1.5)	0.09	(1.0)	0.05	(1.1)
		IRRI	0.00	(0.0)	0.02	(0.9)	0.10	(2.4)	0.25	(2.5)	0.11	(2.2)
	Tur	*UNIRRI*	0.00	(0.0)	0.02	(0.8)	0.02	(0.4)	0.00	(0.0)	0.01	(0.2)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Gram	*UNIRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Math	*UNIRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Urad	*UNIRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Other Pulses	*UNIRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(ii)	Total Kharif Pulses	*IRRI*	0.00	(0.0)	0.02	(0.8)	0.02	(0.4)	0.00	(0.0)	0.01	(0.2)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		Total	0.00	(0.0)	0.02	(0.8)	0.02	(0.4)	0.00	(0.0)	0.01	(0.2)
	Groundnut	*IRRI*	0.20	(15.4)	0.63	(30.6)	1.14	(27.0)	1.38	(13.9)	0.98	(20.1)
		UNIRRI	0.19	(15.1)	0.13	(6.3)	0.24	(5.6)	0.27	(2.7)	0.21	(4.3)
	Sesamum	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.03	(0.3)	0.01	(0.2)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Castor	*IRRI*	0.00	(0.0)	0.01	(0.3)	0.04	(1.0)	0.32	(3.3)	0.10	(2.1)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.04	(0.9)	0.12	(1.2)	0.05	(1.0)
	Soyabean	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Other Oilseeds	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.02	(0.2)	0.01	(0.1)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.02	(0.2)	0.01	(0.1)
(iii)	Total Kharif oilseeds	*IRRI*	0.20	(15.4)	0.63	(30.9)	1.19	(28.0)	1.76	(17.7)	1.10	(22.5)
		UNIRRI	0.19	(15.1)	0.13	(6.3)	0.28	(6.5)	0.41	(4.2)	0.26	(5.4)
		Total	0.39	(30.5)	0.76	(37.2)	1.46	(34.6)	2.17	(21.9)	1.36	(27.9)

Annexure X Continued…

Sr.No.	Season/ Crop	Irrigated/ Unirrigated	Marginal		Small		Medium		Large		All Farms	
(iv)	Cotton	*IRRI*	0.25	(19.8)	0.47	(22.9)	0.83	(19.6)	2.00	(20.1)	0.99	(20.3)
		UNIRRI	0.16	(12.5)	0.06	(2.9)	0.23	(5.3)	1.44	(14.5)	0.50	(10.3)
(v)	Kharif Vegetables	*IRRI*	0.00	(0.0)	0.01	(0.3)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Kharif Fodder	*IRRI*	0.00	(0.0)	0.03	(1.3)	0.04	(0.9)	0.11	(1.1)	0.05	(1.1)
		UNIRRI	0.04	(3.1)	0.01	(0.7)	0.01	(0.3)	0.07	(0.7)	0.03	(0.6)
	Kharif Guar	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.03	(0.6)	0.18	(1.8)	0.06	(1.2)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.05	(0.5)	0.01	(0.3)
	Kharif Mirchi	*IRRI*	0.00	(0.0)	0.03	(1.7)	0.02	(0.5)	0.03	(0.3)	0.03	(0.5)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(vi)	Other Kharif Crops	*IRRI*	0.00	(0.0)	0.06	(3.0)	0.09	(2.1)	0.31	(3.2)	0.14	(2.8)
		UNIRRI	0.04	(3.1)	0.01	(0.7)	0.01	(0.3)	0.12	(1.2)	0.05	(0.9)
		IRRI	0.04	(3.1)	0.07	(3.6)	0.10	(2.4)	0.44	(4.4)	0.18	(3.7)
(vii)	Total Kharif Crops	*UNIRRI*	0.45	(35.2)	1.19	(57.9)	2.16	(51.1)	4.23	(42.6)	2.29	(47.0)
		IRRI	0.39	(30.7)	0.22	(10.7)	0.58	(13.7)	2.08	(20.9)	0.86	(17.7)
		Total	0.84	(65.9)	1.41	(68.6)	2.74	(64.8)	6.30	(63.5)	3.15	(64.6)
2	**Rabi crops**											
	Wheat	*IRRI*	0.06	(5.0)	0.18	(9.0)	0.44	(10.3)	0.53	(5.3)	0.36	(7.3)
		UNIRRI	0.00	(0.0)	0.01	(0.3)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Barely	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Maize	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.01	(0.1)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Bajra	*IRRI*	0.02	(1.4)	0.03	(1.4)	0.01	(0.2)	0.00	(0.0)	0.01	(0.3)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Jowar	*IRRI*	0.05	(3.9)	0.05	(2.4)	0.03	(0.6)	0.08	(0.8)	0.05	(1.0)
		UNIRRI	0.00	(0.0)	0.02	(0.8)	0.00	(0.0)	0.00	(0.0)	0.00	(0.1)
	Other Cereals	*IRRI*	0.00	(0.0)	0.01	(0.3)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(vii)	Total Rabi Cereals	*IRRI*	0.13	(10.4)	0.27	(13.0)	0.48	(11.2)	0.61	(6.1)	0.42	(8.6)
		UNIRRI	0.00	(0.0)	0.02	(1.1)	0.00	(0.0)	0.00	(0.0)	0.01	(0.1)
		IRRI	0.13	(10.4)	0.29	(14.1)	0.48	(11.2)	0.61	(6.1)	0.43	(8.7)
	Peas	*UNIRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Gram	*UNIRRI*	0.00	(0.0)	0.01	(0.6)	0.07	(1.7)	0.04	(0.4)	0.04	(0.8)
		IRRI	0.00	(0.0)	0.01	(0.4)	0.05	(1.3)	0.47	(4.7)	0.15	(3.0)
	Tur	*UNIRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.09	(0.9)	0.02	(0.5)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Other Rabi Pulses	*UNIRRI*	0.00	(0.0)	0.00	(0.0)	0.01	(0.1)	0.00	(0.0)	0.00	(0.0)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(viii)	Total Rabi Pulses	*UNIRRI*	0.00	(0.0)	0.01	(0.6)	0.08	(1.8)	0.13	(1.3)	0.06	(1.3)
		IRRI	0.00	(0.0)	0.01	(0.4)	0.05	(1.3)	0.47	(4.7)	0.15	(3.0)
		Total	0.00	(0.0)	0.02	(0.9)	0.13	(3.1)	0.60	(6.1)	0.21	(4.3)

