

Study No. 146

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

**Dr. Jotin Bordoloi
Dr. Anup Kumar Das**

**Study sponsored by the Ministry of Agriculture and Farmers' Welfare
Government of India, New Delhi**

**Agro-Economic Research Centre for North East India
Assam Agricultural University
Jorhat- 13, Assam
2017**

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**Ministry of Agriculture and Farmers' Welfare,
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Coordinator

**Agricultural Development and Rural Transformation Centre (ADRTC)
Institute for Social and Economic Change (ISEC), Bengaluru**

Agro-Economic Research Centre for North-East India

Assam Agricultural University

Jorhat - 785 013, Assam

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Study Team

Project in-charge & Report writing

Dr. Jotin Bordoloi

Dr. A.K. Das

Field Investigation & Data Collection

Dr. Jotin Bordoloi

Dr. Ranjit Borah

Sri Debajit Borah

Sri Madhurjya Borah

Tabulation

Dr. Jotin Bordoloi

Dr. Ranjit Borah

Sri Debajit Borah

Sri Madhurjya Borah

PREFACE

Urea is the most common nitrogenous fertilizer used extensively across the globe because of its agronomic acceptability and relatively lower cost. Scientific studies have established that despite being a rich source of nitrogen as high as 46 per cent, with associated advantages, Urea has the inherent limitations of heavy water solubility and adverse environmental impact. Also, malpractices of diverting the heavily subsidized Urea for other uses in chemical industry and milk adulteration process at times become issues of major concern. As such, efforts are on to improve its nitrogen use efficiency which have finally resulted in evolution of slow release neem coated urea (NCU) standardized by the National Fertilizer Limited. The Government has therefore, made it mandatory for Urea manufacturers to produce NCU up to a minimum of 75 per cent of their total production of subsidized Urea. The cap is then raised to 100 per cent from May, 2015 onwards, so that the farmers can harness the benefits of NCU in one hand, and diversion of plain Urea for other industrial use can be stopped altogether, on the other.

Under the circumstances, the present study entitled, “Impact of Neem Coated Urea on Production, Productivity and Soil Health in Assam” was undertaken at the instance of the Ministry of Agriculture and Farmers’ Welfare, Government of India. The comments on the draft report was obtained from the Co-ordinating Centre, *i.e.* ADRTC, ISEC, Bengaluru and incorporated in the final report.

The study was based on both primary and secondary level data. The reference period of the study was related to Kharif 2015, covering two (2) crops, *viz.*, paddy (irrigated) and jute (un-irrigated). The primary data were collected from two districts (Kamrup and Nagaon). Altogether, the study covered 400 sample farmers comprising 200 samples for each crop.

The results of the study clearly indicated that there was an increase in yield to the tune of 5.34 per cent for paddy and 3.02 per cent for jute following the usage of Neem Coated Urea in the farmers’ field.

The present study is a joint output of the AER Centre, Jorhat. Special mention may be made of Dr. Jotin Bordoloi who endeavored his best in bringing out this report and he really deserves appreciation. The names of other research staff associated with this study have been mentioned elsewhere in the report.

The findings of the study, I believe, will be useful to the students, researchers and to those who are involved in planning and policy-formulation.

(Anup Kr. Das)
Director i/c
AERC, Jorhat

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CHAPTER I : INTRODUCTION

1.1 Background of the study

At least 16 plant food nutrients are essential for proper crop development. These include Carbon (C), Hydrogen(H), Oxygen(O), Nitrogen(N), Phosphorous (P), Sulphur (S), Potassium(K), Calcium(Ca), Magnesium(Mg), Iron(Fe), Manganese(Mn), Zinc(Zn), Copper(Cu), Molybdenum(Mb), Boron and Chlorine(Cl). Green plants obtain carbon from carbon dioxide in air, oxygen and hydrogen from the water, whereas remaining elements are taken from the soil. Among all the elements, nitrogen is required by the plant in large quantities.

