Study No.-117

IMPACT OF NEEM-COATED UREA ON PRODUCTION, PRODUCTIVITY AND SOIL HEALTH IN MADHYA PRADESH

Agro-Economic Research Centre for
Madhya Pradesh and Chhattisgarh
Jawaharlal Nehru Krishi Vishwa Vidyalaya
Jabalpur (M.P.) 482004

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AGRO- ECONOMIC RESEARCH CENTRE FOR MADHYA PRADESH AND CHHATTISGARH

Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.)

PREFACE

The present study entitled "Impact of Neem-Coated Urea (NCU) on Production, Productivity and Soil Health in Madhya Pradesh" has been assigned by the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India to this centre under the close coordination of Agricultural Development and Rural Transformation Centre (ADRTC), Institute for Social and Economic Change (ISEC), Bangalore.

The study comprises 200 paddy and 200 soybean growers of Balaghat & Seoni and Khargone & Dhar districts respectively. The positive impact of NCU was observed on yield and profitability of crops. The yield of paddy and soybean obtained by NCU respondents was found to be higher than NU respondents. The use of NCU reduced the expenditure of applying nitrogen in both the crops and found economically feasible as consumption NCU is found more profitable as compared to NU.

The present study was conducted by Dr. H. O. Sharma and Dr. Deepak Rathi of this Centre. They have done field investigation, tabulation, analysis, interpretation and drafting of the report. I wish to express my deep sense of gratitude to team members namely; Mr. S.K. Upadhye, Mr. C.K. Mishra, Mr. S.C. Meena, Mr. H. K. Niranjan, Mr. S.S. Thakur, Mr. Rajendra Singh Bareliya and Mr. Ravi Singh Chouhan for their untiring efforts in bringing this innovative study to its perfect shape.

I extend heartfelt thanks to the Coordinator of this study Dr. A.V. Manjunatha, Assistant Professor, Agricultural Development and Rural Transformation Centre (ADRTC), Institute for Social and Economic Change (ISEC), Bangalore for providing valuable guidelines and time to time suggestions for conducting the study successfully.

On behalf of the Centre, I express deep sense of gratitude to Dr. V.S. Tomar, Hon'ble Vice-Chancellor and Chairman Advisory Body of AERC, Jabalpur, Shri. P.C. Bodh, Adviser, AER Division, Ministry of Agriculture, Govt. of India, New Delhi., Dr. S.K. Rao, Director Research Services, Dr. P.K. Mishra, Dean, Faculty of Agriculture, and Dr. D. Khare, Director Instruction, Dr. N.K. Raghuwanshi, Prof. & Head (Dept. of Agril. Econ. &F .M.), Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur for providing the valuable guidance and all facilities during various stages in successful completion of this study of high importance.

I express sincere thanks to Shri Rajesh Tripathi, Shri S.K. Nigam, Shri C.L. Kewada and Shri P.L. Sahu Deputy Director of Agriculture of Balaghat, Seoni, Khargone and Dhar districts respectively and their field staff for providing not only secondary data but also extending great assistance in collection of field data from the selected respondents .

I hope the findings and suggestions made in the study would be useful to policy makers of the State and Govt. of India.

Date : 27.01.2017
Place: Jabalpur

(Hari Om Sharma)
Prof. & Director

Contents

List of Tables

List of Tables

List of Figures

CHAPTER-I

INTRODUCTION

Fertilizers in general and nitrogenous fertilizers in particular have made a major contribution towards enhancement of agricultural productivity in the country. However, there is a continuous need to improve the efficiency of nitrogenous fertilizers in order to achieve more productivity of crops and to minimize the fertilizer related environmental problems. The results of several studies showed that only 50-60 per cent nitrogen is usually recovered by crop plants, when nitrogen is applied through nitrogenous fertilizers. The recovery per cent of applied nitrogen to rice is generally lowers than fifty.

Soil fertility is determined by three major elements namely Nitrogen, Phosphorus & Potassium (N, P, K) of which nitrogen plays a very important role. Out of 17 nutrients essentially required by crop plants for their normal growth and reproduction, nitrogen (N) is generally required by them in the largest amounts. Urea is one of the most widely used sources of nitrogenous fertiliser in the world. It also has high nitrogen content (46%), in comparison to many other popular nitrogenous sources. When applied to soil, urea transformed into ammonical (NH_{4+}) form after its hydrolysis and then to nitrite (NO_{2-}), followed by nitrate (NO_{3-}) form by the process of nitrification.

There are lot of differences in Neem Coated Urea (NCU) and the Normal Urea (NU). In NCU, a layer of Neem over the plain urea that increases the soil fertility capacity that leads to the higher production of crops. The oil coating of Neem in NCU mixes up slowly with the soil and the crop soaks it according to the need. The unwanted urea washed away with the water or gets diluted in the air as nitrogen. If the farmer uses NU, the maximum unit of the manure is left unused.

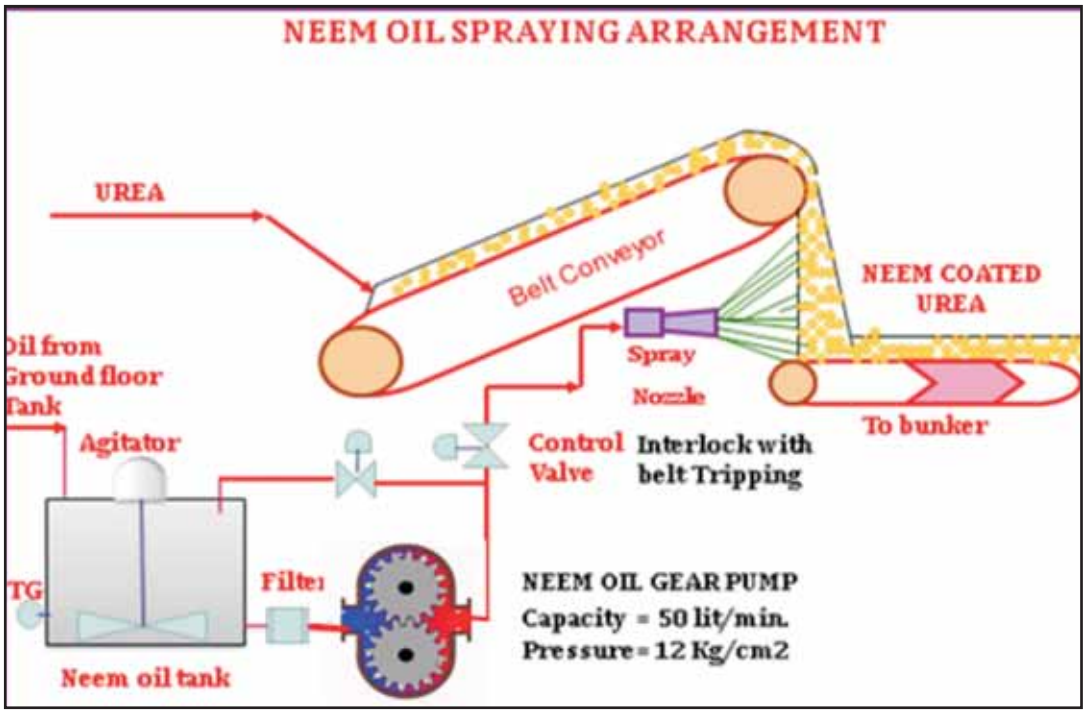
Nature Neem Urea coat is a special formulation of Nature Neem oil and humid acid which contains high quantity of Triterpenes, the denitrifying factor. Use of Neem Urea coating powder helps to retard the activity and growth of the bacteria responsible for de nitrification. Triterpenes in Nature Neem Urea coating agent inhibit the process of nitrification and reduce formation of nitrates which in-turn reduce N_2O emissions. It prevents the loss of Urea in the soil. It can also be used to control a large number of pests such as caterpillars, beetles, leafhoppers, borer, mites etc. The other commercially available Neem coating agents contains some of the isolated compounds of Neem. But Nature Neem urea coating agent contains all natural unaltered form of nutrients, which enables it to be an effective denitrifying agent and as well as a natural soil insecticide.

1.1 Process of Manufacturing NCU

One unloading pump, one storage tank (10 Te capacity), one gear pump for transfer elf-priming; (Size = 25 x 25 MOC = AISI 316; Capacity = 20 M3/hr at 5 Kg/cm2 pressure; Working Temp. = 60° Celsius; Viscosity = 34.8 CST), Neem Oil Storage Tank (MOC = M.S Capacity = 15,000 litters), Neem Oil Day Tank, (MOC = M.S. Capacity = 2500 litters), Neem Oil Unloading Pump (Flow = 10 M3/hr , Head = 13.6 mtr.; Motor = 2.2 KW, 1450 rpm.), Neem Oil Injection Pump (Capacity = 50 ltr/min. Pressure= 12 Kg/cm2) and Nozzle Specification, (Capacity=1.78 ltr/min. at

1.75 Kg/cm2; MOC = SS 316 Spray angle = 110 degree) for Neem coating a gear pump, Nozzle, Two number tanks (cap. 2500, 15000Lit), an electrical heater for heating Neem oil tank or steam coil may be used for this purpose.

Fig.-1.1 Process flow diagram for Neem coating



Control valve for regulating Neem oil spray, filter, and strainer before pump. The arrangement as shown in the Fig. 1.1. A recycle line Control valve also required for recycling the Neem oil. The Neem coating process control by following three parameters.

1. Oil Temperature(control by Heater electrical or steam coil)
2. Oil Pressure.
3. Oil Flow (gpm or lit/min)

The Neem oil tank fitted with level transmitter it may be ultrasonic level indication device. An on/off switch provide for temperature control of the tank range given to 55-70° C. An instrument airline inside the tank provided for uniform temperature throughout

The advantages of the NCU can be enumerated as follows:

1. Saving of 10% of the losses of urea would amount to 2 million tons of urea or a reduction in subsidy component to the tune of 1,700 crores per annum considering total subsidy on urea to be 18,000 crores per annum)
2. Proportional saving in the consumption of naphtha or natural gas.
3. Increased crop yields due to better nitrogen utilization.
4. Reduction in environmental pollution of ground water due to leaching of nitrates and gaseous emissions.
5. Opportunity for entrepreneurs to commercialize local Neem.
6. Resources and Development of Small Scale Industries in rural areas

Use of NCU not only increases the crop yield but at the same time lowers the input cost to farmer. Increasing nitrogen efficiency means reducing ground water and air pollution by nitrates and ammonia, respectively. It also reduces import of precious fertilizers as well as reduces ground and soil pollution. NCU has been demonstrated to improve nitrogen use efficiency and consequently crop yield especially in paddy and wheat. Coating with Neem oil also reduces caking of urea and chances of powder formation during transportation and handling. Repellent action of Neem oil also protects crops from many insects, pest and even rats are also go away due to bitter smell of Neem oil. Neem oil is used to manufacture Neem oil insecticide because it contains Azadirachtin which affects over 600 species of pests including insects, nematodes, fungi and viruses and is completely safe to non-target organisms like beneficial predators, honey bees, pollinators, fish, birds, cattle and human beings. Azadirachtin of Neem oil is a famous natural Anti-fee dent, growth regulator and ovi-positional repellent for insects, as a major active ingredient which make it a perfect alternative to chemical pesticides

1.2 Review of Literature

India is the second largest consumer of fertilizer in the world next to China, while it is the third largest producer of nitrogenous fertilizer in the world after China and USA. In terms of Nutrient-wise also, it stands second in the consumption of nitrogen (N) and phosphorus (P) with the quantity of 16.75 million tonnes and 5.63 million tonnes, respectively. Total consumption of NPK fertilizers in the country in 2013 was 24.48 million tonnes (IFA, 2015). About 80 per cent of the nitrogen was manufactured within the country, whereas the entire potash requirement and 90 per cent of the phosphate requirement was met through imports during 2000-01 to 2013-14 (Indian Fertilizer Scenario, 2013). The country does not have commercially viable production of potash, and hence the entire requirement of potash is met through imports. Efforts are being made by the government to make the nation self-sufficient in nitrogen and phosphate by increasing the manufacturing capacity of fertilizer companies through boosting investment, providing subsidy/concessions and through price control mechanisms.

Box 1: Featured Benefits of NCU

1. Slow down the process of nitrification of urea.
2. Neem Coated Urea reported improved yield up to 48%.
3. Decrease urea requirement by 50%.
4. Controls soil born nematodes, termites and other pest due to pesticide properties.

Urea is the most common nitrogenous fertilizer used uniformly throughout the world. The wide acceptance of Urea is because of its agronomic acceptability and relatively lower cost as compared to other fertilizers. Nitrogen application has both advantages and disadvantages. Advantages of Urea application are: (i) It is one of the primary/macro nutrient frequently required in a crop fertilization programme; (ii) Urea is a concentrated source of available nitrogen with high nitrogen content of 46 per cent; (iii) It increase vegetative growth and is necessary for the photosynthesis of plants. Besides being widely used as an excellent fertilizer for plant growth, it can also be used among numbers of products such as animal feed, commercial products, glue, resin, cosmetics,

pharmaceuticals, dish soaps, hair conditioners, tooth whiteners and so on.. Disadvantages of Urea application are: (i) Urea is easily soluble in water and decomposes even at room temperature that results in serious loss; (ii) It has adverse effect on seed germination, seedling growth, and early plant growth in soil (Bremner & Krogmeier, 1988); (iii)Eexcess nitrogen which is not absorbed by the plants leach into the groundwater aquifers and rivers, enters human body as drinking water, resulting in health disorders (Majumdar and Gupta, 2000); (iv) Excessive air-and water-borne nitrogen from fertilizers may cause respiratory ailments, cardiac disease, and several cancers; (v) It can inhibit crop growth and affect the dynamics of several vector-borne diseases (Townsend et.al, 2003).

With the increased cost of urea fertilizer and concern about its adverse environmental impact of Nitrogen losses, there has been a great interest in improving the Nitrogen Use Efficiency (NUE) through optimization of nitrogen use. By doing so, higher yields can be achieved with less negative impacts (eg. Nitrogen leaching) (Agostini et al., 2010; Burns, 2006; Neeteson and Carton, 2001; Rahn, 2002). NUE is the result of two main components: N uptake efficiency, which is the ability of crops to take up N from the soil (Burns, 2006; Greenwood et al., 1989), and use efficiency of the absorbed which means efficiency with which crops use the absorbed N to high yield (Janssen, 1998; Schenk, 2006). These efficiencies may differ within the same crop because they depend on different organs and mechanisms, and different environmental factors. The status paper on 'Enhancing nitrogen use efficiency - challenges and options' by Biswas and Subba Rao (2015) stated that average N recovery efficiency for fields managed by farmers ranges from about 20 per cent to 30 per cent under rainfed conditions and 30 per cent to 40 per cent under irrigated conditions. Further, they also claimed that Indian Agriculture Research Institute's (IARI) urea coating technology employing neem oil emulsion needing 0.5 -1.0 kg neem oil per tonne of urea was found superior to prilled urea among other slow release forms of urea.

Keeping in view the low NUE, it has been felt to find out the use of some indigenous material and coating process for reducing the nitrogen losses from urea. In this endeavor, National Fertilizer Limited (NFL) standardized the techniques for production of NCU in the year 2002. Since then many changes have been made in the process and applicant solution, to have uniform and consistent coating of Neem oil on urea prills, to maintain the concentration of Neem oil content as per the specification prescribed in Fertilizer Control Order (FCO), 1985. The use of Neem Coated Urea(NCU) has been found to improve the uptake of N, P and K significantly. Based upon the results of extensive field trials, NCU was found to be agronomically superior to normal prilled urea. Thus, NFL became the first company in India which was granted the permission to produce and market the NCU, vide Government of India Notification No S.O.807 (E) dated 9 July 2004. In the initial years, the total production of NCU was limited up to 35 per cent. Later, from March 2015, the Department of Fertilizer (DOF) has made it mandatory for all indigenous producers of urea to produce 75 per cent of their production as NCU and from 25th May, 2015 the cap was increased to 100 per cent.

In general, the demand for fertiliser depends on; (a) the price of the crop(s) output; (b) the price of fertiliser; (c) prices of other inputs that substitute or complement fertiliser; and (d) the parameters of the production function that describe the technical transformation of the inputs into output (i.e., the fertiliser response function) (Debertin 1986). Though, prices may be important in determining fertiliser consumption, they are possibly less important than other non-price factors such as introduction of new technology, high yielding crop varieties, expanded irrigation, availability of credit, changing cropping pattern and so on (Sharma and Thaker, 2011) causing the derived demand for fertilisers to shift over time. Furthermore, result revealed that similar to the total fertiliser consumption, technological factors such as high yielding varieties, irrigation, and cropping intensity and agricultural prices were more powerful in influencing N consumption compared to price factors; price of N fertilisers was the third important determinant of fertiliser demand; among input price and price of agricultural output, price of input (N fertiliser) was more powerful in influencing the consumption (Sharma and Thaker, 2011).

1.3 Need for the Study

Neem acts as a nitrification inhibitor and its coating over urea minimizes loss due to leaching. Coating urea with neem prevents its misuse as well as puts the fertiliser in slow release mode thereby nourishing the saplings for a longer period. Thus, avoids the repeated use of fertilizer and economize the quantity of urea required by crops (enhancing Nitrogen-Use Efficiency (NUE)). Besides, coating of neem oil also reduces the leaching of nitrates into the groundwater aquifers and thus, help in reducing its pollution. With this background, Government of India included neem coated urea, a slow release fertilizer, in the Fertilizer (Control) Order, 1985 and made it mandatory for all the indigenous producers of urea to produce 100 per cent of their total production of subsidized urea as NCU from 2015. Further, it has taken various steps to promote NCU, with a view to improve soil health status and also realise higher yield per hectare. There is need for a study assessing the impact of NCU on the production and yield of major crops in India. Therefore, the present study is proposed to examine the coverage of NCU, its adoption behaviour and its impact on yield among major crops in Madhya Pradesh. Besides, docume-ntation of baseline information on the status and implementation of soil health card scheme will also be done.

1.4 Objectives of the Study

The objectives of the study are as follows:

1. To analyze the trends in usage and prices of NU versus NCU in selected districts.
2. To analyze the adoption behavior of NCU among selected farmers in irrigated and un-irrigated tracts.
3. To analyze the impact of adoption of NCU on crop productivity and farmers' income.
4. To document the status and implementation of soil health card scheme.
5. To suggest suitable policy measures for adoption of NCU.

1.5 Data and Methodology

The study is confined to two major kharif crops i.e. paddy and soybean of Madhya Pradesh. A multistage purposive sampling method was

used to select the districts, blocks, villages and farm households. At the first stage two districts having highest area and highest consumption of NU/NCU has been selected purposively for paddy and soybean. Therefore, Balaghat & Seoni and Khargone and Dhar districts have been selected for Paddy and Soybean respectively in Madhya Pradesh. In second stage, two blocks from each district were selected again on the basis of highest area in the selected crops in these selected districts. Thus, Lalbarra & Kirnapur blocks in Balaghat district, and Kewalari & Barghat blocks in Seoni district have been selected for Paddy, whereas Maheshwar & Badwah blocks in Khargone, and Dhar & Badnawar blocks in Dhar district have been selected for Soybean. From each selected blocks 2 cluster of villages comprising 2-4 villages per cluster have been selected for collection of primary data. (Fig. 1.2) A sample of 50 farmers from each block comprising 100 farmers in each district, totalling to 200 farmers to each crop have been selected for the study. Thus, study comprising of 400 respondents of two major kharif crops i.e. Paddy (200) and Soybean (200). The household were selected randomly for assessing the use of NCU fertilizer and its impact on crop production. (Table 1.1)

Fig. 1.2: Selected districts in Madhya Pradesh

While selecting the households care was taken to have the representation of the farmers with full use of NCU, part use of NCU and no use of NCU (those who have used NU). Further, adequate care was taken to ensure that the selected crops i.e. paddy and soybean were grown under irrigated/un-irrigated condition in the state. Thus, a total number of 200 NCU/partial

NCU and NU user farmers for each crop will be interviewed through interview schedule provided by the coordinator (Agriculture Development and Rural Transformation Centre, Institute for Social and Economic Change, Bangalore) of the study and tested in local conditions of the Madhya Pradesh. Adequate representation was also given to different size of farms classified based on operational land holdings. (Table 1.2)

Table 1.1: Number of respondents in selected crops

S.No.	Districts	Blocks	Villages	Total Sample Size
Paddy				
1	Balaghat	1. Lalbarra	Chichgaon, Salhela, Khair Goni, Baholi	50
		2.Kirnapur	Khara, Batarmala, Chhindgaon, Mohgaon, Bagholi	50
2	Seoni	1. Kewlari	Vibhori, Arandiya, Khairi, Vavli, Sarekha	50
		2. Barghat	Takhala Kalan, Ghurwada, Panwas, Sajanwada, Niwari, Shalai Kalan, Salahiya Khurd, Salhe Kalan	50
Sub Total	2	4	23	200
Soybean				
3	Khargone	1. Maheshwar	Pathrad, Bagod, Ashapur, Surpala, Kharadi	50
		2. Badwah	Bhagwat, Daulatpura, Hanumantya, Balwada, Karahi	50
4	Dhar	1. Dhar	Jamanda, Utawad, Badeniya, Pipraj, Lewada, Kharod, Ekalduna, Sirsauda, Haprikhedi, Teesgaon	50
		2. Badnawar	Chandwariya Kalan, Sandla, Pakkihodi, Lalgaudi	50
Sub Total	2	4	24	200
Total	4	8	47	400

The reference period of the study was kharif 2015. The secondary data have been collected from http://www.urvarak.co.in/ and Department of Farmers' Welfare and Agriculture Development, Madhya Pradesh, Bhopal on district wise NU/NCU consumption and prices of NU/NCU from the year 1990-91 to 2015 to analyze trend of Urea consumption & price variation in Madhya Pradesh and concentration of NU in different districts of Madhya Pradesh.

Table 1.2: Number of selected farmers in different size of farms

Particulars	Small (<5 Acre)	Medium (5-10 Acre)	Large (>10 Acre)	Total
Paddy				
Number of Sample Farmers	119	56	25	200
Irrigated	90	54	25	169
Rain-fed	29	2	0	31
Soybean				
Number of Sample Farmers	126	45	29	200
Irrigated	124	44	27	195
Rain-fed	2	1	2	5
Total				
Number of Sample Farmers	245	101	54	400
Irrigated	214	98	52	364
Rain-fed	31	3	0	36

Collected data have been classified, tabulated and analysed in light of stated objectives of the study. Average, weighted average, percentage, exponential growth {(antilog of b-1) x 100} and paired 't' test have been used to draw conclusions from the data. Partial budgeting technique was also used to analyse impact of NCU over NU.