Annexure X Continued…

Sr.No.	Season/ Crop	Irrigated/ Unirrigated	Marginal		Small		Medium		Large		All Farms	
	Rapseed & Mustard	*IRRI*	0.03	(2.3)	0.02	(1.0)	0.04	(0.9)	0.00	(0.0)	0.02	(0.4)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Rabi other Oilseeds	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.02	(0.4)	0.02	(0.2)	0.01	(0.3)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(ix)	*Total Rabi Oilseeds*	*IRRI*	0.03	(2.3)	0.02	(1.0)	0.06	(1.3)	0.02	(0.2)	0.03	(0.7)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		Total	0.03	(2.3)	0.02	(1.0)	0.06	(1.4)	0.02	(0.2)	0.04	(0.7)
	Cumin	*IRRI*	0.15	(12.1)	0.11	(5.2)	0.30	(7.0)	0.83	(8.3)	0.37	(7.6)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.01	(0.3)	0.01	(0.1)	0.01	(0.2)
	Other spice1	*IRRI*	0.00	(0.0)	0.08	(3.9)	0.19	(4.5)	0.23	(2.3)	0.15	(3.1)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Other spices 2	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.02	(0.4)	0.02	(0.2)	0.01	(0.2)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(x)	Total Spices	*IRRI*	0.15	(12.1)	0.19	(9.1)	0.51	(12.0)	1.07	(10.8)	0.54	(11.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.01	(0.3)	0.01	(0.1)	0.01	(0.2)
		Total	0.15	(12.1)	0.19	(9.1)	0.52	(12.3)	1.08	(10.9)	0.54	(11.1)
	Onion	*IRRI*	0.00	(0.0)	0.02	(1.1)	0.07	(1.7)	0.09	(0.9)	0.06	(1.1)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Other Vegetable	*IRRI*	0.00	(0.0)	0.02	(0.9)	0.03	(0.7)	0.05	(0.5)	0.03	(0.6)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xi)	Total Vegetable	*IRRI*	0.00	(0.0)	0.04	(2.0)	0.10	(2.4)	0.14	(1.4)	0.08	(1.7)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		Total	0.00	(0.0)	0.04	(2.0)	0.10	(2.4)	0.14	(1.4)	0.08	(1.7)
(xii)	Fodder	*IRRI*	0.09	(7.2)	0.01	(0.7)	0.03	(0.8)	0.04	(0.4)	0.03	(0.7)
		UNIRRI	0.00	(0.0)	0.01	(0.3)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xiii)	Total Rabi Crops	*IRRI*	0.41	(32.0)	0.54	(26.3)	1.25	(29.5)	2.02	(20.3)	1.17	(24.0)
		UNIRRI	0.00	(0.0)	0.04	(1.8)	0.07	(1.6)	0.48	(4.8)	0.16	(3.4)
		Total	0.41	(32.0)	0.58	(28.1)	1.32	(31.1)	2.50	(25.1)	1.34	(27.4)