The most common nitrogenous fertilizer, Urea, with the highest nitrogen content (46 per cent), is used widely across the countries of the world as the main source of critical nutrient for crop growth. As per research findings, nitrogen from urea is released in the soil and water and is leached by the activity of nitrifying bacteria, Nitrobacteria and Nitrosomonas. These bacteria turn nitrogen into nitrite and then to nitrate which are highly mobile in nature when present in soil. In the processes, approximately 50 per cent of the applied nitrogen in urea is lost through leaching into the soil, causing extensive ground water contamination. Neem coated urea (NCU) is a solution to the problem, preventing the bacterial activity of nitrification. Neem is considered to be the best nitrification inhibiting agent till date, even better than sulphur. Recent research indicates that 'sustained release' nature of neem coated Urea has resulted in reasonable increase in rice yield by 9.6 per cent and wheat yield by 6.9 per cent. The neem coating also discourages an age-old mal-practice of this cheap fertilizer being diverted for use in the chemical industries.

As the Neem Coated Urea (NCU) releases nitrogen in a slow process, plants can absorb it fully without any loss and thereby, check the use of higher doses of fertilizer in crop fields, leading to saving of hard-earned money of the poor farmers. As a matter of fact, the farmers do not know that a large amount of urea is lost through leaching, and when they observe drop in the desired productivity of crops, often they go for application of higher doses of urea, draining hard-earned money of the poor farmers. The NCU being a slow release fertilizer, the plant can absorb the nutrient and can prevent the farmers from using over doses of fertilizer and in the long run, will protect the natural soil

structure of the crop field. Therefore, NCU increases nitrogen use efficiency. Research findings also indicate three benefits of using NCU *viz.*, (1) it slows down the process of nitrification of urea (2) enhance the yield and (3) decrease urea requirement, hence save money

The Government of India decided in January, 2015 to make it mandatory for the indigenous Urea producers to produce a minimum of 75 per cent neem coated Urea, out of the total domestic production. This cap was then raised to 100 per cent from May, 2015 onwards, so that the farmers are benefitted and diversion of urea for other industrial use can be stopped altogether.

Now in the country, as many as twenty six plants under the Ministry of Chemicals and Fertilizer are producing NCU. The Brahmaputra Valley Fertilizers Corporation Limited-Namrup-III is one of such plants in the state of Assam.

According to the State Agricultural Department, consumption of fertilizer in the state was 65.40 kg per hectare during 2013-14 which is much lower than the national average 118.55 kg per hectare. The consumption is low because the farmers usually are not willing to spend more on fertilizer due to heavy rainfall and floods during *Kharif* season for fear of loss. In *Kharif* season (April to September), the consumption of fertilizers in terms of materials were 1.36 lakh MT of Urea, 0.74 lakh MT of SSP, 0.55 lakh MT of MOP and 0.15 lakh MT of DAP during 2014 while in *Rabi* season (October to March), it was 1.59 lakh MT Urea, 0.74 lakh MT SSP, 0.55 lakh MT MOP and 0.18 lakh MT of DAP during 2014-15 in the State.

The estimated consumption of fertilizers in *Kharif* for 2015-16 stood at 1.59 lakh MT of Urea, 0.77 lakh MT of SSP, 0.58 lakh MT of MOP and 0.23 lakh MT of DAP, while in *Rabi* season (October to March), it was 1.70 lakh MT Urea, 0.90 lakh MT SSP, 0.65 lakh MT MOP and 0.25 lakh MT of DAP.

Soil is the gift of nature for sustaining life. Improper handling of soil for short term benefit can deteriorate the natural soli structure, and has now become a burning issue throughout the globe. Judicious use of chemical fertilizers particularly in the soil for agricultural purpose needs sharp attention. Most of the farmers in India are not fully aware of the level of natural soil nutrient content in their crop fields. They normally use chemical fertilizers as well as micro-nutrients based on their visual diagnosis and previous experiences. As a result, farmers often encountered with two sets of problems,