1.6 Limitations of the Study

The study does not claim its completeness in all aspects and certainly had some limitations. The data relating to the objectives of the study were collected from the selected respondents. The information provided by them is based on the face to face interview and they do not keep any record of their farming practices. Therefore, the information provided by them is entirely based on their memory thus, there is possibility of certain biasness enter in the present study.

1.7 Organization of the Report

The study is organised into 7 chapters. Chapter 1 covers the introductory part of the study followed by trend of Urea consumption in the state (Chapter II). Socio economic characterises of the sample household covered under chapter 3. Chapter 4 deals with the status of awareness and application of NCU. Awareness and adoption level of soil testing technology have been discussed in chapter 5, while impact of NCU application on crop production and soil health covers in chapter 6. Summary and conclusion are given in chapter 7.

CHAPTER-II

TREND IN UREA CONSUMPTION IN MADHYA PRADESH

This chapter deals with the trend of fertilizer consumption in the State along with general information of Madhya Pradesh i.e. location, population, land use pattern, cropping pattern, production and yield of major crops, area under irrigation and land holding. The trend of fertilizer consumption is analyzed by nutrients wise (N, P, K and Total NPK) as well as season wise (Rabi and Kharif) for the State.

Madhya Pradesh, in its present form, came into existence on November 1, 2000 following its bifurcation to create a new State of Chhattisgarh. The undivided Madhya Pradesh was founded on November 1, 1956. Madhya Pradesh, because of its central location in India has remained a crucible of historical currents from North, South, East and West.

Madhya Pradesh is situated in the heart of India between latitudes 21^0 53' to 22^0 53' North and longitude 77^0 47' to 78^0 44' East. It is the second largest State after Rajasthan of Indian Union with a total geographical area of 307.56 thousand square Kilometers. In terms of population (72,597,565) it occupies 7^{th} position in India (2011). It has 10 -commissionaire divisions (Chambal, Gwalior, Bhopal, Ujjain, Indore, Sagar, Rewa, Jabalpur, Hosangabad and Shahdol) divided into 51 districts, 342 Tehsils, 313 blocks & 376 towns and 54,903 villages. (Table 2.1)

It is abundantly rich in minerals and bio resources with 27 per cent of land area under forests; it supports a wide variety of animal and plant life. The State has a rich history, culture and crafts.

Table 2.1: Location of Madhya Pradesh

S. No .	Particulars	
1	Number of Divisions	10
2	Number of Tehsils	342
3	Number of Blocks	313
4	Number of Villages	54,903
5	Latitude	21°53' to22° 59' N
6	Longitude	76°47' to 78°44' E
7	Height from mean sea level (m)	50 - 1200
8	Number of Districts	51
9	Number of Gram Panchayat	23,012
10	Number of electrified Villages	35910
11	Percentage of electrified Villages to total Villages	65.41

The physiography of the state exhibits a great deal of diversity with areas ranging from less than 50 meter above Mean Sea Level (MSL) to more than 1200 meter. The State falls under the catchments of Yamuna, Ganga, Narmada, Mahanadi and Godavari rivers. On the basis of broad land features and different soil and rain fall pattern, the State classified in 5 physiographic regions and 11 Agro-Climatic Zones (Table 2.2)

1. Northern low lying plains comprising Gwalior, Bhind and Morena districts and extend to Bundelkhand up to the West of

Panna range and excludes certain parts of Rewa district between Panna and Kaymore hills of Baghelkhand.

2. The Malwa and Vindhyan Plateau comprises of Vidisha, Shivpuri, Datia, Guna, Ujjain and Mandsour districts and parts of Sehore, Raisen and Dewas districts. It consists of large undulating plains of black cotton soil dotted with flat-topped hills. It has also hilly Vindhyan Plateau situated in the North of Narmada Valley and to the South of the low-lying regions of Bundelkhand and Baghelkhand. It spared from east of Malwa plateau to Maikal and Dorea hills Satpura range.

Fig. 2.1: Agro-Climatic Zones of Madhya Pradesh

3. The Narmada Valley stretching from Jabalpur in the east up to Barwani district in the West. It is nearly 560 Km long and 48 Km wide and is walled on the north by the Vindhya range and on the South by Satpura range. It covers the districts of Jabalpur, Narsinghpur, Hosangabad, Khandwa, Khargone, Barwani, Dhar, and some parts of Raisen, Sehore and Dewas districts.

4. The Satpura range runs from West to East for about 640 Km through Khandwa, Betul, Chhindwara, Seoni, Mandla, Bilaspur and Sarguja districts. Its Northern spurs go into Hosangabad and Narsinghpur districts and in the South an extensive spur of 160 Km covers entire Balaghat district.

5. Madhya Pradesh also covers Balaghat and Shahdol districts of Chhattisgarh Plains and

Table-2.2: Agro-climatic regions and covered districts /tehsils in Madhya Pradesh (Area in Lakh ha)

Agro-Climatic Regions	Districts /Tehsils	Geographical Area	Percent to Geographical Area
1. Malwa Plateau	Indore, Dhar, (Dhar, Badnawar, Sardarpur tehsils) Shajapur, Mandsour, Neemuch, Ratlam, Ujjain, Dewas Rajgarh districts and Petlawad tehsil of Jhabua district	51.47	16.74
2. Vindhyan Plateau	Bhopal, Vidisha, Sehore (Sehore, Ashta, Ichhawar, Narsullaganj tehsils) Raisen (Raisen, Gairatganj, Begamganj, Silwani, Goharganj, Udaipura tehsils), Damoh, Guna (Chachora & Raghogarh tehsils) & Sagar districts	42.59	13.85
3. Central Narmada Valley	Hoshangabad (Seoni-Malwa, Hoshangabad, Sohagpur tehsils), Harda, Nasinghpur districts, Budhani and Barelli tehsil of Sehore and Raisen districts respectively	17.45	5.67
4. Satpura Plateau	Betul, Chhindwara districts	21.93	7.13
5. Jhabua Hills	Jhabua, Jobat, Alirajpur tehsils of Jhabua district & Kukshi tehsil of Dhar district	6.88	2.24
6. Gird Region	Gwalior, Bhind, Morena, Shivpur-Kalan, Guna (Mungawali and Ashoknagar tehsils), Shivpuri (Shivpuri, Kalaras, Pohari tehsils)	31.85	10.36
7. Kymore Plateau	Jabalpur, Katni, Rewa, Panna, Satana, Sidhi, Seoni and Gopadbanas & Deosar tehsils of Sidhi district.	49.97	16.25
8. Bundel Khand Region	Tikamgarh, Chhatarpur, Datia districts, Karela, Pachore tehsil of Shivpuri and Guna tehsil of Guna district	22.82	7.42
9. Nimar Valley	Khandwa, Khargone, Barwani district, Manawar tehsil of Dhar district and Harda district	25.17	8.18
10. Northern Hills of Chhattisgarh	Shahdol, Umariya Mandla, Dindori district & Singrauli tehsil of Sidhi district	28.17	9.16
11. Chhattisgarh Plain	Balaghat district	9.25	3.00
Madhya Pradesh		307.56	100.00

Northern Hills of Chhattisgarh zone respectively.

The state is bordered on the West by Gujarat, on the North-West by Rajasthan, on the North-East by Uttar Pradesh, on the East by Chhattisgarh, and on the South by Maharashtra. The main soil types found in Madhya Pradesh are alluvial, deep black, medium black, shallow black, mixed red and black, mixed red and yellow and skeletal soils (Table 2.3)

Table 2.3: Soil types and districts covered in Madhya Pradesh

Types of Soil	Districts Covered
Alluvial Soil	Bhind, Morena and Gwalior
Deep Black Soil	Hosangabad and Narsinghpur
Medium Black Soil	Jabalpur, Sagar, Vidisha, Sehore, Damoh, Guna, Bhopal, Raisen, Rajgarh, Indore, Dewas, Ujjain, Mandsour, Shajapur, Ratlam, Dhar, Khargone and Khandwa
Shallow Black Soil	Betul, Chhindwara and Seoni
Red & Black Soil	Shivpuri, Rewa, Satna, Panna, Sidhi, Chattarpur, Tikamgarh, Datia and some parts of Guna district.
Red & Yellow Soil	Balaghat.
Gravelly Soil	Mandla.

The climate of Madhya Pradesh by virtue of its location is predominately moist sub humid to dry sub humid, semi arid to dry sub-humid and semi arid in East, West and Central plateau and hills respectively, according to agro-climatic regions of India. The seasons in Madhya Pradesh are as given below (Table 2.4).

Table 2.4: Seasons and their periods in Madhya Pradesh

Seasons	Period	
	From	To
Rainy	June	September
Post Monsoon	October	November
Winter	December	February
Summer	March	May

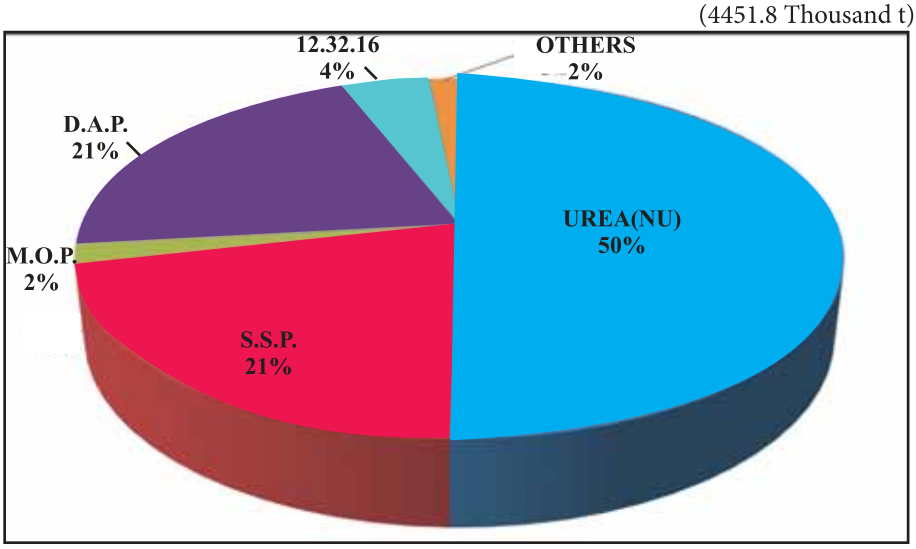
The annual rainfall received in the State varies from 800 mm. in the Northern and Western regions to 1600 mm in the Eastern districts. In some years rainfall goes much below to the normal. The most of rainfall is received in the Monsoon season from June to September and about 10 per cent of the rainfall is received in the remaining months of the year. The maximum temperature during extreme summer reaches as high as 47^{0}C and the minimum during winter dips up to 2^{0}C. The maximum normal temperature varies between 25^0 to 35^{0}C and minimum normal between 10^0 to 20^{0}C. The relative humidity ranges from 40 to 70 per cent throughout the year.

2.1 Trend in NU Consumption and Price Variation

In Madhya Pradesh total fertilizer consumption in different fertilizers was found to be 4451.8 thousand tons in cultivation of crops by the farmer during the year 2015-16.

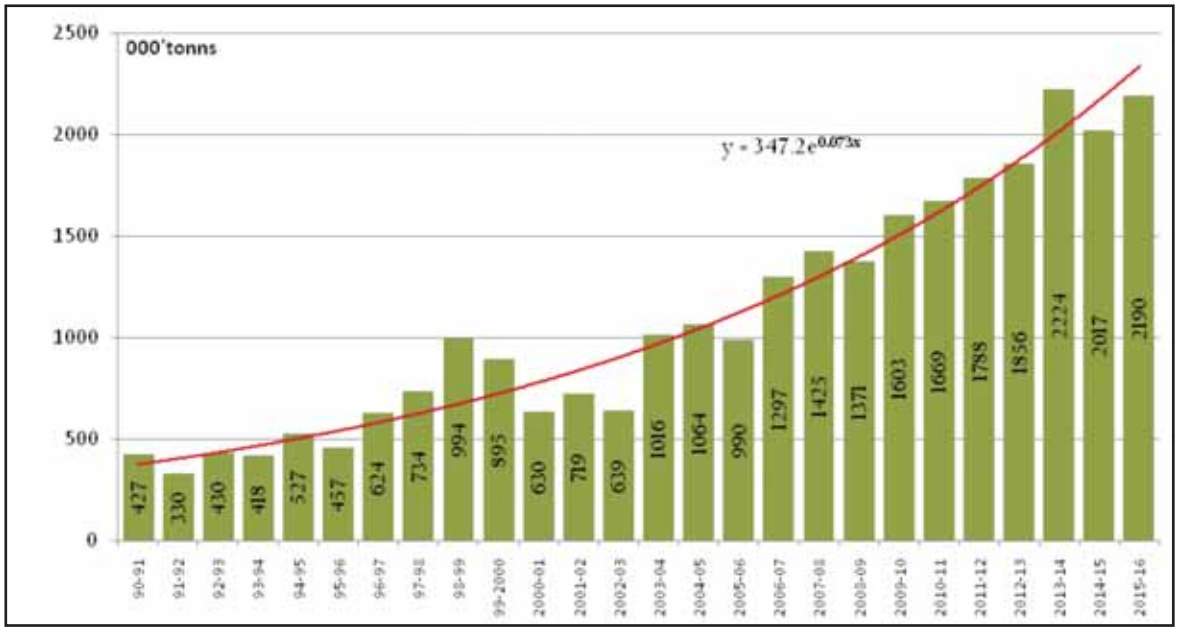
Fig. 2.2: Consumption of different fertilizers in Madhya Pradesh in 2015-16

(4451.8 Thousand t)



Amongst the different fertilizers, the consumption of NU (50%) was found to be highest as compared to Singal Super Phosphate (21%), Di-ammonium Phosphate (21%), Mixture 12:32:16 (4%), Murate of Potash (2%) and others (2%) (Fig.: 2.2). Thus, NU is the most important fertilizer used by the farmers in the state. The consumption of NU was found to be increased from 427 to 2190 thousand tonns (2015-16) with exponential growth of 7.57 per cent per year during the period from 1990-91 to 2015-16 (Fig. 2.3)

Fig. 2.3: Trend of consumption of NU/NCU in different years during 1990 to 2015 in Madhya Pradesh



The trend of prices of NU are also showing increasing trend. The prices of NU were found to be increased from Rs. 4600 (1999) to Rs. 5360 (2016) per ton with exponential growth of 1.00 per cent per year during the period of 1999-2016. (Fig. 2.4)

Fig. 2.4: Trend of prices of NU in different years in Madhya Pradesh

The Neem Coated Urea (NCU) introduced in Madhya Pradesh in the year 2011. The price of NCU (Rs.5628/tonn) was found to be 5 per cent (Rs.268/tonn) more than the NU (Rs.5360/tonn) in 2015-16.

2.2 District wise Distribution of NCU

The district wise distribution of NCU/NU is presented in figure 2.5 in the year 2015-16 in Madhya Pradesh.

Fig. 2.5: Consumption of NU/NCU in different districts of Madhya Pradesh in 2015-16.

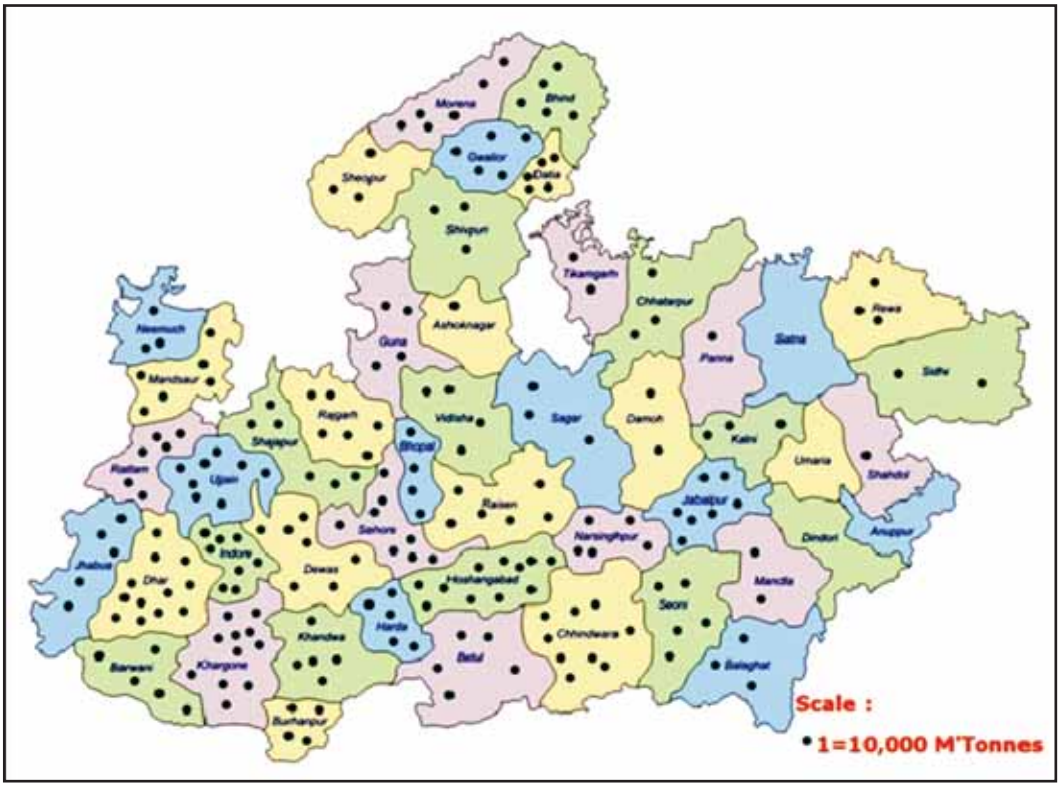
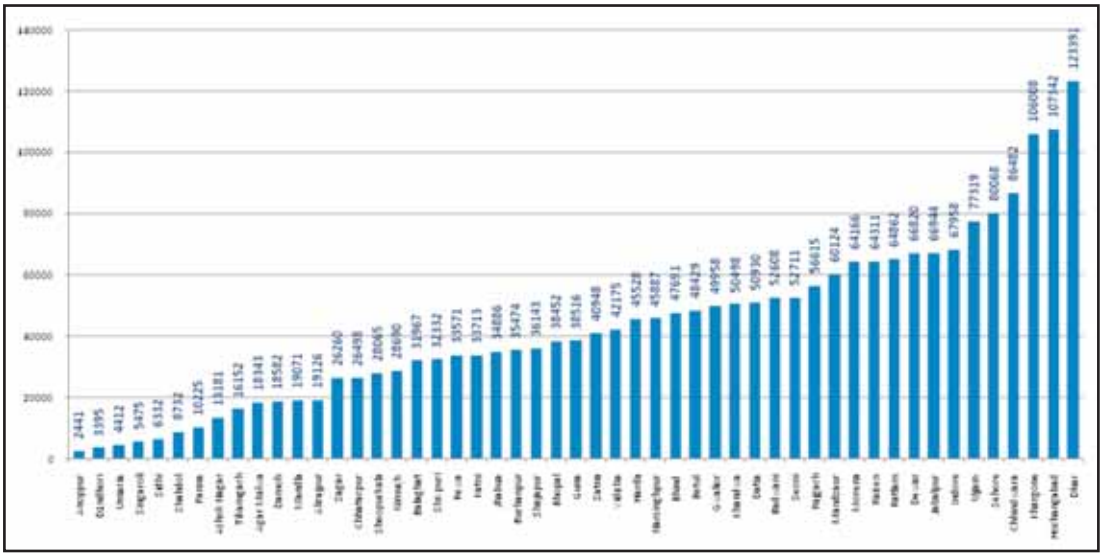


Table: 2.5 Season wise consumption of NU/NCU in different districts of Madhya Pradesh in 2015-16

(M'tonnes)

S.N o.	DISTRICT	Kharif	Rabi	Total	Percentage to Total
1	Dhar	63481	59910	123391	5.63
2	Hoshangabad	34604	72738	107342	4.90
3	Khargone	63103	42905	106008	4.84
4	Chhindwara	48306	38176	86482	3.95
5	Sehore	27906	52162	80068	3.66
6	Ujjain	29040	48279	77319	3.53
7	Indore	29568	38390	67958	3.10
8	Jabalpur	25058	41886	66944	3.06
9	Dewas	27255	39565	66820	3.05
10	Ratlam	31954	32908	64862	2.96
11	Raisen	25046	39265	64311	2.94
12	Morena	23804	40362	64166	2.93
13	Mandsaur	34866	25258	60124	2.75
14	Rajgarh	28011	28604	56615	2.59
15	Seoni	28772	23939	52711	2.41
16	Badwani	29719	22889	52608	2.40
17	Datia	13077	37853	50930	2.33
18	Khandwa	27271	23227	50498	2.31
19	Gwalior	17758	32200	49958	2.28
20	Betul	21806	26623	48429	2.21
21	Bhind	14567	33124	47691	2.18
22	Narsinghpur	16168	29719	45887	2.10
23	Harda	17026	28502	45528	2.08
24	Vidisha	10562	31613	42175	1.93
25	Satna	13529	27419	40948	1.87
26	Guna	10728	27788	38516	1.76
27	Bhopal	12307	26145	38452	1.76
28	Shajapur	14439	21704	36143	1.65
29	Burhanpur	18528	16946	35474	1.62
30	Jhabua	22062	12824	34886	1.59
31	Katni	14151	19562	33713	1.54
32	Rewa	15358	18213	33571	1.53
33	Shivpuri	8791	23541	32332	1.48
34	Balaghat	23564	8403	31967	1.46
35	Neemuch	14805	13885	28690	1.31
36	Sheopurkala	9937	18128	28065	1.28
37	Chhatarpur	8090	18408	26498	1.21
38	Sagar	5188	21072	26260	1.20
39	Alirajpur	9673	9453	19126	0.87
40	Mandla	11782	7289	19071	0.87
41	Damoh	6800	11782	18582	0.85
42	Agar Malwa	8575	9768	18343	0.84
43	Tikamgarh	3506	12646	16152	0.74
44	Ashok Nagar	3311	9870	13181	0.60
45	Panna	3502	6723	10225	0.47
46	Shahdol	5161	3571	8732	0.40
47	Sidhi	2351	3981	6332	0.29
48	Singaroli	2428	3047	5475	0.25
49	Umaria	2004	2408	4412	0.20
50	Dindhori	2954	441	3395	0.16
51	Anoopur	2034	407	2441	0.11
Madhya Pradesh		944285	1245521	2189806	100

Fig. 2.6: Consumption of NU/NCU in different districts of Madhya Pradesh in 2015-16.