Annexure X Continued…

3	**Summer Crops**											
	Summer Bajra	*IRRI*	0.03	(2.1)	0.01	(0.5)	0.00	(0.0)	0.00	(0.0)	0.01	(0.1)
		UNIRRI	0.00	(0.0)	0.00	(0.1)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Summer Paddy	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Summer Maize	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Summer Jowar	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.02	(0.6)	0.04	(0.4)	0.02	(0.4)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xiv)	Total Summer Cereals	*IRRI*	0.03	(2.1)	0.01	(0.5)	0.02	(0.6)	0.04	(0.4)	0.02	(0.5)
		UNIRRI	0.00	(0.0)	0.00	(0.1)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		Total	0.03	(2.1)	0.01	(0.6)	0.02	(0.6)	0.04	(0.4)	0.03	(0.5)
	Summer Groundnut	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Summer Seseamum	*IRRI*	0.00	(0.0)	0.01	(0.6)	0.11	(2.5)	0.13	(1.3)	0.08	(1.6)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xv)	Total Oilseeds	*IRRI*	0.00	(0.0)	0.01	(0.6)	0.11	(2.5)	0.13	(1.3)	0.08	(1.6)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		Total	0.00	(0.0)	0.01	(0.6)	0.11	(2.5)	0.13	(1.3)	0.08	(1.6)
	Other Summer Crops	*IRRI*	0.00	(0.0)	0.04	(1.8)	0.04	(1.0)	0.96	(9.6)	0.29	(5.9)
		UNIRRI	0.00	(0.0)	0.01	(0.3)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xvi)	Total Summer Crops	*IRRI*	0.03	(2.1)	0.06	(2.9)	0.18	(4.1)	1.13	(11.4)	0.39	(7.9)
		UNIRRI	0.00	(0.0)	0.01	(0.4)	0.00	(0.0)	0.00	(0.0)	0.00	(0.1)
		Total	0.03	(2.1)	0.07	(3.3)	0.18	(4.1)	1.13	(11.4)	0.39	(8.0)
4	**Gross Cropped Area**											
		IRRI	0.89	(69.3)	1.78	(87.1)	3.59	(84.7)	7.37	(74.3)	3.85	(78.9)
		UNIRRI	0.39	(30.7)	0.27	(12.9)	0.65	(15.3)	2.56	(25.7)	1.03	(21.1)
		Total	1.28	(100.0)	2.05	(100.0)	4.24	(100.0)	9.93	(100.0)	4.88	(100.0)

Notes: IRR-irrigated, UNIRRI- un-irrigated, figures in parentheses are the percentages of GCA in their respective categories.
Source: Field survey

Annexure XI: Farm Size wise Cropping Pattern of the Sample Households (Control Farmers)

(Area in acre per HH.)

Sr. No.	Season/ Crop	IRRI/ UNIRRI	Marginal		Small		Medium		Large		All Farms	
1	Kharif crops											
	Paddy	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Maize	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Bajra	*IRRI*	0.00	(0.0)	0.01	(0.4)	0.02	(0.4)	0.00	(0.0)	0.01	(0.1)
		UNIRRI	0.00	(0.2)	0.00	(0.0)	0.00	(0.0)	0.01	(0.1)	0.00	(0.0)
	Jowar	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.08	(1.9)	0.13	(1.6)	0.07	(1.5)
		UNIRRI	0.03	(3.2)	0.03	(1.3)	0.01	(0.2)	0.15	(1.9)	0.07	(1.5)
	Ragi	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Other Cereals	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.03	(0.3)	0.01	(0.2)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(i)		*IRRI*	0.00	(0.0)	0.01	(0.4)	0.10	(2.3)	0.15	(1.9)	0.09	(1.8)
	Total cereals	*UNIRRI*	0.03	(3.4)	0.03	(1.3)	0.01	(0.2)	0.16	(2.0)	0.07	(1.5)
		IRRI	0.03	(3.4)	0.04	(1.8)	0.11	(2.5)	0.31	(3.9)	0.16	(3.3)
	Tur	*UNIRRI*	0.00	(0.0)	0.05	(2.2)	0.00	(0.0)	0.00	(0.0)	0.01	(0.2)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Gram	*UNIRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Math	*UNIRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Urad	*UNIRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Other Pulses	*UNIRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(ii)	Total Kharif Pulses	*UNIRRI*	0.00	(0.0)	0.05	(2.2)	0.00	(0.0)	0.00	(0.0)	0.01	(0.2)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.05	(2.2)	0.00	(0.0)	0.00	(0.0)	0.01	(0.2)
	Groundnut	*IRRI*	0.15	(17.9)	0.54	(24.7)	1.17	(28.1)	1.22	(15.2)	0.95	(19.4)
		UNIRRI	0.18	(21.1)	0.10	(4.8)	0.10	(2.3)	0.29	(3.7)	0.18	(3.8)
	Sesamum	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.01	(0.1)	0.00	(0.1)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Castor	*IRRI*	0.05	(5.5)	0.02	(1.1)	0.02	(0.6)	0.12	(1.5)	0.06	(1.3)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.04	(1.0)	0.24	(2.9)	0.10	(2.1)
	Soyabean	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Other Oilseeds	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(iii)	Total Kharif oilseeds	*IRRI*	0.20	(23.4)	0.57	(25.8)	1.19	(28.7)	1.35	(16.8)	1.01	(20.8)
		UNIRRI	0.18	(21.1)	0.10	(4.8)	0.14	(3.3)	0.53	(6.6)	0.29	(5.9)
			0.38	(44.5)	0.67	(30.6)	1.33	(32.0)	1.88	(23.4)	1.30	(26.7)