i.e., the problem of over doses and the problem of under doses of fertilizer. Therefore, a proper diagnostic analysis is a must to know the status of soils in the crop fields, before taking up application of chemical fertilizer. Keeping this in view, the Government of India launched a new programme for issuance of Soil Health Card (SHC) to the farmers in February, 2015 last. Under this scheme, all the farmers of the country will receive Soil Health Card, indicating the status of soil condition and the recommended doses of fertilizers and micronutrients for a good harvest of the crops. The main objective of the programme is to issue the soil health cards to about 14 crores of farmers across India. As per guidelines, a new or a modified card will be given to the farmers once in 3 years, considering the fact that the levels of soil nutrient may undergo change over time. There was a target for issuing 84 lakh cards in 2015, but the achievement was 34 lakh cards up to July 2015. In Assam, as per report of the State Directorate of Agriculture, Government of Assam has already distributed 64,168 Soil Health Cards under this new programme as on August, 2016. As per the information available, Department of Soil Science, Assam Agricultural University (AAU) on its own started the job of issuing SHC in February, 2013 under the RKVY Programme. As reported by AAU, 8,136 soil samples were analyzed for 9 parameters *viz.*, N, P, K, S, Zn, B, Organic Carbon (OC), pH and Lime Requirement(LR) and of the total soil samples, 5,825 SHCs were prepared and 2,110 SHCs have been distributed among the farmers of 4 districts of Assam *viz.*, Jorhat, Golaghat, Dibrugarh and Sonitpur.

1.2 Review of Literature

Soil fertility is mainly determined by three major elements namely, Nitrogen, Phosphorus & Potassium (N, P, K) of which nitrogen plays a very important role. Urea is the major supplier of nitrogen, which is necessary for the growth of plants (**Prem Baboo, 2015**). For this reason, Urea (containing 46% of N) consumption is very high all over the world. Unfortunately, more than half (up to 60%) of the nitrogen leaches out or vaporizes in the form of nitrogen gas, ammonia & nitrous oxide due to the presence of denitrifying bacteria in the soil. "But only 30-40 per cent of nitrogen present in the Urea is utilized by crops. The rest gets degraded," explains Rajendra Prasad, a scientist at the Delhi-based Indian Agricultural Research Institute (IARI) (**Down To Earth, 2003**). On the other hand, usage of Urea in high doses reduces the fertility of the land. In initial years, it may higher the production of crops but simultaneously affects the production capacity of the

land and after successive years, farmers get low production, as stated by the Joint Secretary (Fertilizer), Sham Lal Goyal, (**Krishi Jagaran**). In the last 40 years, the amount of synthetic nitrogen (N) applied to the crops has risen drastically, resulting in significant increase in yield but with considerable impact on the environment. A reduced level of nitrogenous fertilizer was on the agenda for a 'Second Green Revolution' and continued research efforts on nitrogen use efficiency (NUE) has resulted in development of an eco-friendly N fertilizer, *i.e.*, Neem Coated Urea.

Considering the importance of neem coated urea (NCU), the Government of India has decided to promote production of NCU to the extent of 100 per cent through all the Indian Government accredited fertilizer companies, to facilitate crop productivity. It aims at checking the excessive use of urea which caused deterioration in the soil health and adversely impacting the overall crop yield.

Although, the literature on NCU is very scanty, it has been tried to incorporate a brief review of available literature on Urea coated with Neem.

The nitrogen use efficiency (NUE) of fertilizer in lowland rice is quite low (20–50%) in India. Coating of nitrification inhibitors, such as neem cake or neem oil, onto prilled urea may improve NUE. Hence, a field experiment was conducted at the Indian Agricultural Research Institute, New Delhi, during the wet seasons of 2005 and 2006 to study the effect of prilled urea coated with varying doses of major neem oil components on grain yield and NUE of scented rice. Sixteen treatments comprised of combinations of five major neem oil components (free fatty acid, pure oil, meliacins, saturated and unsaturated fractions)-coated prilled urea with three doses (500, 1000 and 5000 mg kg⁻¹). An additional treatment of prilled urea alone (untreated urea) was also taken. The experiment was laid out in a randomized block design with three replications. After analysis the coating of prilled urea with meliacins proved the most effective in enhancing yield and NUE of rice as compared to uncoated prilled urea or coated with other neem oil components. Across all the neem oil components, a coating thickness of 500 mg kg⁻¹ on to prilled urea was sufficient to realize the higher yield and NUE of lowland irrigated rice. (**D. Kumar et al., 2009**).