Amongst the different districts the consumption of NU/NCU was found to be more in Dhar (5.63%) followed by Hoshangabad (4.90%), Khargone (4.84%), Chhindawara (3.95%), Sehore (3.66%), Ujjain (3.53%), Indore (3.10%), Jabalpur (3.06%) and Dewas(3.05%). While, found minimum in Sidhi (0.29%), Singrauli (0.20%), Umaria (0.20%), Dindori (0.16%) and Anooppur (0.11%) districts in the year 2015-16. (Table 2.5)

Table 2.6: Total Sale of NU/NCU through different agencies of Madhya Pradesh in 2015-16 (M'tonnes)

Particulars	Season	Percentage to sub total
	Kharif	
Institutional (MARKFED)	701064	74.24
Private	243221	25.76
Sub Total	944285 (43.12)	100
	Rabi	
Institutional (MARKFED)	752467	60.41
Private	493054	39.59
Sub Total	1245521 (56.88)	100
	Total	
Institutional Total	1453531	66.38
Private	736275	33.62
Total	2189806 (100)	100

Figures in the parenthesis shows percentage to total.

As for as total sale of Urea/NCU is concerned through different agencies and different season in Madhya Pradesh it is found that MARKFED plays an important role in sale of Urea/NCU in Madhya Pradesh with the share of 66.38 per cent in total sale of Urea/NCU in Madhya Pradesh. (Table 2.6) The rest of the sale was found to be done by private dealers (33.62%). The maximum quantity of the Urea/NCU was found to be used in Rabi season (56.88%) as compared to Kharif season (43.12%).

CHAPTER-III

SOCIO-ECONOMIC CHARACTERISTICS OF THE SAMPLE HOUSEHOLDS

This chapter deals with socio-economic profile of the respondents their operational land, cropping pattern and sources of irrigation, purchasing pattern, usage inputs and profitability of selected crops along with details of agricultural credit and training program attended by them in the study area.

3.1 Socio-economic Profile of the Respondents

To understand the Socio-economic characteristics of the household (HHs) related to selected crops viz. paddy and soybean, it is imperative to understand their general characteristics; i.e. level of education, caste and occupation. It forms the basis to judge the level of adoptability of innovative technologies by the farmers in their fields and to assess dependency of respondents on farm, off-farm & non-farm for their employment and income.

The general characteristics of sample farmers related to selected crops are presented in table 3.1. It is clear from the data that the average age of respondents was found to be 47 years having farming experience of 27 years with an average family size of 7 members, out of which 4 members were engaged fully in farming. Out of total respondents 96 per cent were found to be male in gender.

Table 3.1: General characteristics of sample farmers

S.No.	Particulars	Paddy	Soybean	Overall
1	Average age of respondents (Years)	48	45	47
2	Male respondents (% to the total)	97	95	96
3	Average family members engaged fully in farming	4	4	4
4	Average years of farming experience	28	25	27
5	Average family size (No.)	7	7	7

Amongst selected paddy and soybean growers the male respondents were found to be 97 & 95 per cent with average age of 48 and 45 years, having farming experience of 28 and 25 years respectively. The average family size was found to be 7 members with 4 members engaged fully in farming in both the cases. Thus, no remarkable difference was found between selected paddy and soybean growers.

As for as level of education of sample farmers is concerned the majority of the respondents were found to be educated up to primary level (35.50%) followed by higher primary (28%), matriculation (11%) and pre-university & above (9%). In case of soybean growers maximum respondents were found to have education up to higher primary level (38%) followed by primary (23.50%), matriculation (6.50%) and pre-universities & above level (6.50%).

Table 3.2: Education level of sample farmers (% of farmers)

S.No.	Education level	Paddy	Soybean	Overall
1	Illiterates	07.50	25.50	16.50
2	Primary (1 to 4)	47.50	23.50	35.50
3	Higher primary (5 to 9)	18.00	38.00	28.00
4	Matriculation (10)	15.50	06.50	11.00
5	Pre University (10+2) & above	11.50	06.50	09.00
Total		100.00	100.00	100.00

In case of paddy growers 47.50 per cent were educated up to primary level and 18, 15.50 and 11.50 per cent were educated up to higher primary, matriculation and pre-universities & above level, respectively. Only 7.5 and 25.5 per cent of paddy and soybean growers were found to be illiterate respectively in the area under study (Table 3.2).

The distribution of sample farmers according to their caste is presented in table 3.3. It is clear from the data that majority of the respondents belongs to the OBC (52.75%) followed by SC (20.75%), ST (16.50%) and General Categories (10%) at overall level.

Table 3.3: Distribution of sample farmers based on their category (% of farmers)

S.No.	Particulars	Paddy	Soybean	Overall
1	General	09.00	11.00	10.00
2	OBC	75.50	30.00	52.75
3	SC	04.00	37.50	20.75
4	ST	11.50	21.50	16.50
Total		100.00	100.00	100.00

In case of paddy growers the majority of respondents belongs to the OBC (75.50%) followed by ST (11.50%), General (9%) and SC (4%). In case of soybean the distribution of respondents across various categories seems to be equal with maximum respondents under SC (37.50%) followed by OBC (30%), ST (21.50%) and General (11%) categories. (Table 3.3)

As regards to occupation of sample farmers is concerned all the respondents were found to be engaged in agricultural and allied activities as a main occupation for their livelihood security (Table 3.4). Only 1 per cent respondents related to soybean and 0.50 per cent respondents related to paddy were found to be engaged themselves as agriculture labour and salaried work respectively.

Table 3.4: Occupational distribution of the sample farmers (% farmers)

S.No.	Particulars	Paddy	Soybean	Overall
1	Agriculture & allied	99.50	99.00	99.25
2	Agriculture labour	0.0	01.00	0.50
3	Self employed in small scale industries	-	-	-
4	Self employed in services	-	-	-
5	Non- Agriculture casual labour	-	-	-
6	Salaried work	0.50	0.0	0.25
7	Household	-	-	-
8	Pensioner	-	-	-
Total		100.00	100.00	100.00

3.2 Operational Land Holding

To understand operation land holdings of the farmers the data on owned land, uncultivated/fallow land, leased in /out land along with per cent area under irrigation with rental value of leased in /out land of the respondents related to paddy, soybean across various sizes of holdings is also analyzed and depicted in Table 3.5.

It is observed from the data that at overall level an average respondent was found to have 7.56 acres of owned land with 0.30 and 0.03 acres of leased in and leased out land respectively and 0.05 acres uncultivated/fallow land constituting his net operated area (7.78 acres). Out of the total net operated area 88.17 per cent was found under irrigation. The rental value of leased in and leased out land was found to be Rs. 15075 and Rs. 13946 per acre respectively. The average operational holding in case of small, medium and large farmers was found to be 2.72, 6.54 and 14.08 acres respectively.

Table 3.5: Average operational land holdings of the sample farmers (in acres)

Particulars	Paddy				Soybean				Overall			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Owned land	2.65	6.68	12.88	7.40	2.67	5.76	14.74	7.72	2.66	6.22	13.81	7.56
Uncultivated/Fallow	0.00	0.00	0.00	0.00	0.00	0.07	0.24	0.10	0.00	0.04	0.12	0.05
Leased-in	0.05	0.00	0.00	0.02	0.17	0.80	0.77	0.58	0.11	0.40	0.39	0.30
Leased-out	0.08	0.07	0.00	0.05	0.02	0.00	0.00	0.01	0.05	0.04	0.00	0.03
Net Operational Area 1-2+3-4	2.62	6.61	12.88	7.37	2.82	6.49	15.27	8.19	2.72	6.54	14.08	7.78
% Irrigated	72.14	89.28	86.86	82.76	95.57	92.64	92.54	93.59	83.86	90.96	89.70	88.17
% Un Irrigated	27.86	10.72	13.14	17.24	4.43	7.36	7.46	6.41	16.14	9.04	10.30	11.83
Total	100	100	100	100	100	100	100	100	100	100	100	100
Rental value of leased-in land (Rs/acre)	20935	12085	0	16510	13300	14417	13200	13639	17118	13251	14417	15075
Rental value of leased-out land (Rs/acre)	18146	15066	0	16606	11286	0	0	11286	14716	15066	0	13946

The operational holding was found to be 7.37 and 8.19 acre in case of respondents related to paddy and soybean at overall level. It was found to be 2.62, 6.61, 12.88 acres across small, medium and large categories respectively in case of paddy, while 2.82 (small), 6.49 (medium), 15.27 (large) acres in case of soybean.

The leased in and leased out was found to be prevalent in case of soybean as compared to paddy growers. In case of paddy, respondents used to lease out more land as compared to lease in and vice-versa in case of soybean growers. The overall irrigated area was found to be 82.76 & 93.59 per cent in case of paddy and soybean growers. The overall rental value for leased in and leased out land was found to be Rs. 16510 & 16606 per acre respectively in case of paddy, while Rs. 13639 (leased in) & Rs. 11286 (leased out) per acre in case of soybean (Table 3.5)

3.3 Cropping Pattern and Sources of Irrigation

The preference for cultivation of various crops under irrigated area and rain-fed situations during kharif season along with source of irrigation was also analyzed and presented across various size of holdings in table 3.6 to 3.8

Table 3.6: Cropping pattern of the Paddy respondents during kharif season (Area in acres)

Name of the Crop	Irrigated			Rain-fed			Total		
	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
Paddy	1.84	5.96	11.29	0.74	0.71	1.58	2.58	6.67	12.88
Total %	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)
Total Sown Area (Acres)	1.84	5.96	11.29	0.74	0.71	1.58	2.58	6.67	12.88

Figure in parenthesis show percentage to total sown area

It is clear from the data depicted in table 3.6 that paddy was the only crop which is being grown in the study area indicating dominance of mono crop culture in cropping pattern under irrigated and rain fed condition during kharif season across different size of holdings.

Table 3.7: Cropping pattern of the Soybean respondents during kharif season (Area in acres)

Name of the Crop	Irrigated			Rain-fed			Total		
	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
Soybean	2.07 (81.5)	4.07 (72.94)	9.63 (74.59)	0.07 (77.78)	0.16 (100)	0.62 (100)	2.14 (81.37)	4.23 (73.69)	10.25 (75.76)
Cotton	0.38 (14.96)	1.24 (22.22)	2.66 (20.6)	0.02 (22.22)	0 (0)	0 (0)	0.4 (15.21)	1.24 (21.6)	2.66 (19.66)
Maize	0.09 (3.54)	0.27 (4.84)	0.62 (4.8)	0 (0)	0 (0)	0 (0)	0.09 (3.42)	0.27 (4.7)	0.62 (4.58)
Total %	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)
Total Sown Area (Acres)	2.54	5.58	12.91	0.09	0.16	0.62	2.63	5.74	13.53

Figure in parenthesis shows percentage to total sown area

It is clear from the data given in table 3.7 that at overall level cropping pattern of soybean growers during kharif season in rain fed situation was found to be dominated by soybean and remaining area was found to be occupied by cotton and that too by small farmers only. In irrigated situation similar finding was observed with 22.22 and 4.84 per cent of total operated area with around 20 and 5 percent of total operated area covered under cotton and maize respectively across various size of holdings. These findings were found to be same with minor variations in different size of farms under rain fed condition, although soybean and cotton were found to be major crops under rain-fed condition during kharif season. The farmers having medium and large size holdings devoted their 100 per cent area in cultivation of soybean, while 77.78 and 22.22 per cent of total operational holding of small farmers under rain-fed condition was found to be devoted to cultivation of soybean and cotton respectively.

Table 3.8: Sources of irrigation of the sample farmers (% of farmers)

S.No	Particulars	Paddy	Soybean	Overall
1	Open/Dug well	31.00	75.50	53.25
2	Bore well	6.00	24.00	15.00
3	Canal	56.00	0.00	28.00
4	Tank	6.00	0.00	3.00
5	Nala	1.00	0.50	0.75
	Total	100.00	100	100.00

The sources of irrigation of the sample farmers are presented in table 3.8. it is observed from the data that at overall level open/dug well (53.25%) followed by canal (28%), bore well (15%), tank (3%) and nala (0.75%) were found to be sources of irrigation in the area under study. In case of respondents related to paddy canal (56%) followed by open/dug well (31%), bore well (6%), tank (6%) and nala (1%) were found to be sources of irrigation, while in case of respondents related to soybean open/dug well (75.50%) followed by bore well (24%) and nala (0.50%) were found to be sources of irrigation in the area under study. (Table 3.8)

3.4 Purchasing Pattern

The purchase pattern of Neem Coated Urea (NCU) and Normal Urea (NU) by paddy and soybean growers in terms of quantity, price, distance from farm, transportation cost and total cost is shown in table 3.9, while the sources of purchase of NCU and NU by paddy and soybean growers along with overall picture is presented in table 3.10. It is observed from the data depicted in table 3.9 that at overall level the purchase pattern of NCU and NU shows that an average farmer used to purchase 175.11 kg/HH (NCU) and 154.1 kg/HH (NU) for cultivation of crops. The quantity of NCU and NU purchased by an average paddy grower was found to be more as compared to soybean grower. The remarkable difference was not found to be noticed in case of distance from farm and transportation cost of a fertilizer bag while, purchasing of NCU and NU.

Table 3.9: Purchase pattern of NCU (Per HH)

S.No	Particular	Paddy		Soybean		Overall	
		NCU	NU	NCU	NU	NCU	NU
1	Quantity bought (Kgs)	203	212	147.22	96.2	175.11	154.1
2	Price Rs per bag of 50kg	306	298	305	299	305.5	298.5
3	Distance from farm (Kms)	2.22	2.25	6.81	6.55	4.515	4.4
4	Transport cost (Rs per bag of 50kg)	11.44	11.15	9.35	9.77	10.395	10.46
5	Total cost (Rs per bag of 50kg)	317.44	309.15	314.35	308.77	315.90	308.96

The total cost of 50kg bag of NCU and NU was found to be Rs. 317.44 & Rs. 309.15 and Rs. 314.35 & Rs. 308.77 in case of paddy and soybean growers respectively; while at overall level it was found to be Rs. 315.90 & 308.96 per bag (Table 3.9). Thus, an average farmer invested almost Rs. 7 more per bag in purchase of NCU as compared to NU.

The sources of purchase of NCU and NU were also identified in the area under study and found that almost 100 per cent paddy growers used to purchase NCU and NU from cooperative society. The 76.85 and 23.15 per cent of soybean growers were found to purchase NCU and NU from cooperative societies and private fertilizer dealers respectively.

Table 3.10: Sources of purchase of NCU/NU (% of farmers)

S. No	Particulars	Paddy		Soybean		Overall	
		NCU (n=146)	NU (n=93)	NCU (n=108)	NU (n=92)	NCU (n=256)	NU (119)
1	Private fertilizer dealers	0.00	1	23.15	27.17	11.58	14.09
2	Cooperative societies	100	99	76.85	72.83	88.43	85.92
3	Agriculture Department	0.00	0.00	0.00	0.00	0.00	0.00
	Total	100	100	100	100	100	100

At overall level 85.92 & 14.09 (NU) and 88.43 & 11.58 (NCU) per cent of respondents purchased NU and NCU from co-operative societies and private fertilizer dealers respectively. The major source of purchase of fertilizers i.e. NCU and NU was found to be co-operative societies in the area under study. (Table 3.10)

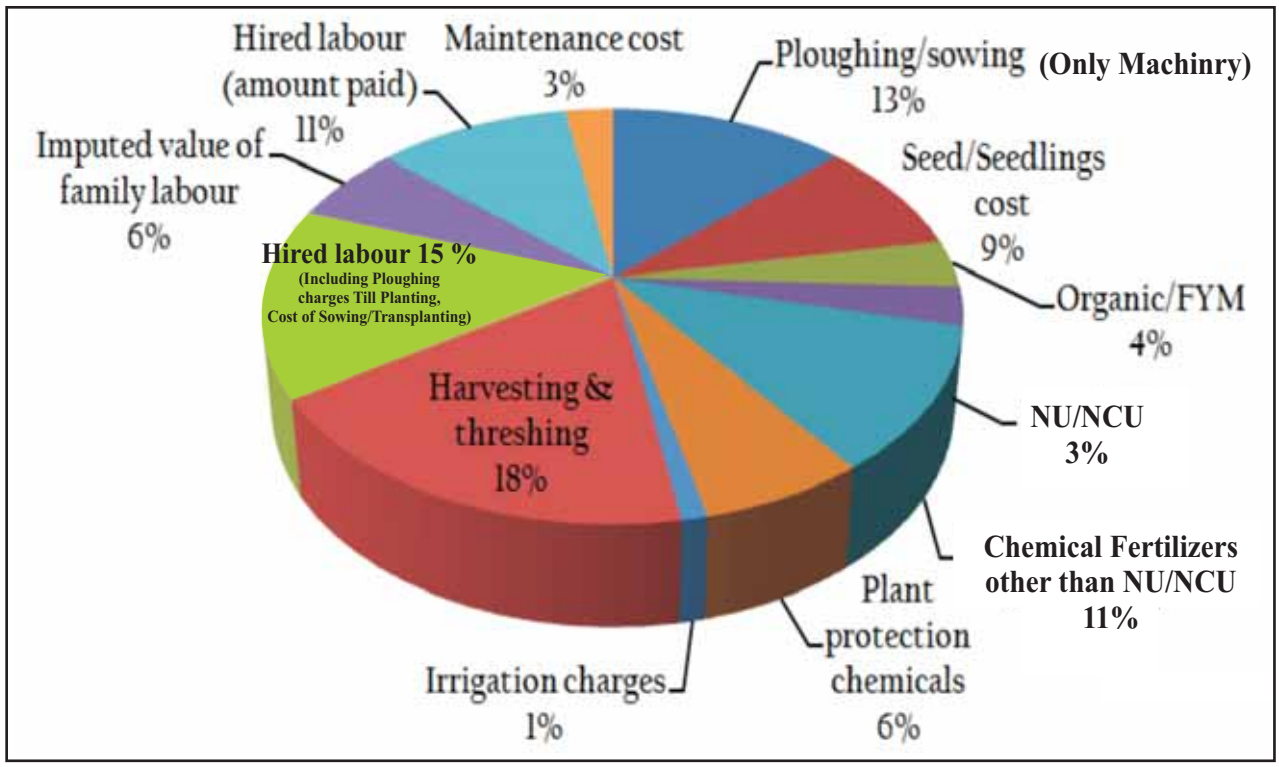
3.5 Inputs Usage and Profitability of Selected Crops

The value of inputs used and profitability of selected crops viz. Paddy and Soybean in various size of holdings for the year 2014 & 2015 were analyzed for the study.

3.5.1 Paddy

The cost incurred in cultivation of paddy and returns received thereof at different size of farms are analysed and presented in table 3.11. It is observed from the data that the total paid out cost in cultivation of paddy was found to be Rs. 10,619 and Rs. 9494 per acre on an average farm in the year 2015 and 2014, respectively.

Fig.3.1: Share of different inputs in total cost of cultivation of paddy in 2015



In the year 2015 the share of total cost was found to be highest in harvesting & threshing (18%) followed by hired labour-including ploughing charges till Planting, cost of sowing/transplanting (15%), ploughing & sowing-only machinery charges (13%), chemical fertilizers -other than Urea/NCU (11%) and hired labour-amount padi (11%). These constituted 68.06 per cent of the total cost of paddy (Fig 3.1).

In the year 2014 the maximum cost was found to be incurred in harvesting & threshing (18%) followed by hired labour-including ploughing, sowing & transplanting cost (15%), ploughing & sowing (13%), chemical fertilizers -other than NU/NCU (12%) and hired labour-amount paid (10%) (Fig 3.2).The per cent expenditure on NU/NCU was found to be more to the total cost of cultivation of paddy in the year 2015 (3.03%) as compared to in the year 2014 (2.83%).

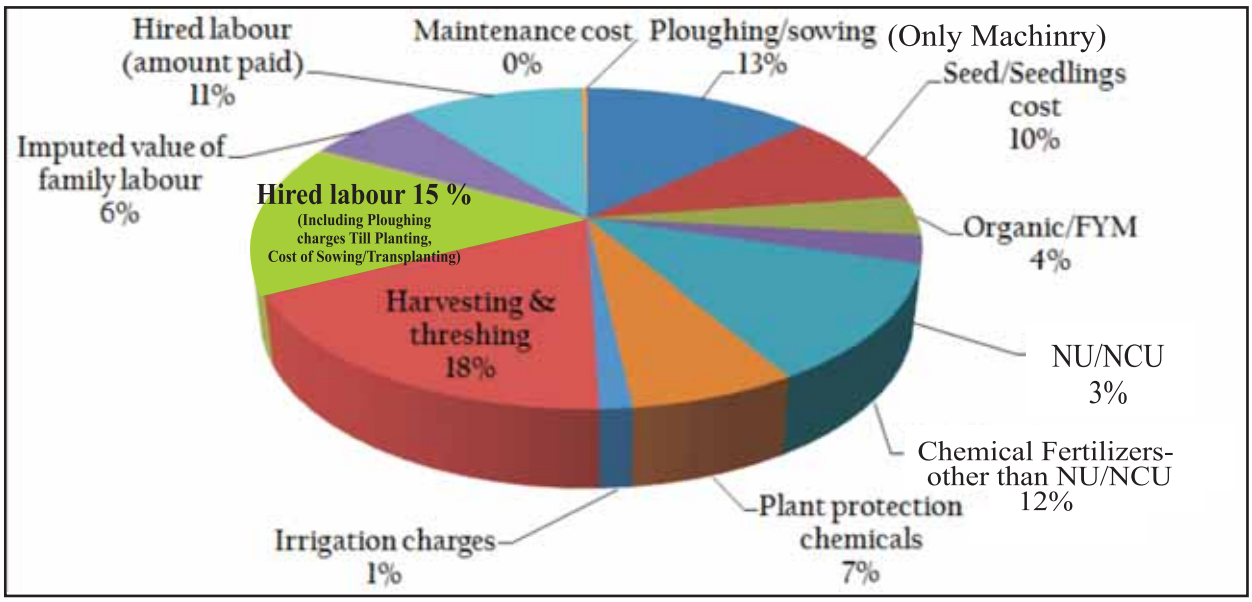
Similar pattern were observed with minor variation across different size of farms. Although, the expenditure on ploughing & sowing, organic manure & FYM, irrigation charges and hired human labour were found to be increased with size of farms, while the expenditure on seed, NCU/NU, plant protection chemical, harvesting & threshing and imputed value of family labour were found to be decreased with the increase in size of farm in cultivation of paddy during the year 2015 in the area under study.