Annexure XI Continued…

Sr. No.	Season/ Crop	IRRI/ UNIRRI	Marginal		Small		Medium		Large		All Farms	
(iv)	Cotton	*IRRI*	0.17	(20.5)	0.58	(26.5)	1.00	(24.0)	1.92	(23.9)	1.18	(24.2)
		UNIRRI	0.00	(0.0)	0.11	(5.1)	0.16	(3.8)	1.11	(13.8)	0.50	(10.3)
(v)	Kharif Vegetables	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(vi)	Kharif Fodder	*IRRI*	0.02	(2.1)	0.03	(1.2)	0.09	(2.2)	0.08	(1.0)	0.07	(1.3)
		UNIRRI	0.00	(0.0)	0.03	(1.3)	0.01	(0.2)	0.15	(1.9)	0.07	(1.4)
(vii)	Kharif Guar	*IRRI*	0.00	(0.0)	0.01	(0.7)	0.03	(0.6)	0.14	(1.7)	0.06	(1.3)
		UNIRRI	0.02	(2.1)	0.02	(1.1)	0.00	(0.0)	0.02	(0.3)	0.02	(0.3)
(viii)	Onion	*IRRI*	0.00	(0.0)	0.01	(0.4)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(ix)	Other Kharif Crops	*IRRI*	0.02	(2.1)	0.05	(2.3)	0.12	(2.8)	0.22	(2.7)	0.13	(2.7)
		UNIRRI	0.02	(2.1)	0.05	(2.4)	0.01	(0.2)	0.17	(2.2)	0.08	(1.7)
			0.04	(4.2)	0.10	(4.8)	0.13	(3.0)	0.39	(4.9)	0.21	(4.4)
(x)	Total Kharif Crops	*IRRI*	0.39	(46.1)	1.26	(57.3)	2.41	(57.7)	3.64	(45.4)	2.42	(49.7)
		UNIRRI	0.22	(26.6)	0.30	(13.6)	0.32	(7.6)	1.97	(24.5)	0.94	(19.4)
		Total	0.61	(72.6)	1.56	(70.9)	2.72	(65.3)	5.61	(69.9)	3.36	(69.1)
2	Rabi crops											
	Wheat	*IRRI*	0.06	(7.4)	0.24	(10.8)	0.57	(13.8)	0.50	(6.2)	0.42	(8.6)
		UNIRRI	0.00	(0.0)	0.01	(0.7)	0.00	(0.0)	0.00	(0.0)	0.00	(0.1)
	Barely	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Maize	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Bajra	*IRRI*	0.03	(3.2)	0.01	(0.6)	0.00	(0.0)	0.01	(0.1)	0.01	(0.2)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Jowar	*IRRI*	0.04	(4.2)	0.01	(0.7)	0.06	(1.4)	0.01	(0.1)	0.03	(0.5)
		UNIRRI	0.05	(5.8)	0.04	(1.8)	0.00	(0.0)	0.00	(0.0)	0.01	(0.3)
	Other Cereals	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xi)	Total Rabi Cereals	*IRRI*	0.12	(14.7)	0.26	(12.1)	0.63	(15.1)	0.51	(6.4)	0.45	(9.3)
		UNIRRI	0.05	(5.8)	0.05	(2.4)	0.00	(0.0)	0.00	(0.0)	0.02	(0.3)
		IRRI	0.17	(20.5)	0.32	(14.5)	0.63	(15.1)	0.51	(6.4)	0.47	(9.6)
	Peas	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Gram	*IRRI*	0.00	(0.0)	0.07	(3.3)	0.10	(2.4)	0.17	(2.1)	0.11	(2.3)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.12	(1.6)	0.05	(1.0)
	Other Rabi Pulses	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xii)	Total Rabi Pulses	*IRRI*	0.00	(0.0)	0.07	(3.3)	0.10	(2.4)	0.17	(2.1)	0.11	(2.3)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.12	(1.6)	0.05	(1.0)
		Total	0.00	(0.0)	0.07	(3.3)	0.10	(2.4)	0.29	(3.7)	0.16	(3.3)

Annexure XI Continued…

Sr. No.	Season/ Crop	IRRI/ UNIRRI	Marginal		Small		Medium		Large		All Farms	
	Rapseed & Mustard	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Rabi other Oilseeds	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.02	(0.3)	0.01	(0.2)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xiii)	Total Rabi Oilseeds	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.02	(0.3)	0.01	(0.2)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
			0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.02	(0.3)	0.01	(0.2)
	Cumin	*IRRI*	0.01	(1.1)	0.07	(3.0)	0.42	(10.1)	1.09	(13.5)	0.56	(11.5)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.02	(0.3)	0.01	(0.2)
	Rabi other spice	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.05	(1.3)	0.04	(0.5)	0.03	(0.7)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xiv)	Total Spices	*IRRI*	0.01	(1.1)	0.07	(3.0)	0.47	(11.4)	1.13	(14.1)	0.59	(12.1)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.02	(0.3)	0.01	(0.2)
		IRRI	0.01	(1.1)	0.07	(3.0)	0.47	(11.4)	1.15	(14.3)	0.60	(12.3)
	Onion	*UNIRRI*	0.04	(5.3)	0.04	(1.7)	0.04	(1.0)	0.04	(0.5)	0.04	(0.8)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Other Vegetable	*UNIRRI*	0.00	(0.0)	0.00	(0.0)	0.01	(0.2)	0.00	(0.0)	0.00	(0.1)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xv)	Total Vegetable	*IRRI*	0.04	(5.3)	0.04	(1.7)	0.05	(1.2)	0.04	(0.5)	0.04	(0.9)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		IRRI	0.04	(5.3)	0.04	(1.7)	0.05	(1.3)	0.04	(0.5)	0.04	(0.9)
(xvi)	Fodder	*IRRI*	0.00	(0.0)	0.01	(0.7)	0.02	(0.0)	0.02	(0.2)	0.01	(0.3)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Rabi Others Crops	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xvii)	Total Rabi Crops	*IRRI*	0.18	(21.1)	0.45	(20.7)	1.27	(30.6)	1.89	(23.5)	1.22	(25.0)
		UNIRRI	0.05	(5.8)	0.05	(2.4)	0.00	(0.0)	0.14	(1.8)	0.07	(1.5)
		Total	0.23	(26.8)	0.51	(23.1)	1.28	(30.6)	2.03	(25.3)	1.29	(26.6)
3	Summer Crops											
	Summer Bajra	*IRRI*	0.00	(0.5)	0.00	(0.0)	0.01	(0.2)	0.00	(0.0)	0.00	(0.1)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Summer Paddy	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Summer Maize	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Summer Jowar	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.01	(0.3)	0.02	(0.3)	0.01	(0.2)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xviii)	Total Summer Cereals	*IRRI*	0.00	(0.5)	0.00	(0.0)	0.02	(0.6)	0.02	(0.3)	0.02	(0.3)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
			0.00	(0.5)	0.00	(0.0)	0.02	(0.6)	0.02	(0.3)	0.02	(0.3)
(xix)	Total Summer Pulses	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
	Summer Groundnut	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)

Annexure XI Continued…

Sr. No.	Season/ Crop	IRRI/ UNIRRI	Marginal		Small		Medium		Large		All Farms	
	Summer Seseamum	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.07	(1.8)	0.15	(1.9)	0.08	(1.7)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xx)	Total Oilseeds	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.07	(1.8)	0.15	(1.9)	0.08	(1.7)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
			0.00	(0.0)	0.00	(0.0)	0.07	(1.8)	0.15	(1.9)	0.08	(1.7)
(xxi)	Other Summer Crops-1	*IRRI*	0.00	(0.0)	0.10	(4.4)	0.06	(1.4)	0.15	(1.9)	0.10	(2.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xxii)	Other Summer Crops-2	*IRRI*	0.00	(0.0)	0.00	(0.0)	0.01	(0.3)	0.03	(0.4)	0.01	(0.3)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xxiii)	Total Summer Crops	*IRRI*	0.00	(0.5)	0.10	(4.4)	0.17	(4.1)	0.36	(4.5)	0.19	(4.0)
		UNIRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		IRRI	0.00	(0.5)	0.10	(4.4)	0.17	(4.1)	0.36	(4.5)	0.19	(4.0)
(xxiv)	Fruits	*UNIRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xxv)	Sugarcane	*UNIRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xxvi)	Tobacco	*UNIRRI*	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xxvii)	Other Crops	*UNIRRI*	0.00	(0.0)	0.03	(1.5)	0.00	(0.0)	0.03	(0.3)	0.02	(0.3)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
(xxviii)	Total Other Crops	*UNIRRI*	0.00	(0.0)	0.03	(1.5)	0.00	(0.0)	0.03	(0.3)	0.02	(0.3)
		IRRI	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)	0.00	(0.0)
		Total	0.00	(0.0)	0.03	(1.5)	0.00	(0.0)	0.03	(0.3)	0.02	(0.3)
4	Gross Cropped Area											
		IRRI	0.57	(67.6)	1.84	(84.0)	3.85	(92.4)	5.92	(73.7)	3.85	(79.1)
		UNIRRI	0.27	(32.4)	0.35	(16.0)	0.32	(7.6)	2.11	(26.3)	1.02	(20.9)
		Total	0.84	(100.0)	2.19	(100.0)	4.17	(100.0)	8.03	(100.0)	4.87	(100.0)