Table 3.11: Input use, output and returns per acre realized by Paddy farmers (Rs. per acre)

S. No	Particular	2015				2014			
		Small	Medium	Large	Overall	Small	Medium	Large	Overall
Expenditure on Input									
1	Ploughing and sowing charges (Only Machinery)	1315 (11.98)	1376 (12.68)	1476 (14.72)	1389 (13.08)	1171 (11.71)	1280 (13.52)	1328 (14.73)	1260 (13.27)
2	Seed cost/ purchase of seedlings	976 (8.89)	1003 (9.24)	871 (8.69)	950 (8.95)	905 (9.05)	977 (10.32)	809 (8.98)	897 (9.45)
3	Organic/FYM	366 (3.33)	417 (3.84)	389 (3.88)	391 (3.68)	398 (3.98)	368 (3.89)	376 (4.17)	381 (4.01)
4	NU/NCU	373 (3.4)	313 (2.88)	280 (2.79)	322 (3.03)	330 (3.3)	238 (2.51)	238 (2.64)	269 (2.83)
5	Chemical fertilizers (Other than NU/NCU)	1348 (12.28)	1027 (9.46)	1188 (11.85)	1187 (11.18)	1357 (13.57)	935 (9.87)	1085 (12.04)	1126 (11.86)
6	Plant protection chemicals	783 (7.13)	683 (6.29)	592 (5.91)	686 (6.46)	685 (6.85)	724 (7.65)	519 (5.76)	643 (6.77)
7	Irrigation charges	107 (0.97)	109 (1)	109 (1.09)	108 (1.02)	115 (1.15)	110 (1.16)	149 (1.65)	125 (1.32)
8	Harvesting & threshing charges	2201 (20.05)	1824 (16.8)	1824 (18.2)	1950 (18.36)	2006 (20.06)	1640 (17.32)	1541 (17.1)	1729 (18.21)
9	Hired labour charges (including ploughing charges till planting, cost of sowing/transplanting)	1634 (14.88)	1583 (14.58)	1499 (14.95)	1572 (14.8)	1512 (15.12)	1449 (15.3)	1361 (15.1)	1441 (15.18)
10	Imputed value of family labour	906 (8.25)	741 (6.83)	314 (3.13)	654 (6.16)	845 (8.45)	676 (7.14)	279 (3.1)	600 (6.32)
11	Hired labour (amount paid)	769 (7)	1238 (11.41)	1383 (13.8)	1130 (10.64)	675 (6.75)	1073 (11.33)	1241 (13.77)	996 (10.49)
12	Maintenance cost	200 (1.82)	540 (4.98)	98 (0.98)	280 (2.64)	0 (0)	0 (0)	86 (0.95)	29 (0.31)
Total paid-out costs		10978 (100)	10854 (100)	10024 (100)	10619 (100)	9998 (100)	9470 (100)	9013 (100)	9494 (100)
Return Received									
1	Output (Main product)	19146	18171	18215	18511	16510	15921	13773	15402
2	By product	4154	3193	2687	3345	2888	2467	2181	2512
3	Gross returns	23300	21364	20902	21855	19398	18389	15955	17914
4	Net returns	12323	10510	10877	11237	9399	8918	6942	8420
5	Per Rupee Return	2.12	1.97	2.09	2.06	1.94	1.94	1.77	1.88

Figures in parenthesis show percentage to total paid out cost.

Fig.3.2: Share of different inputs in total cost of cultivation of paddy in 2014



As the size of holding increases the total paid out cost per acre in cultivation of paddy was found to be decreased. The similar findings were found with minor variation in cultivation of paddy during the year 2014.

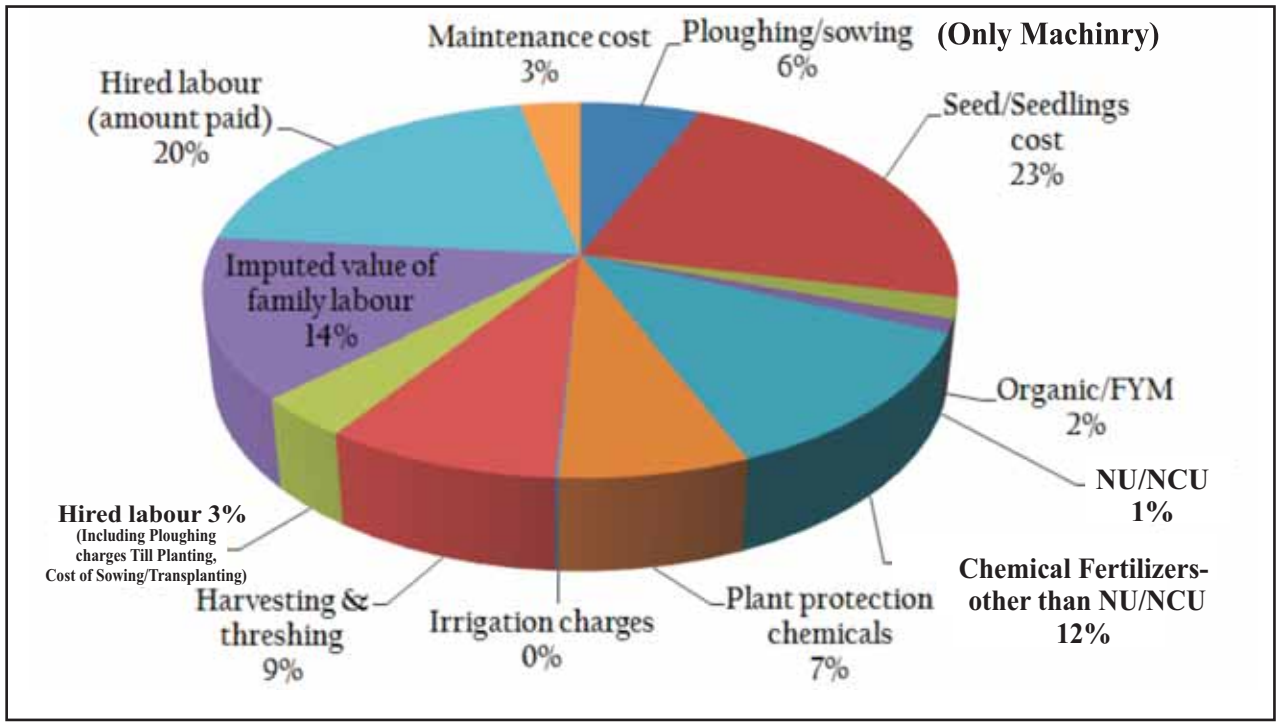
An average paddy grower was found to be received more net return in the year 2015 (Rs. 11237/acre) as compared to 2014 (Rs. 8420/acre) in cultivation of paddy. He also received more return over the investment Re. 1.00 in 2015 (Rs.2.06) as compared to 2014 (Rs. 1.88). This might be due to the application of NCU instead of NU by the paddy grower in the area under study. As the size of farm increases the per acre gross as well as net and per rupee return was found to be decreased in cultivation of paddy in the area under study.

3.5.2 Soybean

The cost incurred and profit received by an average soybean grower was analysed and presented in table 3.12. It is observed from the data that an average soybean grower invested Rs 9776/acre and Rs 8660/acre in cultivation of soybean during the year 2015 and 2014 respectively in the area under study.

The expenditure on seed (21%), hired human labour- amount paid (20%), imputed value of human labour (14%), chemical fertilizer-other than NU (12%), harvesting & threshing (9%), plant protection chemicals (7%) and ploughing & sowing- only machinery (6 %) were found to be major component of cost of cultivation during the year 2015 (Fig 3.3).

Fig.3.3: Share of different inputs in total cost of cultivation of soybean in 2015



In different size of farms the expenditure on ploughing and sowing, chemical fertilizer-other than NU/NCU, plant protection chemical & hired human labour -amount paid were found to be increased with size of farms, while expenditure on seed, hired human charges (including ploughing charges till planting & cost of sowing) and imputed value of family labour were found to be decreased with size of farms. The similar findings were found for the year 2014 with minor variation in cultivation of soybean. (Table. 3.12)

The expenditure on NU/NCU in total cost of cultivation of soybean was found to be more in the year 2015 (Rs. 114/acre) as compared to 2014 (Rs. 87/acre). As the size of holding increases the total paid out cost per acre in cultivation of soybean was found to be increased.

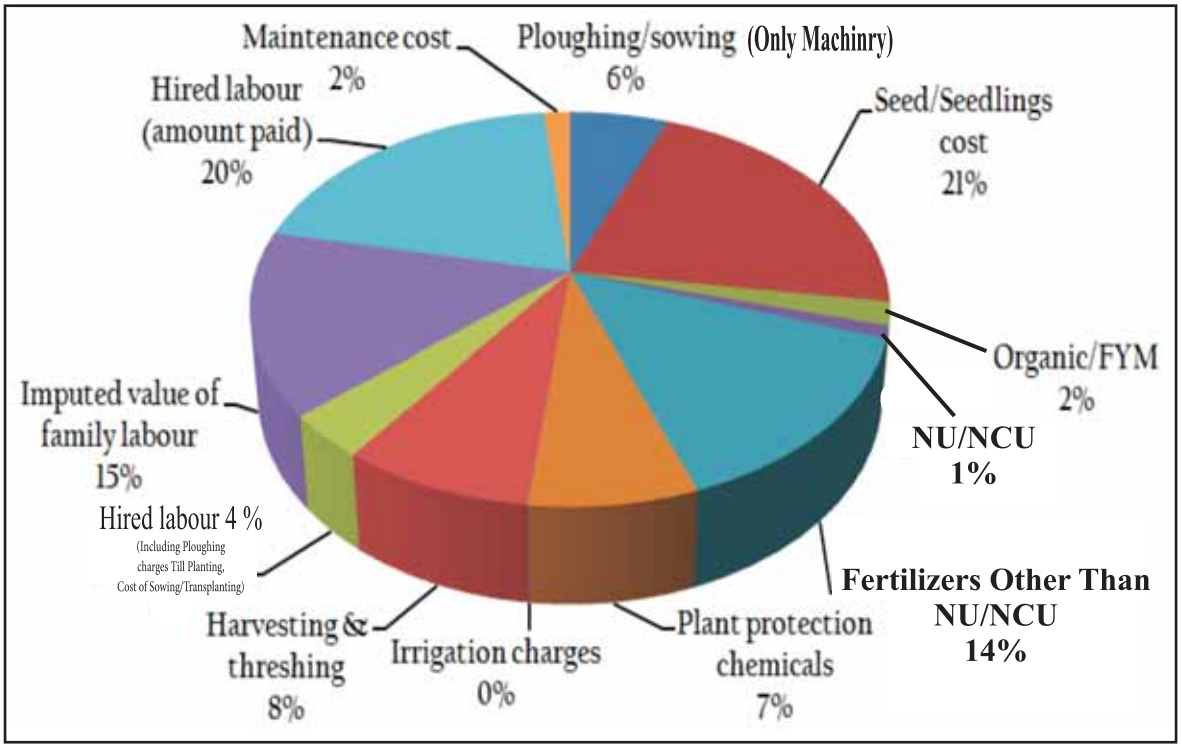
An average soybean grower received more net return in cultivation of soybean in the year 2015 (Rs.7909/acre) as compared to the year 2014 (Rs.6684/acre). He also received more return on investment on Re. 1.00 in cultivation of soybean in the year 2015 (Rs.1.82) as compared

Table 3.12: Input use, output and returns per acre realized by soybean farmers (Rs. per acre)

S. No	Particulars	2015				2014			
		Small	Medium	Large	Overall	Small	Medium	Large	Overall
	Expenditure on Input								
1	Ploughing and sowing charges (Only Machinery)	607 (5.88)	590 (5.93)	605 (6.67)	601 (6.15)	502 (5.42)	515 (5.9)	532 (6.65)	516 (5.96)
2	Seed cost/ purchase of seedlings	2433 (23.58)	2195 (22.07)	1968 (21.71)	2199 (22.49)	1854 (20.02)	1835 (21.03)	1891 (23.65)	1860 (21.48)
3	Organic /FYM	145 (1.41)	132 (1.33)	246 (2.71)	174 (1.78)	96 (1.04)	139 (1.59)	260 (3.25)	165 (1.91)
4	NU/NCU	113 (1.1)	112 (1.13)	119 (1.31)	114 (1.17)	86 (0.93)	93 (1.07)	82 (1.03)	87 (1)
5	Chemical fertilizers (Other than NU/NCU)	1228 (11.9)	1162 (11.68)	1229 (13.56)	1206 (12.34)	1211 (13.08)	1215 (13.93)	1273 (15.92)	1233 (14.24)
6	Plant protection chemicals	683 (6.62)	710 (7.14)	607 (6.7)	667 (6.82)	645 (6.97)	666 (7.63)	546 (6.83)	619 (7.15)
7	Irrigation charges	34 (0.33)	0 (0)	0 (0)	11 (0.11)	5 (0.05)	0 (0)	0 (0)	2 (0.02)
8	Harvesting & threshing charges	904 (8.76)	795 (7.99)	795 (8.77)	832 (8.51)	886 (9.57)	717 (8.22)	523 (6.54)	709 (8.19)
9	Hired labour charges (including ploughing charges till planting, cost of sowing/transplanting)	419 (4.06)	308 (3.1)	297 (3.28)	341 (3.49)	372 (4.02)	286 (3.28)	268 (3.35)	309 (3.57)
10	Imputed value of family labour	1971 (19.11)	1271 (12.78)	760 (8.38)	1334 (13.65)	1920 (20.74)	1246 (14.28)	702 (8.78)	1289 (14.88)
11	Hired labour (amount paid)	1579 (15.31)	2131 (21.42)	2275 (25.09)	1995 (20.41)	1581 (17.08)	1852 (21.23)	1771 (22.15)	1735 (20.03)
12	Maintenance cost	200 (1.94)	540 (5.43)	163 (1.8)	301 (3.08)	101 (1.09)	162 (1.86)	150 (1.88)	138 (1.59)
	Total paid -out costs	10316 (100)	9947 (100)	9066 (100)	9776 (100)	9259 (100)	8725 (100)	7997 (100)	8660 (100)
	Return Received								
1	Output (Main product)	15494	16877	16696	16356	13521	14105	15110	14245
2	By product	1252	1548	1498	1433	1150	1043	885	1026
3	Gross returns	16746	18425	18194	17788	14671	15148	15995	15271
4	Net returns	6430	8478	9129	8012	5412	6423	7998	6611
5	Per Rupee Return	1.62	1.85	2.01	1.83	1.58	1.74	2.00	1.77

Figures in parenthesis show percentage to total paid out cost.

Fig. 3.4: Share of different inputs in total cost of cultivation of soybean in 2014



to the year 2014 (Rs. 1.78) in the area under study. As the size of farm increases the per acre gross as well as net and per rupee return was found to be increased in cultivation of paddy in the area under study.

3.5.3 Paddy Vs Soybean

The cost of cultivation and profitability of paddy and soybean for the year 2015 have been compared for clear-cut understanding and presented in table 3.13. It is observed from the data that total cost of cultivation of paddy (Rs 10619/acre) was found to be more as compared to soybean (Rs. 9776/acre). The expenditure on ploughing & sowing -only machinery (13.89%), harvesting & threshing (18.30%), chemical fertilizers -other than NU/NCU (11.18%), imputed value of family labour (6.16%) and hired labour-amount paid (10.64%) were found to be major component of cost of cultivation of paddy, while in case of soybean the expenditure on seed (22.49%), hired human labour-amount paid (20.41%), imputed value of human labour (13.65%), chemical fertilizer- other than urea (12.34%), harvesting & threshing (8.51%), plant protection chemicals (6.82%) and ploughing & sowing- only machinery (6.15%) were found to be major component of cost of cultivation during the year 2015 (Table 3.13).

An average farmer also received more net return in cultivation of paddy (Rs. 11237/acre) as compared to soybean (Rs. 8012/acre). On in investment of Re. 1.00 he was also found to be got more return in paddy (Rs 2.06) as compared to soybean (Rs. 1.83). Although, no remarkable difference were found to be observed in cost incurred and profit received by an average farmer in cultivation of paddy and soybean in the area under study.

Table: 3.13 Input use, output and returns per acre realized by Paddy and Soybean farmers.

(Rs. per acre)

S.No	Particulars	Paddy	Soybean
Input use and their costs			
1	Ploughing and sowing charges (only machinery)	1389 (13.08)	601 (6.15)
2	Seed cost/ purchase of seedlings	950 (8.95)	2199 (22.49)
3	Organic/FYM	391 (3.68)	174 (1.78)
4	NU/NCU	322 (3.03)	114 (1.17)
5	Chemical fertilizers (Other than NU/NCU)	1187 (11.18)	1206 (12.34)
6	Plant protection chemicals	686 (6.46)	667 (6.82)
7	Irrigation charges	108 (1.02)	11 (0.11)
8	Harvesting & threshing charges	1950 (18.36)	832 (8.51)
9	Hired labour charges (including ploughing charges till planting, cost or sowing/ transplanting)	1572 (14.8)	341 (3.49)
10	Imputed value of family labour	654 (6.16)	1334 (13.65)
11	Hired labour (amount paid)	1130 (10.64)	1995 (20.41)
12	Maintenance costs on assets	280 (2.64)	301 (3.08)
Total paid-out costs including imputed value of own labour		10619 (100)	9776 (100)
Return Received			
1	Output (Main product)	18511	16356
2	By product	3345	1433
3	Gross returns	21855	17788
4	Net returns	11237	8012
5	Benefit cost Ratio	2.06	1.83

Figure in parenthesis show percentage to total paid out cost

3.5.4 Comparative Use of NCU Vs NU

The comparative picture of use of NCU as compared to NU in selected crops i.e. paddy and soybean was also observed and presented in table 3.14. It is observed from the data that the quantity applied of NU was found to be 41 and 18 kg/acre in cultivation of paddy and soybean respectively in the year 2014, while it was decreased to 19 and 9 kg/acre in the year 2015. It may be due to the increased use of NCU in the area under study. In the year 2015, 28 and 12 kg per acre NCU was found to be applied for cultivation of paddy and soybean respectively.

Due to the application of NCU in cultivation of paddy and soybean the productivity of NCU was increased from 0 (2014)

to 1218 kg /acre (2015) in case of paddy and 0 (2014) to 596 kg/acre (2015) in case of soybean. The productivity of NU was found to be decreased from 1237 (2014) to 1173 (2015) kg/acre in case of paddy, while it was found to be increased from 493 (2014) to 506 kg/acre (2015) in case of soybean. The output per unit of NCU was also found to be increased from Rs. 0 (2014) to 609 kg/acre (2015) in cultivation of paddy and Rs. 0 (2014) to 1540 kg/acre (2015) in case of cultivation of paddy.

Table 3.14: Comparative use of NCU versus NU (Kgs/acre)

S.No	Particulars	2014		2015	
		Paddy	Soybean	Paddy	Soybean
1	NCU quantity applied	0	0	28	12
2	NU quantity applied	41	18	19	9
3	Productivity of NCU (Kgs/acre)	0	0	1218	596
4	Productivity of NU (Kgs/acre)	1237	493	1173	506
5	Output per unit of NCU(Rs./acre)	0	0	609	1540
6	Output per unit of NU (Rs./acre)	422	849	864	1743

The output per unit of NU was also found to be increased in cultivation of paddy from Rs. 422 (2014) to 864 (2015) and Rs. 849 (2014) to 1743 (2015) per acre in case of cultivation of soybean.

As for as the comparative benefits of NCU over NU are concerned in cultivation of paddy and soybean in the area under study, it was found that no change was reported by the respondents in cost incurred in weed management, other fertilizers, quality and market acceptability of grains in production of paddy.

The majority (80%) of respondents reported that the cost of NCU was found to be more as compared to NU. No change was observed in cost incurred in control of pest and diseases, improvement in soil health by 85 & 80 percent paddy growers respectively in the area under study. While, 20 per cent respondents were of the opinion that soil health has been improved, while 15 per cent respondents were also reported that the cost incurred in control of pest and diseases were found to be decreased. Out of total respondents 35.81 per cent reported that the yield of paddy was found to be increased by 4.76 per cent after application of NCU. In case of soybean no change has been reported by all the farmers 100 per cent in case of weed management, cost of other fertilizers, improvement in soil health, quality and market acceptability of grains.

Out of total respondents only 3.85 per cent reported that the cost incurred in pest and disease management was found to be increased, while majority (94.23%) of them were of the opinion that there is no change in the pest and disease infestation in cultivation of soybean after

application of NCU. The majority of respondents (65%) also reported that cost of NCU was found to be increased as compared to the NU in cultivation of soybean. Only 35.94 per cent respondents reported that the yield of soybean was found to be increased by 3.82 per cent after application of NCU in cultivation of soybean (Table 3.15).