Note: Figures in parentheses are the percentages of GCA in their respective categories.
Source: Field survey

Annexure XII: Farmer Category wise Area under HYV of Major Crops (Soil Test Farmers)

(% of GCA)

Crop Name	Marginal		Small		Medium		Large		All Farms	
	Area (In Ha.)	% of GCA	Area (In Ha.)	% of GCA	Area (In Ha.)	% of GCA	Area (In Ha.)	% of GCA	Area (In Ha.)	% of GCA
Kharif main crops										
Jowar	0.00	0.00	0.00	2.50	0.01	1.25	0.01	0.83	0.02	4.58
Tur	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.83
Groundnut	0.02	2.92	0.16	15.83	0.34	16.67	0.29	7.08	0.81	42.50
Castor	0.00	0.00	0.00	0.00	0.02	3.33	0.08	5.00	0.10	10.00
Cotton	0.02	4.17	0.13	17.08	0.28	20.00	0.60	15.00	1.03	56.25
Guar	0.00	0.00	0.00	0.00	0.00	0.42	0.04	2.50	0.04	3.33
Mirchi	0.00	0.00	0.01	0.83	0.01	1.25	0.00	0.00	0.01	2.08
Rabi main crops										
Wheat	0.00	0.83	0.03	5.00	0.10	7.50	0.05	4.17	0.18	17.50
Bajra	0.00	0.42	0.00	0.83	0.00	0.83	0.00	0.00	0.01	2.08
Jowar	0.00	0.00	0.00	1.25	0.01	0.83	0.00	0.42	0.01	2.92
Gram	0.00	0.00	0.00	0.42	0.00	0.42	0.00	0.00	0.01	0.83
Rapeseed & Mustard	0.00	0.00	0.00	0.83	0.00	0.42	0.00	0.00	0.01	1.25
Cumin	0.01	0.83	0.01	1.67	0.05	5.00	0.13	7.50	0.19	15.00
Other Spices	0.00	0.00	0.02	1.67	0.02	1.67	0.02	2.08	0.06	5.42
Onion	0.00	0.00	0.00	0.83	0.01	1.25	0.02	1.25	0.03	3.33
Summer main crops										
Jowar	0.00	0.00	0.00	0.00	0.01	1.67	0.01	1.25	0.02	2.92
Sesamum (Til)	0.00	0.00	0.00	0.00	0.01	0.83	0.03	1.67	0.03	2.50
Total HYV area	0.04	3.42	0.32	15.84	0.73	17.13	1.17	11.74	2.26	46.26

Source: Field Survey

Annexure XIII: Farmer Category wise Area under HYV of Major Crops (Control Farmers)

(% of GCA)

Crop Name	Marginal		Small		Medium		Large		All Farms	
	Area (In Ha.)	% of GCA	Area (In Ha.)	% of GCA	Area (In Ha.)	% of GCA	Area (In Ha.)	% of GCA	Area (In Ha.)	% of GCA
Kharif										
Kharif Jowar	0.00	0.00	0.01	4.29	0.01	10.00	0.02	15.00	0.04	29.29
Groundnut	0.04	6.88	0.11	9.38	0.33	17.50	0.52	17.50	0.99	51.25
Cotton	0.00	0.00	0.03	2.50	0.03	1.88	0.15	3.13	0.22	7.50
Castor	0.00	0.63	0.01	0.63	0.00	0.00	0.02	1.25	0.03	2.50
Other Fodder	0.00	0.00	0.00	0.00	0.01	0.63	0.00	0.00	0.01	0.63
Gaur	0.00	0.00	0.00	0.63	0.00	0.00	0.01	1.25	0.01	1.88
Onion	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.00	0.00
Rabi										
Wheat	0.00	1.25	0.04	4.38	0.09	6.25	0.08	6.25	0.21	18.13
Jowar	0.01	1.88	0.00	0.63	0.00	0.00	0.00	0.00	0.01	2.50
Gram	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.63	0.01	0.63
Cumin	0.00	0.00	0.01	1.88	0.06	5.00	0.10	8.75	0.17	15.63
Onion	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.63	0.01	1.25
Fodder 1					0.00	0.63			0.00	0.63
Summer										
Bajra	0.00	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63
Jowar	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.63	0.01	1.25
Others	0.00	0.00	0.01	1.25	0.02	1.25	0.01	1.25	0.03	3.75
Total HYV area	0.05	5.97	0.22	10.14	0.55	13.17	0.93	11.55	1.75	35.77

Source: Field Survey

Annexure XIV: Average Value of Crop Output (All Farmers-both Cotton and Groundnut)