Table 3.15: Comparative benefits of NCU over NU in case of Paddy (% of farmers)

S. No.	Particulars	Increased	Decreased	No change	Extent of Increase (%)	Extent of Decrease (%)
Paddy						
1	Yield (quintals)	35.81	53.38	10.81	4.76	-2.74
2	Cost of pest and disease control (Rs)	0	15	85	2	2
3	Weed management (Rs)	0	0	100		-
4	Cost of NCU compared to Urea (Rs)	80	0	20	2	-
5	Cost of other fertilizers (Rs)	0	0	100	-	-
6	Improvement in soil health	20	0	80	2	-
7	Quality of grain	0	0	100	-	-
8	Market acceptability of grains	0	0	100	-	-
Soybean						
1	Yield (quintals)	35.94	34.38	29.69	3.82	-2.18
2	Cost of pest and disease control (Rs)	3.85	1.92	94.23	2.56	2
3	Weed management (Rs)	0	0	100	-	1
4	Cost of NCU compared to Urea (Rs)	65.0	0	35.0	2.5	-
5	Cost of other fertilizers (Rs)	0	0	100	-	-
6	Improvement in soil health	0	0	100	-	-
7	Quality of grain	0	0	100	-	-
8	Market acceptability of grains	0	0	100	-	-

3.6 Agriculture Credit Availed

The credit availed by the respondents related to the paddy and soybean from different institutional and non-institution sources along with purpose of borrowing was also analyzed and presented in table 3.16 and 3.17. It is observed

Tables 3.16: Credit details of farmers in 2015-16 (Rs. per household)

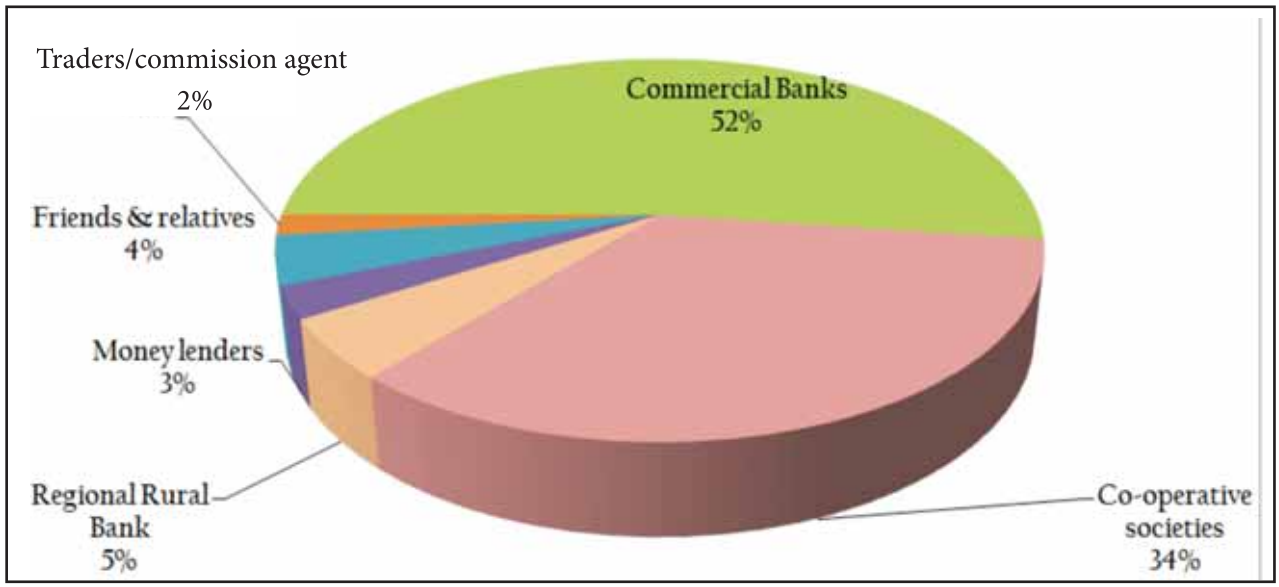
S. No	Sources	Paddy (n=200)	Soybean (n=200)	Overall (n=400)
Institutional sources/Land development				
1	Commercial Banks	15164	16421	15793
2	Co-operative societies	8608	12200	10404
3	Regional Rural Bank	755	2300	1528
Total		24527 (98.45)	30921 (86.50)	27724 (91.41)
Non-Institutional Sources				
1	Money lenders	386	1275	831
2	Friends & relatives	0	2500	1250
3	Traders/commission agent	0	1050	525
Total		386 (1.55)	4825 (13.50)	2606 (8.59)
Grand Total		24912 (100)	35746 (100)	36829 (100)

Figures in parenthesis shows percentage to grand total

from the data that an average respondent was found to avail more credit from institutional sources (91.41%) as compared to non-institutional sources (8.59%).

An average respondent related to paddy used to avail credit from institutional sources (98.45%) as compared to non-institutional sources (1.55%). He borrowed more credit from commercial bank (Rs. 15164/HH) followed by co-operative banks (Rs. 8608/HH) and regional rural bank (Rs. 755/HH). The total credit availed by an average respondents related to paddy was found to be only Rs. 24912/HH during 2015-16 (Table 3.16)

Fig. 3.5: Sources of credit



In case of respondents related to soybean an average respondent availed more credit from commercial banks (Rs. 16421/HH) followed by cooperative societies (Rs. 12200/HH) and regional rural bank (Rs. 2300/HH). He borrowed Rs 35746/HH during 2015-16. An average soybean grower also borrowed more credit from institutional sources (86.50%) as compared to non-institutional sources (13.50%) (11.74).

Table 3.17: Purpose of borrowing loans (2015-16)

(% of farmers & % of amount (Rs/HH)

Purpose	Paddy			Soybean		
	% of amount	% of farmers	per HH credit	% of amount	% of farmers	per HH credit
Seasonal crop cultivation	75.00	82.21	18685	79.84	85.83	25571
Purchase of tractor	7.02	1.23	1750	11.69	5.00	5900
Purchase of livestock	8.03	2.45	2000	6.19	5.00	3125
Consumption expenditure	5.59	11.66	1393	1.39	2.50	700
Marriage and social ceremonies	0	0	0	0	0	0
Non-farm activity	0	0	0	0.89	1.67	450
Other expenditure	4.36	2.45	1085	0	0	0
Total	100	100	24912	100	100	35746

As for as purpose of borrowing is concerned, 82.21 and 2.45 per cent paddy growers borrowed 75.0 and 8.03 per cent of total amount with Rs. 18685 and Rs. 2000/HH for cultivation of seasonal crops and purchase of livestock respectively. In case of soybean, majority of farmers used to borrow loan for cultivation of seasonal crop (85.83%) followed by purchase of tractor (5%), purchase of livestock (5%), consumption expenditure (2.50%) and non-farm activity (1.67%).

The amount borrowed by soybean growers was found to be maximum for cultivation of seasonal crop (79.84%) followed by purchase of tractor (11.69%), purchase of livestock (6.19%), consumption expenditure (1.39%) and non-farm activity (0.89).Amount borrowed per HH was found to be maximum in case of seasonal crop cultivation (Rs. 25571/HH), purchase of tractor (Rs. 5900/HH), purchase of livestock (Rs. 3125/HH), consumption expenditure (Rs. 700/HH) and Non-farm activity (Rs. 450/HH) (Table 3.19). The total amount borrowed by soybean growers (Rs. 35746/HH) was found to be more as compared to paddy growers (Rs.24912/HH) (Table 3.17).

3.7 Training Programme attended

As for as training programme attended by the respondents are concerned, only 22 paddy grower (11%) and 56 soybean grower (28%) were found to be reported that on an average they attended one training programme of one day only conducted by State Agriculture Department during 2015-16 (Table 3.18).

Table 3.18: Trainings attended on application of fertilizers by respondents

(% of farmers)

S. No	Name of the Organizer	Average duration of training (No. of days)	Paddy		Soybean	
			Nos	%	Nos	%
1	State Agriculture Department	1	22	11	56	28

CHAPTER-IV

STATUS OF AWARENESS AND APPLICATION OF NCU

This chapter deals with the awareness of NCU amongst the respondents and sources of information that make them responsive to use it, their status of application and perception with regards to NCU as compared to NU and benefits over NU. The chapter also deals with the diversions of NCU if any in other purposes by the respondents. The constraints faced by the respondents in application of NCU & suggestions thereof and part of this chapter.

4.1 Awareness & Sources of Information

The awareness about NCU amongst selected farmers and sources of information that made them aware in the area under study related to the selected crops viz. paddy and soybean were identified across size of holdings are presented in table 4.1. It is observed from the data that more than 60 per cent of small (79.59%), medium (87.13%) and large (81.48%) farmers related to soybean and paddy were found to be aware to NCU in the area under study. The major source of awareness as reported by majority of small (36.33%), medium (49.50%) and large (44.44%) farmers was Agricultural Officers. The farmers' facilitator, fellow farmers were also found to be the source of information which makes them aware about NCU. The role of other sources viz. print media, wall painting, Agricultural Universities, input shops and suppliers was found to be negligible in creating awareness regarding use of NCU in the area under study.

Table 4.1: Awareness and sources of information about NCU among the respondents

(% of farmers)

Sl. No	Sources of Information	Paddy			Soybean			Overall		
		Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
% of farmers Aware		93.28	96.43	100	66.67	75.56	65.52	79.59	87.13	81.48
Sources of awareness										
1	Agricultural Officer	63.96	75.93	76.00	21.43	26.47	26.32	36.33	49.50	44.44
2	Farmer Facilitator	3.60	1.85	8.00	66.67	55.88	73.68	24.49	19.80	29.63
3	Fellow Farmers	32.43	22.22	16.00	9.52	8.82	0.00	17.96	14.85	7.41
4	Print & Visual media	0.00	0.00	0.00	1.19	2.94	0.00	0.41	0.99	0.00
5	Wall panting	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Agricultural University	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Input shop	0.00	0.00	0.00	1.19	5.88	0.00	0.41	1.98	0.00
8	Company (suppliers)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

These findings were found to be similar with minor variations as regards to respondents related to individual selected crop i.e. paddy and soybean. Although, the role of farmers' facilitator were found to be more as compared to other sources of information as reported by the majority of small (66.67%), medium (55.88%) and large (73.68%) soybean growers in the area under study.

4.2 Status of Application of NCU Vs NU

The status application of NU versus NCU were identified to know the features from which farmers differentiate NCU to NU, application of NCU in cultivation of paddy and soybean, split doses of NCU and NU at various stage of crop growth, method of application of NCU and its uses for other than crop production purposes.

4.2.1 Features Differentiate NCU to NU

The percentage of farmers noticed difference in NCU to NU and features from which they differentiate them are presented in table 4.2. It is observed from the data that more than 90 percent of small (94.86%), medium (93.81) and large (94.74%) farmers were noticed the difference in NCU to NU.

Table 4.2: Factors from which farmers differentiate NCU compared to NU

(% of farmers)

Sl. No	Sources of Information	Paddy			Soybean			Overall		
		Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
% of farmers noticed difference in NCU		93.28	96.43	100	96.43	91.18	89.47	81.63	84.16	77.78
	Factors									
1	Colour difference	40.00	27.63	40.00	25.00	20.59	15.79	26.94	21.78	24.07
2	Price difference	09.75	06.00	09.00	29.76	29.41	10.53	14.29	12.87	7.41
3	Leaf figure on the bag	50.25	66.37	51.00	45.24	50.00	73.68	38.37	52.48	50.00

The major feature of identification of NCU to NU was found to be leaf figure of Neem on the bag as reported by more than 48 per cent of small (38.37%), medium (52.48%) and large (50.00%) farmers. A few of them also reported that they were differentiating NCU to NU by colour difference and price variation. These findings are found to be similar with minor variations in case of respondents related to paddy and soybean.

4.2.2 Application of NCU in Different Crops

The application of NCU in different selected crops by the respondents was also identified in different years and presented in table 4.3. It is observed from the data that the majority of respondents related to paddy (73%) and soybean (54%) reported that they were applied NCU in crop husbandry after 2015-16.

Table 4.3: Application of NCU across different seasons by respondents

(% of farmers)

Sl. No	Name of the Crops	Before 2015 -16		After 2015 -16	
		No	%	No	%
1	Paddy	00.00	00.00	146	73.00
2	Soybean	00.00	00.00	108	54.00

None of them reported to apply NCU 2015-16 in cultivation of paddy/soybean before.

4.2.3 Application of NCU and NU in Split Doses

The information regarding quantity of NCU and NU applied in split doses in cultivation of paddy and soybean was also analyzed and presented in table 4.4. It is observed from the data that the majority of respondents related to the study reported that they used NCU and NU in spilt doses at the time of vegetative growth (40%) of the crop followed by after weeding (30%) and basal application (30%) at the time of sowing.

Table 4.4: Split doses of NCU / NU application by respondents

(Kgs/Acre)

S. No.	Crop Stages	Paddy				Soybean				Overall			
		NCU	%	NU	%	NCU	%	NU	%	NCU	%	NU	%
1	Basal application	4	14.3	1	5.3	8	66.7	6	66.7	6	30.0	4	25.0
2	Vegetative growth	12	42.9	9	47.4	4	33.3	3	33.3	8	40.0	6	42.9
3	After weeding	12	42.9	9	47.4	0	0.0	0	0.0	6	30.0	5	32.1
4	Maturity	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total		28	100	19	100	12	100	9	100	20	100	14	100

The respondents related to paddy reported that they used to apply NCU/NU at the time of vegetative growth (43%), only 14 percent in case of NCU and 5 per cent in case of NU used to apply urea as basal dose. While, in case of soybean 66 per cent respondents used to apply NCU/NU as basal dose while 33 per cent was found to be applying at the time of vegetative growth.

4.2.4 Method of Application

The information regarding method of application of NCU and NU in cultivation of paddy and soybean have also been gathered from the respondents and presented in table 4.5.

Table 4.5: Method of application of NCU/NU

(Kgs/Acre)

S. No	Method of Application	Paddy				Soybean				Overall			
		NCU qty	%	NU qty	%	NCU qty	%	NU qty	%	NCU qty	%	NU qty	%
1	Broadcasting	28.00	100	19.00	100	12.00	100	9.00	100	20.00	100	14.00	100
2	Spraying	-	-	-	-	-	-	-	-				
3	Fertigation	-	-	-	-	-	-	-	-				
4	Drilling	-	-	-	-	-	-	-	-				
Total		28.00	100	19.00	100	12.00	100	9.00	100	20.00	100	14.00	100

It is observed from the data that an average farmer was found to apply 20 (NCU) & 14 kg (NU) per acre at overall level. Amongst the cultivation of selected crops an average farmer used 28 (NCU) & 19 kg (NU) per acre in case of paddy and 12 (NCU) & 09 kg (NU) per acre in case of soybean in the year 2015-16. None of them was found to use NCU other than crop husbandry viz. silages (feed preparation of animals), mix with weedicides and fishery feed preparation (Table 4.6).

4.2.5 Uses of NCU

The usage of NCU for other than crop production purposes were also identified and found that all the selected farmers of the study area were found to use NCU only in cultivation of crops.

Table 4.6: Usage of NCU for other than crop production purposes

(% of farmers)

S. No	Purpose	% of farmers	% of total amount Used
1	Silages (Feed preparation of animals)	0	0
2	Mixed with weedicides	0	0
3	Fishery feed preparation	0	0

4.3 Perception of Farmers about NCU and its Benefits

The perception of respondents about NCU and NU were taken into consideration on different parameters viz. quality, availability, timely availability, price, benefits in terms of total fertilizer and Urea usage, incidence of pest and diseases attack and accessible of NCU in the market and presented in table 4.7

As for as quality of NCU is concerned the majority of farmers reported that the quality of NCU available in the market is of good quality (55.91%) while, 24.80 per cent of them reported that its quality was found to be very good. The 49.32 & 17.12 per cent of paddy and 64.81 & 35.19 per cent soybean growers considered NCU as good and very good, respectively. The 96.30 per cent soybean and 63.01 per cent paddy growers reported that NCU is available in adequate quantity, while 3.42 & 3.70 per cent paddy and soybean growers reported inadequate availability of NCU and 33.56 per cent (paddy growers) reported no change. At overall level most of the farmers reported that there is adequate (77.17%) and timely (84.38%) availability of NCU with almost same price of urea (68.90%) or not very high price (18.11%), only 12.99 per cent farmers reported that price of NCU is high (6.69) and very high (6.30).

Most of the farmers reported that there is no change in benefit of NCU in terms of total fertilizer usage as reported by paddy (80.82%) and soybean growers (49.07%), while 34.26 and 12.33 per cent soybean and paddy growers reported that it has capacity to increase benefits.

Table 4.7: Perception about NCU versus NU

Particulars	Paddy (n=146)		Soybean (n=108)		Total (n=254)	
	No	%	No	%	No	%
NCU quality						
Very good	25	17.12	38	35.19	63	24.80
Good	72	49.32	70	64.81	142	55.91
Bad	48	32.88	0	0	48	18.90
No change	1	0.68	0	0	1	0.39
NCU availability						
Adequate	92	63.01	104	96.3	196	77.17
Inadequate	5	3.42	4	3.7	9	3.54
No change	49	33.56	0	0	49	19.29
Timely availability of NCU						
Yes	120	82.19	94	87.04	214	84.25
No	26	17.81	14	12.96	40	15.75
Neem Coated Urea Price						
Very high	0	0.00	16	14.81	16	6.30
High	0	0.00	17	15.74	17	6.69
Not very high	1	0.68	45	41.67	46	18.11
Same as urea	145	99.32	30	27.78	175	68.90
Benefits of NCU in terms of total fertilizer usage						
Increased	18	12.33	37	34.26	55	21.65
Decreased	10	6.85	18	16.67	28	11.02
No Change	118	80.82	53	49.07	171	67.32
Benefits of NCU in terms of NU usage						
Increased	22	15.07	11	10.19	33	12.99
Decreased	6	4.11	14	12.96	20	7.87
No Change	118	80.82	83	76.85	201	79.13
Pest and diseases attack						
Increased	0	0.00	0	0	0	0.00
Decreased	76	52.05	5	4.63	81	31.89
No Change	70	47.95	103	95.37	173	68.11
NCU is more easily accessible in the market compared to NU						
Yes (reason)	0	0.00	37	34.26	37	14.57
No	146	100.00	70	64.81	216	85.04

The decrease in benefits of NCU in terms of total fertilizer usage was reported only by 16.67 & 6.85 per cent soybean and paddy growers, respectively. At overall level it was found to be reported by farmers that it has been increased (21.65%), decreased (11.02%) and no change (67.32%) in benefits of NCU in term of total fertilizer usage.

The most of the respondents (79.30%) reported that there has been no change in benefits of NCU in term of Urea usage at overall level and among the crops also. The majority of respondents also reported that there was no change in pest and disease infestation after use of NCU in cultivation of crops, while 31.83 per cent reported that it was decreased. The majority of farmers also reported that NCU is easily accessible in the market, its accessibility was found to be just similar to NU in the market.

4.4 Constraints and Suggestions about NCU and its Adoption

The major constraints faced by the farmers and suggestions thereof of adoption of NCU in cultivation of paddy and soybean were also identified and presented in table 4.8 and 4.9 respectively. All the farmers in the area under study reported that they did not have knowledge about usage of NCU for other than crop production purposes i.e. silage making, mixed with weedicide and fisheries feed preparation.

Table 4.8: Major constraints faced by the respondents in adoption of NCU fertilizer

(% of farmers)

S. No	Constraints	Paddy	Soybean	Overall
1	Lack of awareness	26	46	36
2	Lack of technical know how about usage of NCU in split doses and method of application	28	74	51
3	Lack of knowledge about usage of NCU for other than crop production purposes i.e. silage making, mixed with weedicide and fisheries feed preparation	100	100	100
4	Lack of capital	18	13	16
5	High cost of fertilizer	21	16	19
6	Difficulty to calculate the recommended doses of nutrients from the different brand of fertilizer available in the market	71.5	77	74
7	Not available on time	13	19	16
8	Distant market	9	12	11
9	Conditional tagging of other inputs in buying of fertilizers from cooperatives	39	41	40
10	Inadequate supply	23	26	24

The difficulty to calculate the recommended doses of nutrients from the different brands of fertilizers available in the market was reported by 74 per cent of respondents, lack of technical know how about usage of NCU in split doses and method of application (51%), conditional tagging of other inputs in buying of fertilizers from cooperatives (40%), lack of awareness (36%), inadequate supply (24%), high cost of fertilizer (19%), lack of capital (16%), not available on time (16%) and distant market (11%) were found to be major constraints in adoption of NCU at over all level.

As for as, suggestions for improving the uses of NCU fertilizers are concerned sample farmers and soil scientists were consulted and the same is presented in table 4.9.

1. More and more field demonstrations regarding usage of NCU in cultivation of

crops and its usage in other than crop production purposes i.e. silage making, mixed with weedicide and fisheries feed preparation to be conducted in farmers field.

2. Awareness amongst farmers regarding integrated nutrients management with NCU is required to be created.

3. Packaging/minikit of fertilizer for an acre should be done in such a way so that one bag of fertilizer will serve the purpose of applying recommended doses of fertilizers for different crops as per Agro-Climatic Zones of the State. The farmers are not able to calculate desired nutrients to be applied from the various brands of fertilizers available in the market having different proportion of nutrients. In this way farmer will automatically apply recommended doses of fertilizers (RDF) that too in balanced quantity as per requirement of crops/types of soil. This will not only increase the consumption and use of fertilizers in the cultivation of crops but at the same time he will be able to save the precious capital invested on fertilizer by using all the nutrients resulting not only realization of better production from the less investment but save the land & soil degradation as well.

Table 4.9: Major suggestions for improving the NCU fertilizers usage

(% of farmers)

S.No	Suggestions	Paddy	Soybean	Overall
1	Creating awareness amongst farmers	76	68	72
2	Conduction of field demonstration	81	72	77
3	Creation of producer company	46	38	42
4	Creation of awareness about cooperatives	53	49	51
5	Introduction of national Gateway	26	21	24
6	Packaging/minikit of fertilizer for cultivation of crops	56	43	50

4. Creation of at least one Producer Company at village level for timely supply of input, in adequate quantity at reasonable rate and assured quality.

5. Introduction of national Gateway with respect to e-marketing of seed fertilizer and other inputs at the door step of the farmers to assure quality at reasonable price and timely delivery at desired place.

CHAPTER-V

AWARENESS AND ADOPTION LEVEL OF SOIL TESTING TECHNOLOGY

This chapter deals with the soil health related programme and scheme–implemented in Madhya Pradesh and its performance. The chapter also comprises awareness on soil testing among the farmers, details of soil testing, reasons for soil testing and adoption of recommended doses of fertilizer in cultivation of crops based on soil test report.

5.1 Soil Health Related Programme and Scheme–implementation and Performance

Apart from the prestigious Soil Health Card programme, the Government of Madhya Pradesh executed various soil health programmes under various programmes, which are implemented by the Government of India viz. National Mission under Oilseeds and Oil Plam, National Horticulture Mission (NHM), National Food Security Mission (NFSM) and National Mission for Sustainable Agriculture (NMSA) in different districts of the State. It is observed that Government of Madhya Pradesh provide assistance of 50% of profit + transportation cost, total limited to be Rs. 750/ha for supply of gypsum /pyrite /lime/solomite and 50% of total cost and limited to Rs. 500/ha for purchase of plant protection chemicals for the farmers. insecticides'/fungicides/bioinsecticides/bio-components/micronutrients/bio-fertilizers/etc. under National Mission for Oilseed and Oil Palm scheme. (Table 5.1)

Table 5.1: Assistance for improvement of soil under National Mission for Oilseed and Oil Palm

S. No.	Type of Assistance	Scale of Assistance/ Maximum Limit
1	Supply of Gypsum /Pyrite /Lime/Dolomite	50% of profit + Transportation, Total limited to Rs. 750/ha
2	Plant Protection Chemicals	Insecticides'/Fungicides/Bioinsecticides/Bio-components/Micronutrients/ Bio-fertilizers /etc 50% of total cost and limited to Rs. 500/ha

The assistances of Rs. 10,000/ha for adoption of organic farming at their farms, Rs. 50,000 per Unit (measurement 30'X 8'X 2.5' or in proportion of 60sq. ft.) for establishing unit of vermi compost, Rs. 8000/unit (measurement 12'X 4'X 2 or in proportion of 60cu. ft.) for improvement in intensive polythene vermi bed and Rs. 1200/ha limited to 4 ha to the farmers for encourage them for Integrated Nutrient Management (INM) in cultivation of crops for improvement of soil under NHM. (Table 5.2)

Table 5.2: Assistance for improvement of soil under National Horticulture Mission (NHM)

S. No.	Type of Assistance	Scale of Assistance/ Maximum Limit
1	Adoption of Organic Farming	Rs. 10,000/ha
2	Unit of Vermi Compost	Rs. 50,000 per unit (Measur ement 30'X 8'X 2.5) or in proportion of 60sq. ft.
3	Improved Intensive Polythene Vermi Bed	Rs.8000/unit (Measurement 12'X 4'X 2) or in proportion of 60cu. ft.
4	Encouragement to Integrated Nutrient Management (INM)	Rs. 1200/ha limited to 4 ha.

The assistance of 50% of cost limited to 750/ha,50% of cost limited to 500/ha, 50% of cost limited to 1000/ha, 50% of cost limited to 100/ha is being provided under NFSM for supply of zypsum/ phaspho zypsum/bentonite sulpher in Wheat and Pulses, adoption of micronutrient in Wheat, Pulses and Rice, introduction of liming in Rice and Pulses and encourage them to use bio-fertilizers (rizobium/PSB) in cultivation of crops respectively. (Table 5.3)

Table 5.3: Assistance for improvement of soil under National Food Security Mission (NFSM)

S. No.	Type of Assistance	Scale of Assistance/ Maximum Limit
1	Supply of Zypsum/ Phaspho Zypsum/ Bentonite Sulpher in Wheat and Pulses	50% of cost limited to 750/ha
2	Micronutrient in Wheat Pulses and Rice	50% of cost limited to 500/ha
3	Liming in Rice and Pulses	50% of cost limited to 1000/ha
4	Bio-Fertilizers (Rizobium/PSB)	50% of cost limited to 100/ha

The assistances for establishing New Mobile/State Soil Testing Laboratories (MSTL/SSTL), distribution and encouragement to micronutrient, establishment of bio-fertilizer/ bio- insecticides based state of art liquid carrier unit, production unit for making compost from market waste of fruits and vegetables/ agriculture wastages, encouragement to organic inputs at farmers field (manure, vermi compost, bio-fertilizer, liquid/solid, waste, compost/extract from herbs), adoption of bio farming through cluster approach under co-operative persuasion grading system, online data management and residue analysis under PGS technique, adoption of organic village for fertilizer management and organic nitrogen, demonstration of organic farming and improvement of problematic soil are being provided for improvement of soil under National Mission for Sustainable Agriculture (Table 5.4)

Table 5.4: Assistance for improvement of soil under National Mission for Sustainable Agriculture (NMSA)

S. No.	Type of Assistance	Scale of Assistance/ Maximum Limit
1	Establishment / Training for New Mobil/State Soil Testing Laboratories (MSTL/SSTL)	50% of total project cost for MSTL/SSTL and limited to Rs. 56 lakh
2	Distribution and Encouragement to Micronutrient	50% of cost limited to Rs. 500 or Rs. 1000/Beneficiaries
3	Establishment of Bio-Fertilizer/ Bio-Insecticides based State of Art Liquid Carrier Unit	25% of total cost and limited to Rs. 40 lakh for the production capacity of 200 tonns/ year (Assistance for NABARD for Private/Individual agencies)
4	Production Unit for Making Compost from Market Waste of Fruits and Vegetables/ Agriculture Wastages	33% of total cost and limited to Rs. 63 lakh for the production capacity of 3000 tonns/ year (Assistance for NABARD for private/individual agencies)
5	Encouragement to Organic Inputs at Farmers Field (Manure, Vermi Compost, Bio-Fertilizer, Liquid/Solid, Waste, Compost/Extract from Herbs	50% of total cost and Limited to Rs. 5000/ha or Rs. 1000/ beneficiaries coverage 1 million ha.
6	Adoption of Bio Farming through Cluster Approach under Co-operative Persuasion Grading System	Rs. 20,000/ha for the period of three year/beneficiaries maximum limit limited to Rs. 40,000
7	Assistance for Online Data Management and Residue Analysis under PGS Technique	Rs. 200/farmer limited to Rs.5000/group/year or 1 lakh per regional committee for online data management under PGS technique Rs.10,000/sample for residue analysis
8	Adoption of Organic Village for Fertilizer Management and Organic Nitrogen	Rs. 10 lakh /village /year limited to 10 villages/ state
9	Demonstration of Organic Farming	50 or Rs. 20,000 for group of more than 50 beneficiaries
10	Improvement of Problematic Soil	50% of cost limited to 25,000/ha and/or 50,000/beneficiaries alkaline /saline soil 50% of cost limited to 3000/ha and/or 6000/beneficiaries acidic soil

Table 5.5: Performance of soil testing and Soil Health Card Scheme in Madhya Pradesh (2015-16)

Particulars	Numbers
Physical target	805000
Collection of soil sample	565843
Percentage of sample collected to target	70.29
Sample received by soil testing labs	494938
Total sample analyzed	390682
Percentage of sample analyzed to sample received by soil testing labs	78.94
Target of distribution of soil health card	3000000
Achievement of distribution of soil health card	1207353
Percentage achievement to target of soil health card	40.25

The performance of soil health card scheme is presented in table 5.5. This scheme being implemented in all the districts of the State through 75 soil testing labs (24 under State Department, 26 under Madhya Pradesh State Agriculture Marketing Board and 25 under Agricultural Universities) running under the control of State Agriculture Department. It is observed that State Govt. fixed the target of 805000 soil samples, from which 70.29 per cent soil samples have been collected from the farmers fields till December 2014. The total soil samples received in soil testing labs were recorded to be 494938, out of which 78.94 per cent have been analyzed. As for as the progress of distribution of soil health cards is concerned, 40.25 per cent (1207353) soil health cards of the target 3000000 have been found to be distributed among farmers.

5.2 Awareness on Soil Testing

The distribution of sample respondents tested soil of their farm and adopted recommendation in cultivation of selected crops, awareness among the respondents regarding soil testing from different sources have been identified for the study.

5.2.1 Distribution of Sample Respondents Tested their Soil and Adopted Recommendation

The distribution of sample respondents tested their soil and adopted recommendation in cultivation of selected crops has been presented in table 5.6. It is observed from the data that at overall level only 18.5 percent of respondents tested their soil, out of which only 14.2 per cent were reported to receive the soil testing report and only 11.7 per cent adopted the recommendation of soil testing report.

Table 5.6: Number of sample respondents tested their soil and adopted recommendation

Particulars	Paddy	Soybean	Overall
Total Respondents	200	200	400
Who test soil	40 (20.0)	34 (17.0)	74 (18.5)
Who Received Report	31 (15.5)	26 (13.0)	57 (14.2)
Who Adopt Recommendation	26 (13.0)	21 (10.5)	47 (11.7)

Figures in parenthesis show percentages to total respondents

Amongst different crops, it is also observed from the data that only 20 per cent paddy growers getting their soil tested from soil testing labs, out of which only 15.5 per cent were reported to receive soil testing report and only 13 per cent of them adopted the recommendation of soil testing report, while only 17 per cent of selected soybean growers getting their soil tested, out of which only 13.0 and 10.5 per cent receive soil testing report and adopted the recommendation of soil testing report respectively in the area under study.

5.2.2 Sources of Soil Testing

The different agencies from which sample farmers getting their soil tested are presented in table 5.7. It is observed from the data that the major agency of soil testing in the area under study was found to be district laboratories of State Department of Agriculture as reported by

more than 90 per cent of the respondents getting their soil tested.

The 4, 3 and 1 per cent of sample farmers also reported that they used to getting their soil tested from Krishi Vignan Kendra (KVKs), Agriculture Universities and Private laboratories respectively in the area under study. The same finding with minor variation has also been reported by the selected paddy and soybean growers. (Table 5.7)

Table 5.7: Sources of soil testing of the sample farmers

(% of farmers who tested their soil)

S.No	Particulars	Paddy	Soybean	Overall
1	Krishi Vignan Kendra (KVKs)	4	3	4
2	Agriculture Universities	3	2	3
3	State Department of Agriculture District laboratories	92	94	93
4	Private laboratories	1	1	1

5.2.3 Sources of Information:

The sources of information about soil testing and soil sample collection are identified from the sample farmers and presented in table

Table 5.8: Different sources of information about soil testing and soil sample collection

(% of farmers who tested their soil)

S.No	Particulars	Paddy	Soybean	Overall
	Sources for soil testing			
1	State Agriculture Universities (SAUs)	4	3.01	3.5
2	Krishi Vignan Kendra (KVKs)	3	5.82	4.4
3	Private Companies	1	8.82	4.9
4	Friends	0	2.94	1.5
5	Neighbors	0	20.59	10.3
6	Agriculture Department	92	58.82	79.41
	Who collected the soil			
1	Self	65	35.29	50.15
2	State Department of Agriculture Officers	35	20.59	27.79
3	Farmer Facilitator	0	44.12	22.06

It is observed from the data that the Agricultural Department was found to be a major source of information as reported by more than 75 per cent of respondents related to cultivation of paddy (92.0%) and soybean (58.82%).The respondents also reported that they used to get information of soil testing from neighbours (10.3%), private companies (4.9%), Krishi Vignan Kendra (KVKs) (4.4%) and friends (1.5%). These finding were found to be same with minor variation in case of sample farmers related to paddy and soybean.

The majority of farmers were found to collect soil by self (50.15%) followed by with the help of officials of State Department of Agriculture (27.79 %) and farmer facilitator (22.06%) at over all level. Most of the paddy respondents reported that they used to collect soil sample by self (65.0%) followed by officials of State Agriculture Department (35.0%). None of the selected paddy grower was found to be avail the services of farmers' facilitators in collection of soil sample, while majority of soybean growers were found to collect soil sample with the help of

farmers' facilitators (44.12%) followed by self (35.29%) and with the help of officials of State Agriculture Department (20.59%). (Table 5.8)

5.3 Details of Soil Testing

The details of soil testing done by paddy and soybean growers within and before 3 years was analyzed in terms of per cent of farmers who were getting their soil tested, number of times soil testing done, cost of soil testing, distance from field to soil testing lab, numbers of samples taken for soil testing, area covered under soil test and sources of information about soil testing and soil sample collection are presented in tables 5.9.

Table 5.9: Details of soil testing by the respondents

(% of farmers who tested their soil)

S. No	Particulars	Within 3 yrs		Before 3 yrs	
		Paddy	Soybean	Paddy	Soybean
	% of farmers done soil testing	20	17	2	3
1	Number of times soil testing done	1	1	1	1
3	Cost of soil testing (Rs/sample)	5.60	4.71	4.73	3.78
4	Distance from field to soil testing lab (Kms)	67.60	38.76	66.38	39.21
5	Samples taken for soil testing (No.s)	2	2	1	1
6	Area covered under soil test (all plots) (Acres)	3.81	3.14	3.78	2.96

It is observed from the data that soil testing was found little bit popular amongst farmers in recent years than 3 years before and percentage of farmers getting their soil tested was found to be increased 2 to 20 and 3 to 17 in case of paddy and soybean growers respectively. The number of soil samples was also found to be increased from 1 to 2 in case of paddy and soybean growers. The cost per soil sample was found to be increased from Rs. 4.73 to 5.60 (paddy) and 3.78 to 4.71 (soybean) in recent years than 3 years before in the area under study. The distance from field to soil testing lab and area covered under soil test were found to be same in both the periods. The number of samples taken for soil testing was found to be increased in recent years from 1 to 2 than three years before. This could happen only because of the programme of soil testing has been converted into mission mode since the year 2014-15.

5.4 Reasons for Soil Testing

Reasons for soil testing i.e. most important, important, least important were also analyzed for selected paddy and soybean growers. At overall level the most important reasons for soil testing were found to be recently aware about soil testing and its use, to understand fertilizer requirement for the crop and poor crop yield as reported by 71.08, 52.50 and 51.44 per cent of the respondents in the area under study. The important reasons which were reported by the majority of the respondents are to understand fertilizer requirement for the crop (41.25%), poor crop yield (31.41%) and recently aware about soil testing (22.67%). The least important constraints as reported by the majority of respondents of the area under study were found to be motivation from village demonstration/training/exposure visits to places with best farming practices (93.50%) and availing benefits under subsidy

scheme (86.31%). These findings were found to be similar with minor variation for the respondents related to paddy and soybean (Table 5.10).

The reasons for not getting soil tested by the respondents who did not get their soil tested were also analyzed for the study and are presented in the table 5.11.

The least important reason of not getting the soil tested as reported by the majority of respondents were found to be do not know how to take soil samples (42.47%) and soil testing laboratories are located far away (40.20%) in the area under study. They did not know whom to contact for details on soil testing as reported by paddy (80%) and soybean (83%) growers. (Table 5.11)

Table 5.10: Reasons for Soil testing by the respondents

(% of farmers who tested their soil)

S. No	Reasons	Paddy			Soybean			Overall		
		Most imp	Important	Least imp	Most imp	Important	Least imp	Most imp	Important	Least imp
1	Recently aware about soil testing and its use	52.50	35.00	12.50	89.66	10.34	0.00	71.08	22.67	6.25
2	For availing benefit under subsidy schemes	5.00	10.00	85.00	4.76	7.62	87.62	4.88	8.81	86.31
3	Poor crop yield	46.43	35.71	17.86	56.44	26.56	17.00	51.44	31.14	17.43
4	Motivation from village demonstration/training/exposure visits to places with best farming practices	2.00	4.00	94.00	4.00	3.00	93.00	3.00	3.50	93.50
5	To understand fertilizer requirement for the crop	50.00	42.50	7.50	55.00	40.00	5.00	52.50	41.25	6.25

Table 5.11: Reasons for not testing soil by the respondents

(% of farmers who did not tested their soil)

S. No	Reasons	Paddy			Soybean			Overall		
		Most imp	Important	Least imp	Most imp	Important	Least imp	Most imp	Important	Least imp
Do not know whom to contact for details on testing		80.0			83.0			82.0		
1	Do not know how to take soil samples	59.99	31.88	8.13	53.06	38.77	8.17	8.15	49.39	42.47
2	Soil testing laboratories are located far away	44.03	28.93	27.04	42.15	36.36	21.49	25.21	34.60	40.20
3	Soil testing not required for my field as crop yield is good	83.34	8.33	8.33	45.05	29.67	25.27	54.30	19.00	26.69
4	Report timely not available	60.43	26.62	12.95	63.40	18.30	18.30	61.92	15.63	22.46
5	Do not know whom to contact for details on testing	66.67	16.67	16.66	48.81	32.14	19.05	42.86	32.74	24.40

It is observed from the data that at over all level, the most important reasons for not getting the soil tested by the respondents were found to be soil testing report not available on time (61.92%), soil testing not required as crop yield is good (54.30%) and do not know whom to contact for detail on testing (42.86%). The important reason for not getting soil tested by the respondents were found to be do not know how to take soil samples, soil testing laboratories are located far away, do not know whom to contact for details on testing as reported by the 49.39,34.60 and 32.74 per cent of respondents.

5.5 Adoption of Recommended Doses of Fertilizer Application Based on Soil Test Report

The elucidation of recommended doses of fertilize (RDF) for the respondents of paddy and soybean and their adoption thereof was also determined in the area under study

The elucidation of RDF on selected crops for the selected farmers related to paddy and soybean has been presented in table 5.12. It is observed from the data that Department of Agriculture was found to be major source of explanation about the RDF for cultivation of crops to the farmers in the study area. Amongst respondents related to paddy and soybean, the selected paddy growers reported that the major sources of elucidation of RDF for the farmers in cultivation of crops were Department of Agriculture (92%) followed by Agricultural University (3%), fellow farmers (3%) and private dealers/ retailers (1%), while in case respondents related to soybean reported that Department of Agriculture (60%) followed by fellow farmers (21%), private dealers/ retailers (9%), agriculture university (6%)and others (4%)were found to be major sources of elucidation of RDF in cultivation of crops by the farmers.

Table 5.12: Elucidation of Recommended Doses of Fertilizers

(% cent of farmers who tested their soil)

S.No.	Who explained to you	Paddy	Soybean	Overall
1	Department of Agriculture	92	60	76
2	Agriculture University	3	6	5
3	Cooperatives/ Growers'	0	0	0
4	Association	0	0	0
5	Private dealers/retailers	1	9	5
6	Fellow Farmers	3	21	12
7	NGO	0	0	0
8	Others	1	4	3

Note : RDF (Recommended Doses of Fertilizer)

The information related to RDF adopted by the respondents related to paddy and soybean is presented in table 5.13. It is observed from the data that as per farmers opinion only 15.5 and 13.0 per cent sample paddy and soybean growers were found to be aware about the recommended doses of fertilizers. In paddy an average farmer used to apply NU (49.46 Kg/ac), SSP (47.44 Kg/ac), DAP (36.04 Kg/ac), MOP (23.61 Kg/ac), FYM (8.06 Kg/ac) and $ZnSo_4$ (5.08 Kg/ac) in cultivation of paddy. The farmers were found to apply 19.4, 52.0, 32.0, 9.20, 68.4 and 49.2 per cent less doses of above mentioned fertilizers in cultivation of paddy as per soil test report.

Table 5.13: Recommended doses of fertilizer adopted by respondents

S. No.	Particulars	Paddy		Soybean	
		As per Farmer Opinion	As per Soil Test Report	As per Farmer Opinion	As per Soil Test Report
% of farmers aware of RDF		15.5		13.0	
1	FYM (q/ac)	8.06 (-19.4)	10	6 (-40.0)	10
2	Urea(kg/ac)	49.46 (-52.6)	104.4	27.56 (175.60)	10
3	DAP(Kg/ac)	36.04 (-32.0)	53	49.18 (-5.52)	52
4	MOP (Kg/ac)	23.61 (-9.20)	26	37.27 (-44.08)	13
5	SSP(Kg/ac)	47.44 (-68.4)	150	18 (-82)	100
7	$ZnSo_4$* (kg/ac)	5.08 (-49.2)	10	5.45 (45.00)	10

Figures in parenthesis show percentage gap to soil test report, *Once in three years

The selected soybean growers were found to apply maximum quantity of DAP (49.18 Kg/ac) followed by MOP (37.27 Kg/ac), SSP (33.75 kg/ac), NU (27.56 Kg/ac), $ZnSo_4$ (5.45 Kg/ac) and FYM (6 q/ac), while as per the soil test report an average farmer used to apply 10 kg FYM, 10 Kg NU, 52 Kg DAP, 13 Kg MOP and 10 Kg $ZnSo_4$ per acre in cultivation of soybean. Hence, They were used to apply 82.0, 44.08, 40.00 and 5.52 per cent less SSP, MOP, FYM and DAP respectively and 175.60 per cent more NU in cultivation of soybean. (Table 5.13) Hence, farmers were not found to be in practise of applying balanced doses of fertilizer in cultivation of crops even after receiving the soil testing report well in time. It might be due to various constraints present in the area under study.

5.6 Constraints in Adoption of Soil Testing Technology

The constraints reported by the sample cultivators in adoption of soil testing technology are presented in Table 5.14. It is observed from the data that at overall level lack of knowledge about soil testing facility among cultivators (70%) was found to be the main constraint in adoption of soil testing technology followed by non availability of soil testing reports on time to cultivator (62%),

Table 5.14: Constraints in adoption of soil testing technology.

S.No	Constraints	Paddy	Soybean	Overall
1	Lack of knowledge about testing facility	67	73	70
2	Non availability of soil testing report in time	63	61	62
3	Less cooperation from Agriculture Officers/staff	42	50	46
4	Complicated methods of Soil Sampling	35	25	30
5	Technology is far different from farming practices	24	28	26
6	Lack of Training for testing	20	24	22
7	High cost of recommendation	19	21	20
8	Difficulty in adoption of recommendation	23	17	20
9	Soil testing is incredible	14	10	12
10	Lab situated far away from the village	11	13	12

less cooperation from Agriculture Officers/ Staff of Agriculture Department (46%), complicated method of taking soil sampling (30%), technology totally different from farming practices (26%), lack of training about soil testing technology (22%), high cost of adoption of recommended practices (20%,) difficulty in adoption of recommendations (20%), incredibility of soil testing report (12%) and situation of soil testing labs not with the reach of cultivators (12%), were found to be other main constraints reported by farmers during the course of investigation. These findings were found to be similar with minor variations as regards to selected paddy and soybean growers.

5.7 Suggestion for Improving the Soil Health Card Scheme

The major suggestions as reported by the respondents are presented in table 5.15.