Particulars	Per Household				Per Acres			
	Output (Qt)	Value of output (Rs.)	Output sold (Qt)	Value of qty sold (Rs.)	Output (Qt)	Value of output (Rs.)	Output sold (Qt)	Value of qty sold (Rs.)
1	2	3	4	5	6	7	8	9
Soil Test Farmers								
Marginal	33.8	100028.7	26.3	90003.9	27.9	83989.2	22.7	75812.2
Small	62.8	202415.2	53.9	188213.1	31.0	97578.4	26.5	90687.1
Medium	132.8	400061.7	107.8	366513.2	30.3	88125.1	24.0	79506.2
Large	255.0	729734.3	207.4	693740.2	26.4	71604.7	21.8	68394.1
Total	137.0	406301.4	112.1	379756.8	29.2	86159.4	24.1	79558.5
Control Farmers								
Marginal	33.8	75141.7	15.2	64169.4	34.6	82794.0	15.2	71730.2
Small	50.0	157189.1	12.5	141180.8	32.8	140231.4	5.2	134087.4
Medium	92.4	318147.8	27.6	288733.6	22.0	73221.3	6.5	66747.2
Large	185.7	549164.6	37.7	516874.6	24.0	69094.4	5.2	69161.2
Total	113.2	347130.9	27.0	321442.0	26.4	86519.9	6.7	82132.1

Source: Field Survey

Annexure XV: Farm Assets Holdings (All Farmers-both Cotton and Groundnut)

Particulars	Soil Test Farmers		Control Farmers	
	Number/ household	Value/ household (Rs)	Number/ household	Value/ Household (Rs)
Tractor	0.3	99083.3	0.3	97073.8
Trailer/trolley	0.2	16966.7	0.3	17842.8
Harrow and cultivator	0.3	6286.3	0.4	7188.7
Electric motor	0.7	22601.3	0.7	21122.6
Diesel Engine	0.5	9282.1	0.4	7430.8
Thresher	0.1	3716.7	0.1	5283.0
Planker	0.0	11.7	0.0	0.0
Manual/power sprayer	1.1	2535.1	0.9	2283.9
Fodder chopper	0.0	35.2	0.0	14.5
Bullock cart	0.5	11612.1	0.5	13128.9
Drip System	0.3	12037.5	0.1	7562.2
Sprinkler System	0.5	4196.7	0.3	1424.5
Small tools (spade, hoe, sickle etc.)	5.5	2410.5	5.6	3153.2
Animal shed/pump house	0.4	8340.4	0.6	12677.4
Others	0.0	10770.8	0.0	534.6

Source: Field Survey

Annexure XVI: Farmer Category wise Agricultural Credit Outstanding (Soil Test Farmers-Both Cotton and Groundnut)

(Rs/household)

Sources	Marginal	Small	Medium	Large	Total
Co-operative Credit Societies	24200.0	6312.5	23777.8	65750.0	30945.5
Land development banks	0.0	70000.0	0.0	0.0	70000.0
Commercial banks	0.0	9046.9	33953.5	59541.7	31485.6
RRBs	0.0	0.0	20000.0	0.0	6896.6
Money lenders	0.0	0.0	0.0	0.0	0.0
Fiends/Relatives	0.0	0.0	0.0	0.0	0.0
Traders/Commission agents	0.0	0.0	0.0	0.0	0.0
Others	0.0	0.0	0.0	0.0	0.0
Total	6368.4211	6395.8	24857.1	39646.2	21860.4

Source : Field Survey

Annexure XVII: Farmer Category wise Agricultural Credit Outstanding (Control Farmers-Both Cotton and Groundnut)

(Rs/household)

Sources	Marginal	Small	Medium	Large	Total
Co-operative Credit Societies	21000	7500	26588.24	54541.67	27407.48
Land development banks	0	0	0	0	0
Commercial banks	8333.33	6250	51619.05	103581.87	42446.06
RRBs			0	16666.67	8333.33
Money lenders	0	0	0	0	0
Fiends/Relatives	0	0	0	0	0
Traders/Commission agents	0	0	0	0	0
Others	0	0	0	0	0
Total	4888.89	6060.61	32680.85	65382.69	37253.26

Source : Field Survey

Annexure XVIII: Farmer Category wise Purpose of Agricultural Loan Availed (Soil Test Farmers-Both Cotton and Groundnut)

(% of farmers)

Purpose	Marginal	Small	Medium	Large	Total
Seasonal crop cultivation	52.38	79.17	81.71	73.85	75.42
Purchase of tractor and other implements	0.00	0.00	2.44	1.54	1.25
Purchase of livestock	0.00	0.00	1.22	0.00	0.42
Land development	0.00	1.39	1.22	0.00	0.83
Consumption expenditure	0.00	0.00	0.00	0.00	0.00
Marriage and social ceremonies	0.00	0.00	0.00	0.00	0.00
Non-farm activities	0.00	0.00	0.00	0.00	0.00
Other expenditures	0.00	0.00	0.00	0.00	0.00
Total	52.38	80.56	86.59	75.38	77.92

Source: Field Survey

Annexure XIX: Farmer Category wise Purpose of Agricultural Loan Availed (Control Farmers-Both Cotton and Groundnut)

(% of farmers)

Purpose	Marginal	Small	Medium	Large	Total
Seasonal crop cultivation	33.33	84.85	87.23	77.42	76.88
Purchase of tractor and other implements	0.00	0.00	0.00	3.23	1.25
Purchase of livestock	0.00	0.00	0.00	0.00	0.00
Land development	0.00	0.00	0.00	0.00	0.00
Consumption expenditure	0.00	0.00	0.00	0.00	0.00
Marriage and social ceremonies	0.00	0.00	0.00	0.00	0.00
Non-farm activities	0.00	0.00	0.00	0.00	0.00
Other expenditures	0.00	0.00	0.00	1.61	0.63
Total	33.33	84.85	87.23	82.26	78.75

Source : Field survey

Appendix I:

Reviewer Comments on the Report

1. **Title of the draft report examined:**

Adoption of Recommended Doses of Fertilizers on Soil Test Basis by Farmers in Gujarat.

2. **Date of receipt of the Draft report:** January 5, 2015.

3. **Date of dispatch of the comments:** March 27, 2015.

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 has been followed.

6. **Comments on analysis, organization, presentation etc.**

(i) **Strictly follow the Table Formats sent across all AERCs** (mailed on August 19, 2014)

(ii) **Chapter III**- Table 3.1 Remove the absolute number of households and keep only percentages of sample.

(iii) Table 3.2 - the table is not in the format as suggested

Separate tables to be made for each crop and "All farmers" columns can be removed.

Only present total family size in the table and rows representing male and female family members under the same heading can be removed.

Rows presenting different education level of the sample can be removed from the table.

(iv) Table 3.3 Uncultivable waste land can be clubbed with uncultivated/fallow land. And each crop can be presented in separate table ignoring "Total" column.

(v) Table 3.4: Each crop can be presented in separate table ignoring "Total" column.

(vi) Table 3.5 and 3.6: only percentages to be presented in the table.

Crops having major share in the GCA can only be presented in the table and the rest (other crops) can be grouped in each season. If required, note can be inserted below the Table.

(vii)Table 3.7: Only percentage of cropped area can be presented in the Table and area can be removed. As suggested earlier, five to six crops having major share in GCA can only be presented in the Table.

(viii) Table 3.8 and Table 3.9: Value of output Rs/ha has to be recalculated as Rs/acre.

(ix) Table 3.10: Tractor with Trailor/trolley, electric motor with diesel engine and drip with sprinkler system can be added and presented.

(x) A row representing any other assets shows that number/household is zero but that zero asset has value in terms of Rupees. Hence it can be recalculated.

(xi) Table 3.12 and 3.13: Percentage of farmers out of total sample who availed loan from any source to be mentioned in the note below for better understanding of the situation.

(xii) Table 3.14 and 3.15: Only percentage of farmers to be presented in the table.

(xiii) **Chapter IV:** Table 4.1 and 4.2 -Title of the table to be changed as "Details of soil testing by sample farmers".

(xiv) Table 4.3 and Table 4.4: Last section of the table representing all farmers can be removed.

(xv)Table 4.5: Last three reasons can be removed from the table to maintain uniformity among different state reports.

(xvi) Table 4.7: Rows representing nitrogen, phosphorus, potassium and FYM to be removed.

(xvii) **Chapter V** - Table 5.4: The values presented in the table are calculated for hectare which should be recalculated and presented for acre in order to maintain uniformity.

(xviii) Table 5.5: In present table, the data is presented under different categories of farmers, which is not necessary and can be removed retaining only total. But the analysis must be done for each crop separately and presented.

(xix) **Chapter VI** - Table 6.1: Different prices have been used among different categories to analyse the present table instead one average price prevailing in the region must be used.

(xx)**Chapter VII** – Authors are suggested to edit the chapter based on corrections made in the previous chapters and support the findings with suitable economic reasons.

(xxi) Authors should provide economic explanation of data presented in all the chapters. **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 for consolidation.

Appendix II:

Action Taken on Comments

All comments have been considered carefully and necessary changes/additions/modifications have been made at appropriate places in the report.

Agro-Economic Research Centre
For the states of Gujarat and Rajasthan
(Ministry of Agriculture, Govt. of India)
H.M. Patel Institute of Rural Development,
Opp. Nanadalaya Temple, Post Box No. 24,
Sardar Patel University,
Vallabh Vidyanagar 388120,
Dist. Anand, Gujarat.

Ph. No. +91-2692-230106, 230799; Fax- +91-2692-233106
Email: director.aerc@gmail.com; directoraercgujarat@gmail.com

Website: www.aercspu.ac.in

University Press