Table 5.15: Major suggestion for improving the Soil Health Card Scheme

(% of farmers)

S.No	Suggestion	Paddy	Soybean	Overall
1	More awareness campaign of soil testing	66	58	62
2	Ensured timely availability of soil testing report	89	81	85
3	More training programme should be organised	85	81	83
4	Report available in local/regional language	55	49	52
5	Soil testing labs at least at block level	62	54	58
6	Regular visits of Agricultural officers in the villages	36	28	32

At overall level it is observed from the data that ensured timely availability of soil testing report on mobile/internet (85%), more training programme should be organised regarding procedure of collection of representative soil sample (83%), more awareness campaign should be organised regarding benefits of soil testing (62%), ensure soil testing labs at least at block level to increase the access at farmer's door step and promotion of soil testing (58%), report should be made available in local/regional language (52%) and Rural Agriculture Extension Officer (RAEO's) should visit the village at least twice in a week so that farmer will be able to get proper/ timely advice for his problems (32%) were the major suggestions given by the respondents for improving soil health card scheme in the area under study.

CHAPTER-VI

IMPACT OF NCU APPLICATION ON CROP PRODUCTION AND SOIL HEALTH

This chapter deals with the impact of NCU application on yield, total fertilizers used, and cost of cultivation of paddy & soybean in Madhya Pradesh.

6.1 Background

The impact of application of NCU over NU in terms of yield, cost of NU/NCU, other fertilizers use, cost of pest & diseases control and weed management used was analysed by using paired t-test and impact on cost of cultivation was analysed by using partial budgeting technique (return from investment) and benefit cost ratio. The impact of NCU over NU was analysed with respective to yield total fertilizers and cost of cultivation by using NCU and NU data pertains to the year 2015 and 2014 respectively as NCU was not found to be applied during the year 2014 in the area under study.

6.2 Impact on Yield of Soybean and Paddy

The impact of NCU over NU on yield of paddy and soybean respondents was analysed by considering quantity and value of main and by products and depicted in Table 6.1.

Table 6.1: Impact of NCU over NU on yield of paddy and soybean among the sample households

Particulars	NCU	NU	't' Value	% change in NCU over NU
Paddy				
Number of Sample Farmers	146	146		
Main product yield (kg)	1406	1206	6.48***	16.58
Value of main product (Rs)	19432	16333	7.02***	18.97
By produce on yield (kg)	2369	2250	1.75*	5.29
Value of by product (Rs)	3669	2700	9.15***	35.89
Soybean				
Number of Sample Farmers	108	108		
Main product yield (kg)	532	386	4.35***	37.82
Value of main product (Rs)	16763	13876	4.80***	20.81
By produce on yield (kg)	798	718	2.97**	11.14
Value of by product (Rs)	1430	1173	3.49***	21.91

*** 1 % level of significance ** 5 % level of significance * 10 % level of significance

It is clear from the data that out of 200 sample farmers, 146 and 108 respondents were found to apply NCU in cultivation of paddy and soybean, respectively. The impact of application of NCU over NU is reflected in terms of yield obtained by paddy and soybean growers, which was found to be increased by 16.58 and 37.82 per cent respectively. The impact of NCU was found to be highly significant in paddy and soybean when compared with NU in terms of yield of main and value of main and by product, while yield of by product in case of paddy and soybean was found to be significant.

6.3 Impact of NCU on Important Indicators of Input Cost

The Impact of NCU over NU on important indicators of input cost viz. cost of NU/NCU, other fertilizers, pest & diseases control and weed management was analysed for paddy and soybean growers and presented in Table 6.2

Table 6.2: Impact of NCU over NU on important parameters of input cost in case of Paddy and Soybean growers

Particulars	NCU Mean	NU Mean	't' Value	% change in NCU over NU
Paddy				
Cost of NU/NCU	300	334	-2.34**	-10.25
Cost of others Fertilizers	1309	1253	0.81	4.44
Cost of Pest and Disease Control	399	353	1.64	12.82
Cost of Weed Management	339	298	1.27	13.44
Total Cost	2347	2146	1.82	9.37
Soybean				
Cost of NU/NCU	118	130	-1.73	-9.20
Cost of others Fertilizers	1229	1352	-1.27	-9.14
Cost of Pest and Disease Control	220	184	1.22	19.92
Cost of Weed Management	414	421	-0.17	-1.68
Total Cost	1981	1872	1.38	5.82

** 5 % level of significance

The analysis of the impact of NCU over NU on various input cost shows that the cost of NU/NCU fertilizers was found to be reduced by 10.25 per cent as compared to NU fertilizers, while the cost of weed management, pest & diseases control and other fertilizers were found to be increased by 13.44, 12.82 and 4.44 per cent respectively in cultivation of paddy. In case of soybean the cost of NU/NCU, other fertilizers, and weed management was found to be reduced by 9.14, 9.20 & 1.68 respectively, while the cost and pest & disease control was found to increased by 19.92 per cent. Only cost of NU/NCU which was found to be reduced and found significant in case of paddy, while other inputs cost in case of both the crops were found to be non-significant, which indicates that application of NCU in paddy leads to reduction in cost of NU/NCU fertilizers.

6.4 Economic Feasibility of NCU over NU: A Partial Budgeting Framework

The impact of NCU over NU on cost of cultivation of paddy and soybean was analyzed using partial budgeting technique and results obtained are presented in table 6.3 and 6.4. The variables considered for estimating partial budgeting framework in the study included the cost of seed, organic/FYM, NU/NCU, chemical fertilizers (Other than NU/NCU), plant protection chemicals, irrigation charges, labour charges and miscellaneous charges.

In case of paddy, the added cost & reduced return and reduced cost & added return due to application of NCU were analysed and presented in table 6.3

Table 6.3: Economic feasibility of NCU in Paddy, using partial budgeting Framework

(Rs./acre)

A				B	
S.No	Added cost due to NCU	Costs	S.No	Reduced cost due to NCU	Returns
1	Seed cost/ purchase of seedlings	53	1	Seed cost/ purchase of seedlings	0
2	Organic/FYM	10	2	Organic/FYM	0
3	NU/NCU	53	3	NU/NCU	0
4	Chemical fertilizers (Other than NU/NCU)	61	4	Chemical fertilizers (Other than NU/NCU)	0
5	Plant protection chemicals	43	5	Plant protection chemicals	0
6	Irrigation charges	0	6	Irrigation charges	17
7	labour charges	669	7	Labour cost	0
8	Miscellaneous charges	251	8	Maintenance costs	0
Total Added Cost		1140	Total Reduced Cost		17
S. No.	Reduced Return due to NCU	Costs	S. No.	Added Return due to NCU	Return
1	Main product	0	1	Main product	3109
2	By-product yield	0	2	By-product yield	833
Total of reduced return		0	Total Added Returns		3942
Total "A" (Additional Cost)		1140	Total "B" (Additional Return)		3959
Additional Return from NCU (Total B-Total A)		2819			
Benefit Cost Ratio (Total B/Total A)		3.47			

In case of paddy, the added cost due to NCU application amounted to Rs. 1140 per acre. The added cost was found to be maximum in case of labour (Rs. 669/acre) followed by miscellaneous charges (Rs. 251/acre) other chemical fertilizers (Rs. 61/acre), seed (Rs. 53/acre), NU/NCU (Rs. 53/acre), plant protection chemical (Rs. 43/acre) and organic manures/FYM (Rs. 10/acre). Only the cost of irrigation was found to be reduced by Rs. 17/acre. Thus, the total cost of Rs. 1140/acre was added under different sub-head due to application of NCU in paddy and added return was found to be Rs.3959/acre. Hence, net return due to application of NCU in paddy was found to be Rs. 2819/acre with benefit cost ratio of 3.47

The added cost & reduced return and reduced cost & added return due to application of NCU in cultivation of soybean was analysed and presented in table 6.4 In case of soybean, the added cost was amounted to Rs. 1140 with reduced cost of irrigation by Rs. 27/acre. The maximum cost was incurred in case of labour (Rs. 545/acre) followed by seed (Rs. 339/acre), plant protection chemical (Rs. 48/acre), miscellaneous charges (Rs. 163/acre), NU/NCU (Rs. 27/acre), irrigation (Rs. 9/acre) and organic manures (Rs. 9/acre).

Table 6.4: Economic feasibility of NCU in Soybean, using partial budgeting Framework

(Rs./acre)

A			B		
S.No	Added cost due to NCU	Costs	S.No	Reduced cost due to NCU	Return
1	Seed cost/ purchase of seedlings	339	1	Seed cost/ purchase of seedlings	0
2	Organic/FYM	9	2	Organic/FYM	0
3	NU/NCU	27	3	NU/NCU	0
4	Chemical fertilizers (Other than NU/NCU)	0	4	Chemical fertilizers (Other than NU/NCU)	27
5	Plant protection chemicals	48	5	Plant protection chemicals	0
6	Irrigation charges	9	6	Irrigation charges	0
7	labour charges	545	7	Labour cost	0
8	Miscellaneous charges	163	8	Maintenance costs	0
Total Added Cost		1140	Total Reduced Cost		27
S. No.	Reduced Return due to NCU	Costs	S. No.	Added Return due to NCU	Return
1	Main product	0	1	Main product	2111
2	By-product yield	0	2	By-product yield	407
Total of reduced return		0	Total Added Returns		2518
Total "A" (Additional Cost)		1140	Total "B" (Additional Return)		2545
Additional Return from NCU (Total B-Total A)		1405			
Benefit Cost Ratio (Total B/Total A)		2.23			

Thus, the total cost under different sub-head due to application of NCU amounted to Rs. 1140/acre with added return of Rs. 2545/acre. Hence, net return and benefit cost ratio due to application of NCU in soybean were found to be Rs. 1405/acre and 2.23 respectively.

The impact and economic feasibility analysis clearly indicates that the application of NCU is more profitable as compared to NU in case of paddy and soybean in the area under study.

6.5 Impact of NCU on Soil Health Improvement

As for as impact of NCU on soil health viz. improvement in soil texture, soil moisture, water infiltration, soil softness and decrease in compaction etc. are concerned, the farmers were not comfortable to respond regarding the different indicators of soil heath as they have applied NCU in their fields for the first time.

CHAPTER-VII

SUMMARY, CONCLUSIONS AND POLICY SUGGESTIONS

This chapter deals with the background of the study, summary of findings, conclusions drawn from the finding and policy recommendations related to the use of NCU in Madhya Pradesh

7.1 Background

Neem acts as a nitrification inhibitor and its coating over normal urea (NU) minimizes losses due to leaching. Coating urea with neem prevents its misuse as well as puts the fertiliser in slow release mode thereby nourishing the saplings for a longer period. Thus avoids the repeated use of fertilizer and economize the quantity of urea required by crops by enhancing Nitrogen-Use Efficiency. Besides, coating of neem oil also reduces the leaching of nitrates into the groundwater aquifers and thus, help in reducing its pollution. With this background, Government of India included Neem Coated Urea (NCU), a slow release fertilizer, in the Fertilizer (Control) Order, 1985 and made it mandatory for all the indigenous producers of urea to produce 100% of their total production of subsidized urea as NCU from 2015. Further, it has taken various steps to promote NCU, with a view to improve soil health status and also realise higher yield per hectare. There is need for a study assessing the impact of NCU on the production and yield of major crops in India. Therefore, the present study is proposed to examine the coverage of NCU, its adoption behaviour and its impact on yield among major crops in Madhya Pradesh with following objectives

1. To analyze the trends in usage and prices of NU/NCU in Madhya Pradesh.
2. To analyze the adoption behaviour of NCU among selected farmers in irrigated and un-irrigated tracts.
3. To analyze the impact of adoption of NCU on cost and profitability of paddy and soybean.
4. To document the status and implementation of soil health card scheme.
5. To suggest suitable policy measures for adoption of NCU.

The study confined to two major kharif crops i.e. paddy and soybean of Madhya Pradesh. A multistage purposive sampling method was used to select the districts, blocks, villages and farm households. At the first stage two districts having highest area under and highest consumption of NU/NCU have been selected purposively for paddy and soybean. Therefore, Balaghat & Seoni (paddy) and Khargone and Dhar (soybean) districts have been selected in Madhya Pradesh. In second stage, two blocks from each selected districts were selected again on the basis of highest area in the paddy & soybean in these selected districts. Thus, Lalbarra & Kirnapur blocks in Balaghat district, and Kewalari & Barghat blocks in Seoni district have been selected for Paddy, whereas Maheshwar & Badwah blocks in Khargone, and Dhar & Badnawar blocks in Dhar district have been selected for Soybean. Two cluster of villages comprising 3-4 villages per cluster were selected

for collection of primary data from the selected blocks. A sample of 50 farmers from each block comprising 100 farmers in each district, totaling to 200 farmers to each crop have been selected for the study. Thus, study comprising of 400 respondents of two major kharif crops i.e. Paddy (200) and Soybean (200).

7.2 Summary of Findings

The summary of findings includes the results which are emerged through analysis of data related to trends of urea consumption in the state, socio -economic characteristics of the sample households, cost of cultivation and profitability of selected crops, status of awareness and application of NCU, awareness and adoption level of soil testing technology and impact of NCU application on crop production.

7.2.1 Trend in NU Consumption

The following findings are emerged from the secondary data

- In Madhya Pradesh total fertilizer consumption in different fertilizers was found to be 4451.8 thousand tons in cultivation of crops by the farmers during the year 2015-16. Amongst the different fertilizers the consumption of NU (50%) was found to be highest as compared to Single Super Phosphate (21%), Di-ammonium Phosphate (21%), Mixture 12:32:16 (4%), Murate of Potash (2%) and others (2%) Thus, Urea is the most important fertilizer used by the farmers in the State.
- The consumption of Urea was found to be increased from 427 to 2190 thousand tonns (2015-16) with exponential growth of 7.57 per cent per year during the period from 1990-91 to 2015-16 The trend of prices of urea are also showing increasing trend. The prices of Urea were found to be increased from Rs. 4600 (1999) to Rs. 5360 (2016) per ton with exponential growth 1.00 per cent during the period of 1999-2016. The Neem Coated Urea (NCU) introduced in Madhya Pradesh in the year 2011. The price of NCU (Rs.5628/tonn) was found to be 5 per cent (Rs.268/tonn) more than the NU (Rs.5360/tonn) in the year 2015-16.
- Amongst the different districts the consumption of NU/NCU was found to be maximum in Dhar (5.63%) followed by Hoshangabad (4.90%), Khargone (4.84%), Chhindawara (3.95%), Sehore (3.66%), Ujjain (3.53%), Indore (3.10%), Jabalpur (3.06%) and Dewas (3.05%). While, found minimum in Sidhi (0.29%), Singrauli (0.20%), Umaria (0.20%), Dindori (0.16%) and Anooppur (0.11%) districts in the year 2015-16. As for as total sale of NU/NCU is concerned through different agencies and different season in Madhya Pradesh.
- The institutions (MARKFED) followed by private dealers play an important role in sale of NU/NCU in Madhya Pradesh with the share of 56.38 and 33.62 per cent in total sale of NU/NCU in Madhya Pradesh.
- The maximum quantity of the NU/NCU was found to be used in rabi (56.88%) followed by kharif season (43.12%) by the farmers in M.P.

7.2.2 Socio-Economic Characteristics of Sample Respondents

The findings emerged through analysis of primary data related to socio economics

characteristics of sample households are as follows

- The average age of respondents was found to be 47 years having farming experience of 27 years with an average family size of 7 members, out of which 4 members were engaged fully in farming and out of total respondents 96 per cent were found to be male in gender.
- The majority of the respondents were found to be educated up to primary level (35.50%) followed by higher primary (28%), matriculation (11%) and pre-university & above (9%) and majority of them belongs to OBC (52.75%) followed by SC (20.75%), ST (16.50%) and General Categories (10%) at overall level.
- All the respondents were found to be engaged in agricultural and allied activities as a main occupation for their livelihood security.
- An average respondent was found to have 7.56 acres of owned land with 0.30 and 0.03 acres of leased in and leased out land respectively and 0.05 acres uncultivated/ fallow land constituting his net operated area (7.78 acres).
- The average operational holding in case of small, medium and large farmers was found to be 2.72, 6.54 and 14.08 acres respectively.
- The cropping pattern of paddy growers in irrigated and rain fed condition during kharif season across different size of holdings paddy was the only crop which is being grown in the study area indicating dominance of mono crop culture.
- In irrigated situation more than 70 per cent of area was found to be covered under soybean with 22.22 and 4.84 per cent of total operated area covered under cotton and maize respectively across various sizes of holdings.
- The farmers having medium and large size holdings devoted their 100 per cent area in cultivation of soybean, while 77.78 and 22.22 per cent of total operational holding of small farmers under rain-fed condition was found to be devoted to cultivation of soybean and cotton respectively.
- An average farmer used to purchase 175.11 kg/HH (NCU) and 154.1 kg/HH (NU) for cultivation of crops. The quantity of NCU and NU purchased by an average paddy grower was found to be more as compared to soybean grower. The remarkable difference was not found to be noticed in case of distance from farm and transportation cost of a fertilizer bag while, purchasing of NCU and NU.
- The total cost of 50kg bag of NCU and NU was found to be Rs. 317.44 & Rs. 309.15 and Rs. 314.35 & Rs. 308.77 in case of paddy and soybean growers respectively; while at overall level it was found to be Rs. 315.90 & 308.96 per bag. Thus an average farmer invested almost Rs. 7 more per bag in purchase of NCU as compared to NU.
- Almost 100 per cent of respondents related to paddy was found be purchased NCU and NU from cooperative society. The 76.85 and 23.15 of soybean growers were found to be purchase NCU and NU from cooperative societies and private fertilizer

dealers respectively.

7.2.3 Cost of Cultivation and Profitability of Selected Crops

The major finding emerged through analysis of primary data collected from various categories of farmers related to cost of cultivation and profitability of selected crop viz. paddy & soybean are as follows:

- The total cost in cultivation of paddy was found to be Rs. 10619 and Rs. 9494/acre on an average farm in the year 2015 and 2014, respectively. The per cent expenditure on NU/NCU to the total cost of cultivation of paddy was found to be more in the year 2015 (3.03%) as compared to in the year 2014 (2.83%). As the size of holding increases the total paid out cost per acre in cultivation of paddy have found to be decreased. The similar findings were found with minor variation in cultivation of paddy during the year 2014. An average paddy grower was found to be received more net return in the year 2015 (Rs. 11237/acre) as compared to 2014 (Rs. 8420/acre) in cultivation of paddy. He also received more return over the investment Re. 1.00 in 2015 (Rs.2.06) as compared to 2014 (Rs. 1.88). This might be due to the application of NCU instead of NU by the paddy grower in the area under study. As the size of farm increases the per acre gross as well as net and per rupee return was found to be decreased in cultivation of paddy in the area under study.
- An average soybean grower used to invest Rs 9776/acre and Rs 8660/acre in cultivation of soybean during the year 2015 and 2014 respectively in the area under study. The expenditure on urea/NCU in total cost of cultivation of soybean was found to be more in the year 2015 (Rs. 114/acre) as compared to 2014 (Rs. 87/acre). As the size of holding increases the total paid out cost per acre in cultivation of soybean was found to be increased. An average soybean grower received more net return in cultivation of soybean in the year 2015 (Rs.8012/acre) as compared to the year 2014 (Rs.6611/acre). He also received more return on investment of Re. 1.00 in cultivation of soybean in the year 2015 (Rs.1.83) as compared to the year 2014 (Rs. 1.77) in the area under study. As the size of farm increases the per acre gross as well as net and per rupee return was found to be increased in cultivation of soybean in the area under study.
- The total cost of cultivation of paddy (Rs. 10619/acre) was found to be more as compared to soybean (Rs. 9776/acre). The expenditure on ploughing & sowing- only machinery (13.08%), harvesting & threshing (18.36%), chemical fertilizers-other than NU/NCU (11.18%), imputed value of family labour (6.16%) and hired labour-including in ploughing charges till planting, cost of sowing / transplanting (14.8%) were found to be major component of cost of cultivation of paddy, while the expenditure on seed (22.49%), hired human labour- amount paid (20.41%), imputed value of human labour (13.65%), chemical fertilizer-other than NU/NCU (12.34%), harvesting & threshing (8.51%), plant protection chemicals (6.82%) and

ploughing & sowing-machinery (6.15%) were found to be major component of cost of cultivation of soybean during the year 2015 An average farmer also received more net return in cultivation of paddy (Rs. 11237/acre) as compared to soybean (Rs. 8012/acre). On investment of Re 1.00 he was also found to get more return in paddy (Rs 2.06) as compared to soybean (Rs. 1.83). Although, no remarkable difference were found to be observed in cost incurred and profit received by an average farmer in cultivation of paddy and soybean in the area under study.

- The quantity of NU applied in cultivation of paddy and soybean was found to be 41 and 18 kg/acre respectively in the year 2014, while it was decreased to 19 and 9 kg/acre in the year 2015. This may be due to increased use of NCU in the area under study. In the year 2015, 28 and 12 kg/acre NCU was found to be applied for cultivation of paddy and soybean respectively.
- The majority (80%) of respondents reported that the cost of NCU was found to be more as compared to NU. No change has been observed in cost incurred in control of pest and diseases, although there was found improvement in soil health. Out of total respondents 35.81 per cent of respondents also reported that the yield of paddy was found to be increased to 4.76 per cent after application of NCU in cultivation of paddy.
- In case of soybean no change has been reported by all the farmers as for as weed management, cost of other fertilizers, improvement in soil health, and quality and market acceptability of grain.
- Out of total respondents only 3.85 per cent reported that the cost incurred in pest and disease management was found to be increased, while majority (94.23%) of them were of the opinion that there is no change in the pest and disease infestation in cultivation of soybean after application of NCU. The majority of respondents (65%) also reported that cost of NCU was found to be increased as compared to the NU in cultivation of soybean. Only 35.94 per cent respondents reported that the yield of soybean was found to be increased by 3.82 per cent after application of NCU in cultivation of soybean.
- An average respondent was found to be availed more credit from institutional sources (91.41%) as compared to non-institutional sources (8.59%). As for as purpose of borrowing is concerned, 82.21 and 2.45 per cent paddy growers borrowed 75.0 and 8.03 per cent of total amount with Rs. 18685 and Rs. 2000/HH for cultivation of seasonal crops and purchase of livestock respectively. Amount borrowed per HH was found to be maximum in case of seasonal crop cultivation (Rs. 25571/HH), purchase of tractor (Rs. 5900/HH), purchase of livestock (Rs. 3125/HH), consumption expenditure (Rs. 700/HH) and Non-farm activity (Rs. 450/HH)

7.2.4 Status of Awareness & Adoption of NCU

The findings emerged through analysis of primary data regarding status of awareness & adoption of NCU by paddy and soybean growers at various size of farms of the study area are as

follows:

- The awareness amongst the respondents related to the two major crops of kharif season, more than 60 per cent of small (62.55%), medium (85.50%) and large (82.76%) farmers related to soybean and paddy were found to be aware to NCU in the area under study. The major source of awareness as reported by majority of small (42.70%), medium (51.20%) and large (51.16%) farmers was found to be agricultural officers. The farmers' facilitator, fellow farmers were also found to be the source of information which makes them aware about NCU.
- The more than 90 percent of small (94.86%), medium (93.81) and large (94.74%) farmers were noticed the difference in NCU to NU.
- The major feature of identification of NCU to NU was found to be leaf figure of Neem on the bag as reported by more than 48 per cent of small (48.75%), medium (60.19%) and large (66.84%) farmers, few of them also reported that they differentiating NCU to NU by colour difference and price variation. The majority of respondents related to paddy (74%) and soybean (54%) reported that they were applied NCU in crop husbandry after 2015-16.
- The majority of respondents related to the study reported that they used NCU and NU in spilt doses at the time of vegetative growth (40%) of the crop followed by after weeding (30%) and basal application (30%) at the time of sowing.
- The respondents related to paddy and soybean reported that they used to apply more than 40 percent NCU/NU at the time of vegetative growth and after weeding. In case of paddy NCU and NU was found to be applied by 14 and 5 percent respondents as basal dose. While, in case of soybean 66 per cent respondents used to apply NCU/NU as basal dose and only 33 per cent were found to apply at the time of vegetative growth.
- All the selected farmers of the study area were found to use NCU in cultivation of crops. None of them was found to other than crop husbandry viz. silages (feed preparation of animals), mixed with weedicides and fishery feed preparation.
- As for as quality of NCU is concerned the majority of farmers reported that the quality of NCU available in the market is of good quality (55.91%) while, 24.80 per cent of them reported that its quality was found to be very good. The 49.32 & 17.12 per cent of paddy and 64.81 & 35.19 per cent soybean growers considered NCU as good and very good, respectively
- The 96.30 per cent soybean and 63.01 per cent paddy growers reported that NCU is available in adequate quantity. At overall level most of the farmers reported that there is adequate (77.17%) and timely (84.38%) availability of NCU with almost same price of urea (68.90%) or not very high price (18.11%).
- The majority of the farmers reported that there is no change in benefit of NCU in terms of total fertilizer usage as reported by paddy (80.82%) and soybean growers (49.07%), while 34.26 and 12.33 per cent

soybean and paddy growers reported that it has capacity to increase benefits. The decrease in benefits of NCU in terms of total fertilizer usage was reported by 16.67 & 6.85 per cent soybean and paddy growers, respectively. At overall level it was found to be reported by farmers that it has been increased (21.65%), decreased (11.02%) and no change (67.32%).

- The majority of the respondents (79.30%) reported that there has been is no change in benefits of NCU in term of Urea usage at overall level and among the crops also. The majority of respondents also reported that there was no change in pest and disease infestation after use of NCU in cultivation of crops. The majority of farmers also reported that NCU is easily accessible in the market; its accessibility was found to be just similar to NU in the market
- All the farmers in the area under study reported that they did not have knowledge about usage of NCU for other than crop production purposes i.e. silage making, mixed with weedicide and fisheries feed preparation.
- The difficulty to calculate the recommended doses of nutrients from the different brands of fertilizers available in the market was reported by 74 per cent of respondents, lack of technical know how about usage of NCU in split doses and method of application (51%), conditional tagging of other inputs in buying of fertilizers from cooperatives (40%), lack of awareness (36%), inadequate supply (24%), high cost of fertilizer (19%), lack of capital (16%), not available on time (16%) and distant market (11%) were found to be constraints in adoption of NCU at overall level.

7.2.5 Status & Implementation of Soil Health Cards

The findings which are emerged regarding status and implementation of soil health cards through collection of secondary and primary data are as follows:

7.2.5.1 Secondary Data

- The Government of Madhya Pradesh executed soil health programmes under various programmes, which are implemented by the Government of India. Apart from the prestigious SOIL HEALTH CARD programme,. The Government of Madhya Pradesh provide assistances to farmers/institutions for improvement of soil health under the various national programmes viz. National Mission under Oilseeds and Oil Plam, National Horticulture Mission (NHM), National Food Security Mission (NFSM) and National Mission for Sustainable Agriculture (NMSA) in different districts of the state.
- Soil health card scheme is being implemented in all the districts of the State through 75 soil testing labs. The State Government reported to achieved 70.29 per cent target of collection soil samples (805000) from the farmers' fields till December 2014. The total soil samples received in soil testing lab were recorded to be 494938, out of which 78.94 have analyzed by soil testing labs in the State. As

for as, the progress of distribution of soil health cards is concerned 40.25 per cent (1207353) soil health cards of the target 3000000 have been found to be distributed among farmers.

7.2.5.2 Primary Data

- The primary data collected from sample respondents revealed that only 20 per cent paddy growers getting their soil tested from soil testing labs, out of which only 15.5 per cent were reported to receive soil testing report and only 13 per cent of them adopted the recommendation of soil testing report, while only 17 per cent of selected soybean growers getting their soil tested, out of which only 13.0 and 10.5 per cent receive soil testing report and adopted the recommendation of soil testing report respectively in the area under study.
- The more than 90 per cent of the respondents tested their soil from district laboratories of State Department of Agriculture.
- The Agricultural Department was found to be a major source of information as reported by more than 75 per cent of respondents related to cultivation of paddy (92.0%) and soybean (58.82%).The respondents also reported that they used to get information of soil testing from neighbours (10.3%), private companies (4.9%), Krishi Vignan Kendras (4.4%) and friends (1.5%).
- The majority of farmers were found to collect soil by self (50.15%) followed by with the help of officials of State Department of Agriculture (27.79 %) and farmer facilitator (22.06%) at over all level.
- Soil testing was found little bit popular amongst farmers in recent years than 3 years before and percentage of farmers getting their soil tested was found to be increased 2 to 20 and 3 to 17 in case of paddy and soybean growers respectively. The number of soil samples was also found to be increased from 1 to 2 in case of paddy and soybean growers. The cost per soil sample was found to be increased from Rs. 4.73 to 5.60 (paddy) and 3.78 to 4.71 (soybean) in recent years than 3 years before in the area under study.
- The most important reasons for soil testing were found to be recently aware about soil testing and its use, to understand fertilizer requirement for the crop and poor crop yield. The important reasons which were reported by the majority of the respondents are to understand fertilizer requirement for the crop (41.25%), poor crop yield (31.41%) and recently aware about soil testing (22.67%).
- The most important reasons for not getting the soil tested by the respondents were found to be soil testing report not available on time (61.92%), soil testing not required as crop Yield is good (54.30%) and do not know whom to contact for detail on testing (42.86%).
- The important reason for not getting soil tested by the respondents were found to be do not know how to take soil samples, soil testing laboratories are located far away, do not know whom to contact for details on testing as reported by the 49.39,34.60 and

32.74 per cent of respondents.

- The Department of Agriculture was found to be major source of explanation about the RDF for cultivation of crops to the farmers in the study area.
- In paddy an average farmer used to apply UN (49.46 Kg/ac), SSP (47.44 Kg/ac), DAP (36.04 Kg/ac), MOP (23.61 Kg/ac), FYM (8.06 Kg/ac) and $ZnSo_4$ (5.08 Kg/ac) in cultivation of paddy. The farmers were found to apply 19.4, 52.0, 32.0, 9.20, 68.4 and 49.2 per cent less doses of above mentioned fertilizers in cultivation of paddy as per soil test report, while an average soybean grower were found to apply maximum quantity of DAP (49.18 Kg/ac) followed by MOP (37.27 Kg/ac), SSP (33.75 kg/ac), NU (27.56 Kg/ac), $ZnSo_4$ (5.45 Kg/ac) and FYM (6 q/ac) , while as per the soil test report an average farmer used to apply 10 kg FYM, 10 Kg NU, 52 Kg DAP, 13 Kg MOP and 10 Kg $ZnSo_4$ per acre in cultivation of soybean.
- The major constraints in soil testing analysis as reported by majority of respondents were lack of knowledge about soil testing facility among cultivators (70%) followed by non availability of soil testing reports in time to cultivator (62%), less cooperation from Agriculture Officers/Staff of Agriculture Department (46%) & complicated method of taking soil sampling (30%).
- Ensured timely availability of soil testing report on mobile/Internet (85%), more training programme should be organised regarding procedure of collection of representative soil sample (83%), More awareness campaign should be organised regarding benefits of soil testing (62%), Ensure soil testing labs at least at block level to increase the access at farmer's door step and promotion of soil testing (58%), Report should be made available in local/regional language (52%) and RAEO's should visit the village at least twice in a week so that farmer will be able to get proper/ timely advice for his problems (32%) were the major suggestions given by the respondents for improving soil health card scheme in the area under study.

7.2.6 Impact of NCU Application on Crop Production

The impact of application of NCU over NU in terms of yield, cost of Urea/NCU, other fertilizers use, cost of pest & diseases control and weed management used was analyzed by using paired t-test and impact on cost of cultivation was analyzed by using partial budgeting technique:

- The impact of application of NCU over NU is reflected in terms of yield obtained by paddy and soybean growers, which was found to be increased by 16.58 and 37.82 per cent respectively. The yield of main and by product in case of paddy and soybean was found to be highly significant.
- The cost of NU/NCU fertilizers was found to be reduced by 10.25 per cent as compared to NU fertilizers, which was found significant in case of paddy.
- The impact of NCU over NU on cost of cultivation of paddy and soybean was

analyzed using partial budgeting technique which shows that the total cost of Rs. 1140/acre was added under different sub-head due to application of NCU in paddy and added return was found to be Rs.3959/acre. Hence, net return due to application of NCU in paddy was found to be Rs. 2819/acre with benefit cost ratio of 3.47.

- In case of soybean the total cost under different sub-head due to application of NCU amounted to Rs. 1140/acre with added return of Rs. 2545/acre. Hence, net return and BC ratio due to application of NCU in soybean were found to be Rs. 1405/acre and 2.23 respectively.
- The farmers were not comfortable to respond regarding the different indicators of soil heath as they have applied NCU in their fields for the first time

7.3 Conclusions

• The conclusions which were drawn from the above finding are as follows:

☑ Urea is the most important fertilizer used by the farmers in the state. Amongst the different fertilizers the consumption of Urea (50%) was found to be highest as compared to Single Super Phosphate (21%), Di-ammonium Phosphate (21%), Mixture 12:32:16 (4%), Murate of Potash (2%) and others (2%) fertilizers.

☑ The trend of consumption and price of urea/ NCU was found to be positive and increased with exponential growth of 7.57 per cent per year (1991-2016) and 1.00 per cent per year (1997-2016), respectively in Madhya Pradesh. Institutions i.e. MARKFED (56.38%) followed by private dealers (33.62%) play an important role in sale of Urea/NCU in Madhya Pradesh. The maximum quantity of the Urea/NCU was found to be used in rabi (56.88%) as compared to kharif (43.12%) season.

☑ Out of 51 districts in the state the consumption of NCU/NU was found to be maximum in Dhar (5.63%) followed by Hoshangabad (4.90%), Khargone (4.84%), Chhindawara (3.95%), Sehore (3.66%), Ujjain (3.53%), Indore (3.10%), Jabalpur (3.06%) and Dewas(3.05%), while found minimum found minimum in Sidhi (0.29%), Singrauli (0.20%), Umaria (0.20%), Dindori (0.16%) and Anooppur (0.11%).

☑ Almost 100 per cent respondents related to paddy used to purchase NCU and NU from cooperative society. The 76.85 and 23.15 per cent of soybean growers were found to be purchase NCU and NU from cooperative societies and private fertilizer dealers respectively.

☑ The total cost of cultivation of paddy (Rs 10619/acre) was found to be more as compared to soybean (Rs. 9776/acre). An average farmer also received more net return in cultivation of paddy (Rs. 11237/acre) as compared to soybean (Rs. 8012/acre). On in investment of Re 1.00 he was also found to obtain return in paddy (Rs 2.06) as compared to soybean (Rs. 1.83). Although, no remarkable difference

were found to be observed in cost incurred and profit received by an average farmer in cultivation of paddy and soybean in the area under study.

- ☑ An average paddy and soybean grower received more gross return, net return and return over investment of Rs. 1.00 in kharif 2015 as compared to kharif 2014. This might be due to the application of NCU instead of NU in the area under study, as the NCU introduced in farmers' fields in kharif 2015 in the state.
- ☑ As the size of holding increases the total paid out cost per acre in cultivation of paddy was found to be decreased, while it was found to be increased in soybean.
- ☑ As the size of farm increases the per acre gross as well as net and per rupee return was found to be decreased in cultivation of paddy while increased in cultivation of soybean in the area under study.
- ☑ The consumption of NCU over NU in cultivation of crops by the farmers was found to be increased in kharif 2015 as compared to kharif 2014 and majority of farmers reported that the cost of NCU was found to be Rs. 4-5/bag as compared to NU. The 35.18 and only 3.82 per cent of paddy and soybean growers respectively reported that the yield of crops was found to be increased after application of NCU.
- ☑ No change was observed by the respondents as for as cost incurred in pest and disease control, weed management, cost of other fertilizers, improvement in soil health, and quality and market acceptability of grains after application of NCU in cultivation of crops
- ☑ More than 60 per cent farmers were found to be aware to NCU and majority of them reported that the main source of awareness was officials of Department of Farmers' Welfare and Agriculture Development in Madhya Pradesh.
- ☑ As for as the difference between NCU/NU is concerned, the majority of farmers noticed that the leaf figure of Neem is pasted on NCU bag, difference in colour and variation in prices.
- ☑ The majority of respondents used NCU/NU in split doses at the time of the vegetative growth of the crops followed by after weeding and basal application at the time of sowing.
- ☑ None of the farmer found to use NCU for other then crop husbandry purpose i.e. silage making, mixed with weedicide and preparation of feed for fisheries.
- ☑ The majority of farmer reported that the quality of NCU available in the market is of good to very good. NCU was found to be available in adequate quantity and on time with almost same price of NU.
- ☑ Lack of knowledge about uses of NCU, difficulty in calculating the RDF from different brand of fertilizer available in the market, lake of knowledge about method of application of fertilizer, and lack of awareness about fertilizer use in crop husbandry are the major constraints reported by majority in the area under study.

- ☑ The performance of soil testing was found far different in farmers' field and as reported by the Department of Farmers' Welfare and Agriculture Development in Madhya Pradesh. The distribution of Soil Health Card reported by the Department of Agriculture 40.25 per cent while, at farmers' field it was found only 14.20 percent.
- ☑ The majority of farmers reported that the Department of Agriculture was one of the major sources of information of soil testing and elucidation about the RDF for cultivation of crop.
- ☑ The soil testing was found popular among the farmers in recent years and most important reason for soil testing was found to be recently aware about soil testing and its uses followed by understanding fertilizer requirement for the crop and poor crop yield.
- ☑ Farmers were not found to use balanced doses of fertilizer in cultivation of crops even after getting soil testing report well in time.
- ☑ The timely availability of soil testing report on Mobil/Internet, creating awareness through training programme, wall painting etc., availability/access to soil testing labs within reach of the farmers, availability of soil testing report in local language and regular visit of Rural Agriculture Extension Officer were found to be major suggestion for improving Soil Health Card scheme as reported by the majority of the farmers.
- ☑ The impact and economic feasibility analysis clearly indicates that the application of NCU is more profitable as compared to NU in case of paddy and soybean in the area under study.

7.4 Policy Recommendation

The following suggestions/policy recommen-dation are made to popularized NCU in the cultivation of crops

- ☞ More and more field demonstrations are required to be conducted regarding uses of NCU in cultivation of crops and other than crop production purposes i.e. silage making, mixed with weedicide and fisheries feed preparation. Creation of awareness is also required amongst farmers regarding integrated nutrients management with NCU.
- ☞ Packaging/minikit of fertilizer for an acre should be done in such a way so that one bag of fertilizer will serve the purpose of applying recommended doses of fertilizers for different crops as per Agro-Climatic Zones of the State because farmers are not able to calculate desired nutrients to be applied from the various brands of fertilizers available in the market having different proportion of nutrients. In this way farmer will automatically apply RDF that too in balanced quantity as per requirement of crops. This will not only increase the consumption and use of fertilizers in the cultivation of crops but at the same time he will be able to save the precious capital invested on fertilizer by using all the nutrients, realization of better

production from the less investment, save the land & soil degradation.

- Creation of at least one Producer Company at village level for timely supply of input in adequate quantity and at reasonable rate to ensure timely availability, adequate quantity and assured quality.
- Introduction of National Gateway with respect to e-Marketing of Inputs viz; seed, fertilizer and other inputs at the door step of the farmer. This will facilitate them in order to assured quality at reasonable price and timely delivery at desired place.

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ANNEXURE - I

REVIEWER COMMENTS AND ACTION TAKEN REPORT

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

   Impact of Neem Coated Urea on Production, Productivity and Soil Health in Madhya Pradesh

2. **Date of receipt of the Draft report:** November , 2016.

3. **Date of dispatch of the comments:** December 9, 2016.

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 but methodology should come in chapter-I. Chapter-II should be on Trend analysis.

   Action: Done as per comment.

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

   (i) Trend Estimation was wrongly used . Use exponential trend equation to estimate trend values and growth rates of Urea Consumption. Tables and figures in the chapter should be accordingly.

   Action: Done as per comment.

   (ii) In Chapter III, verified the data related to yield, cost of cultivation of different categories of farmers (particularly in soybean).

   Action: Done as per comment.

   (iii) In Chapter IV, All the table should be calculated on weighted average basis instead of simple averages. Units in table 4.4 is missing and table 4 & 5 values were not matching, although both are related.

   Action: Done as per comment.

   (iv) In Chapter VI, mention different 'stars' (*) based on level of significant , no need of mentioning t & p- values revised the table accordingly.

   Action: Done as per comment.

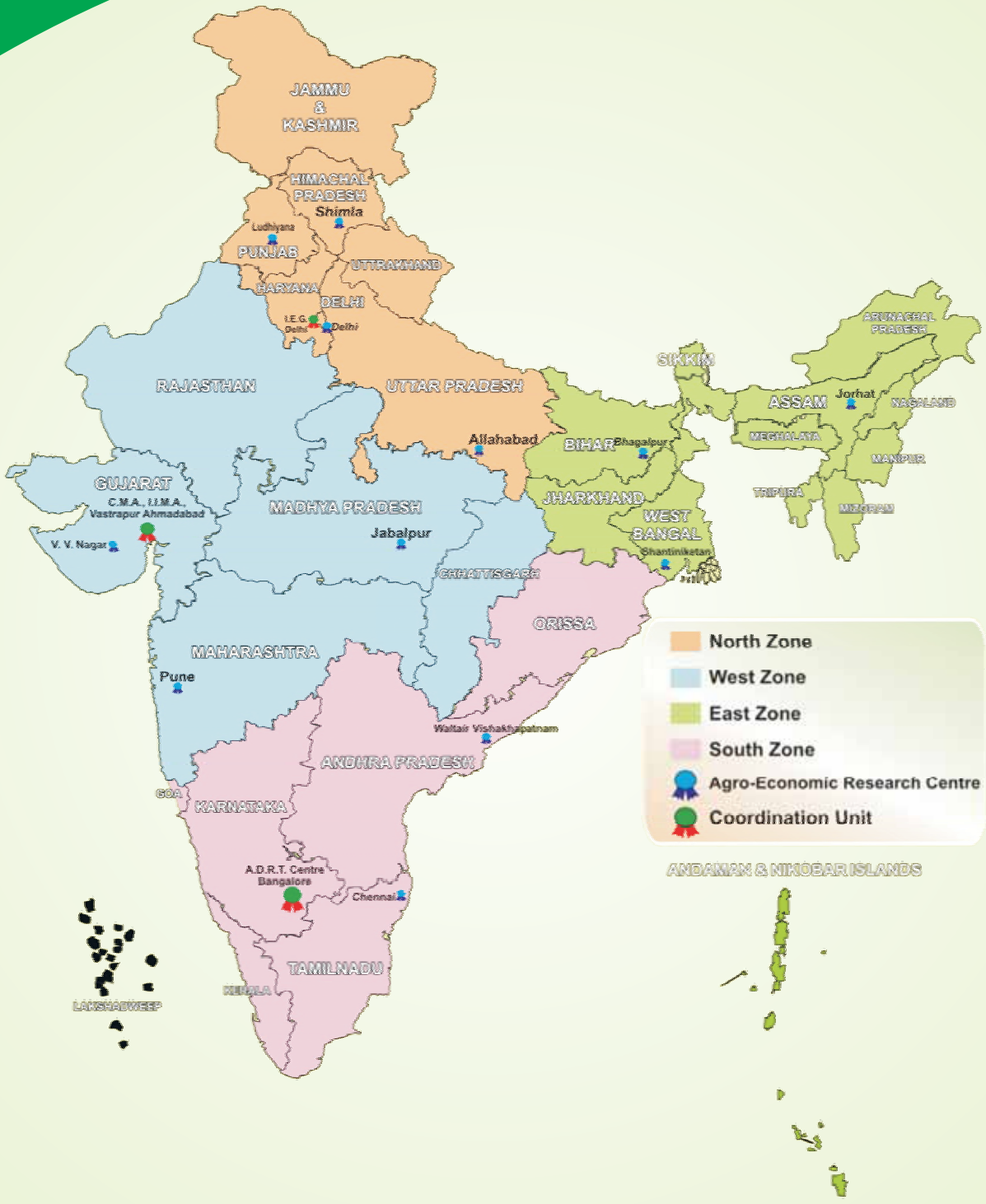
   (v) Tables related to impact of NCU, input cost of different cost have not taken into consideration, while estimating the partial budgeting techniques. Follow, each indicators while estimating parameters using partial budgeting (added cost due to NCU in different indicators such as cost on pest & diseases, labour, fertilizer etc.). table 6.4 added cost and added return are not matching. BC Ratio seems to be wrong and total cost 'A' is missing similarly in table 6.5, mention the different components (yield and by-product yield values, which enhanced added returns.

   Action: Done as per comment.

7. **Overall view on acceptability of report.**

   Authors are requested to incorporate all the comments and submit the final report for consolidation.

   Action: Done as per comment.



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