The National Fertilizer Ltd adopted the technology for coating of Urea with neem oil from Indian Agricultural Research Institute and produced NCU and evaluated the product for rice during 2002 at farmers' fields under northwestern India. From the

field trial it was seen that after applying the NCU at recommended rate of nitrogen, it produced 1.3–11.1% higher grain yield of rice than ordinary Urea in different districts of northwestern India (**Singh, K.K, 2004**)

Neem coated urea (NCU) applied to rice can result in high Nitrogen use efficiency as it contains nitrification inhibition properties. Field experiments were conducted for three years (2005–2007) at Ludhiana (sandy loam soil) and Gurdaspur (clay loam soil) for evaluating the relative performance of NCU vis-à-vis ordinary urea as a source of Nitrogen for transplanted wetland rice. The application of NCU using leaf colour chart (LCC) produced significantly higher (8.6%) rice grain yield than ordinary urea at Ludhiana but increase was not significant at Gurdaspur. The superiority of NCU over ordinary urea at Ludhiana was accompanied by spectacular increase in N uptake and nitrogen use efficiencies when applied on soil test basis or using of LCC. (**H. S. Thind, et. al., 2009**)

When farmers use normal urea, about half the applied nitrogen are not assimilated by the plant and leaches into the soil, causing extensive groundwater contamination. Spraying urea with [neem oil](#) slows the release of nitrogen, by about 10 to 15 per cent, concomitantly reducing consumption of the fertiliser. According to recent research, the "sustained release" nature of neem-coated urea has seen rice yields jump by 9.6 per cent and wheat by 6.9 per cent. (**K. Datta, 2016**)

"On an average, 20 per cent less neem-coated urea is required as compared to ordinary urea. It is also helpful in preventing insect attacks," claimed by I K Suri, former General Manager (Technical) of NFL (**Down To Earth, 2003**).

The research institutes like ICAR found that neem-coated urea ([NCU](#)) may acts as organic pesticide and with slow release of nitrogen there would be 10 per cent less requirement of the fertiliser while the yield could go up by 10 per cent, as stated by Fertilizer Minister, Anant Kumar (**PTI, 2015**)

The Union [Agriculture Minister, Radha Mohan Singh](#) once, asked the farmers to use NCU as it helps in increasing the yield with its minimum use. "Plants cannot absorb nitrogen found in urea to its maximum extent; a large amount of it goes waste. By increasing the utility factor of nitrogen through neem-coated urea, the consumption of urea can be reduced," Singh said. He also pointed out that neem-coated urea is helpful in reducing the pollution of water, soil and air. And by balanced use of fertilisers, the health

of soil can be sustained over a long period, he added. **(PTI, The Economic Times, 9 January, 2015).**

The neem coated urea also acts as an insecticide and the farmers require less quantity of urea. It costs 5 per cent more than the normal urea. In a bid to check excessive use and diversion of urea for other purposes, the Government last year allowed fertilizer firms to produce 100 per cent neem-coated urea. The demand for normal urea has declined after the Government made it mandatory to neem coat the entire urea produced and imported in the country. The Parliament (Rajya Sabha) was informed by the Minister of State for Chemicals and Fertilisers, Hansraj Gangaram Ahir as, "...the urea demand from states has fallen by 7 lakh tonnes after the neem coating of urea was started." **(PTI, The Economic Times, 11 March, 2016).**

"Neem coated urea is unfit for industrial use while this is good for the soil, crop and beneficial to farmers. The wastage is less and it works as a bio-pesticide. Even the extent of ground water pollution is less. We are also launching a campaign to make farmers aware that they will face action if they are caught selling subsidized urea to industrial units," said the Joint Secretary (Fertilizer), Sham Lal Goyal. **(PTI, 2015)**

1.3 Need for the study

The application of Neem Coated Urea in crops is a part of New Urea Policy-2015 initiated by the Government of India. Issuance of Soil Health Cards to the farmers is yet another scheme launched by the Government of India in February, 2015 last. Both the policies complement each other. Obviously, there is a need for a study to assess the efficiency of both the schemes at the farmers' level to see how it helps the farmers in terms of economic benefits and soil health.

1.4 Objectives of the Study

The objectives of the study are as follows:

1. to analyze the trends in usage and prices of Urea versus NCU in selected states.
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 and implementation of SHCs scheme

1.5 Limitation of the study

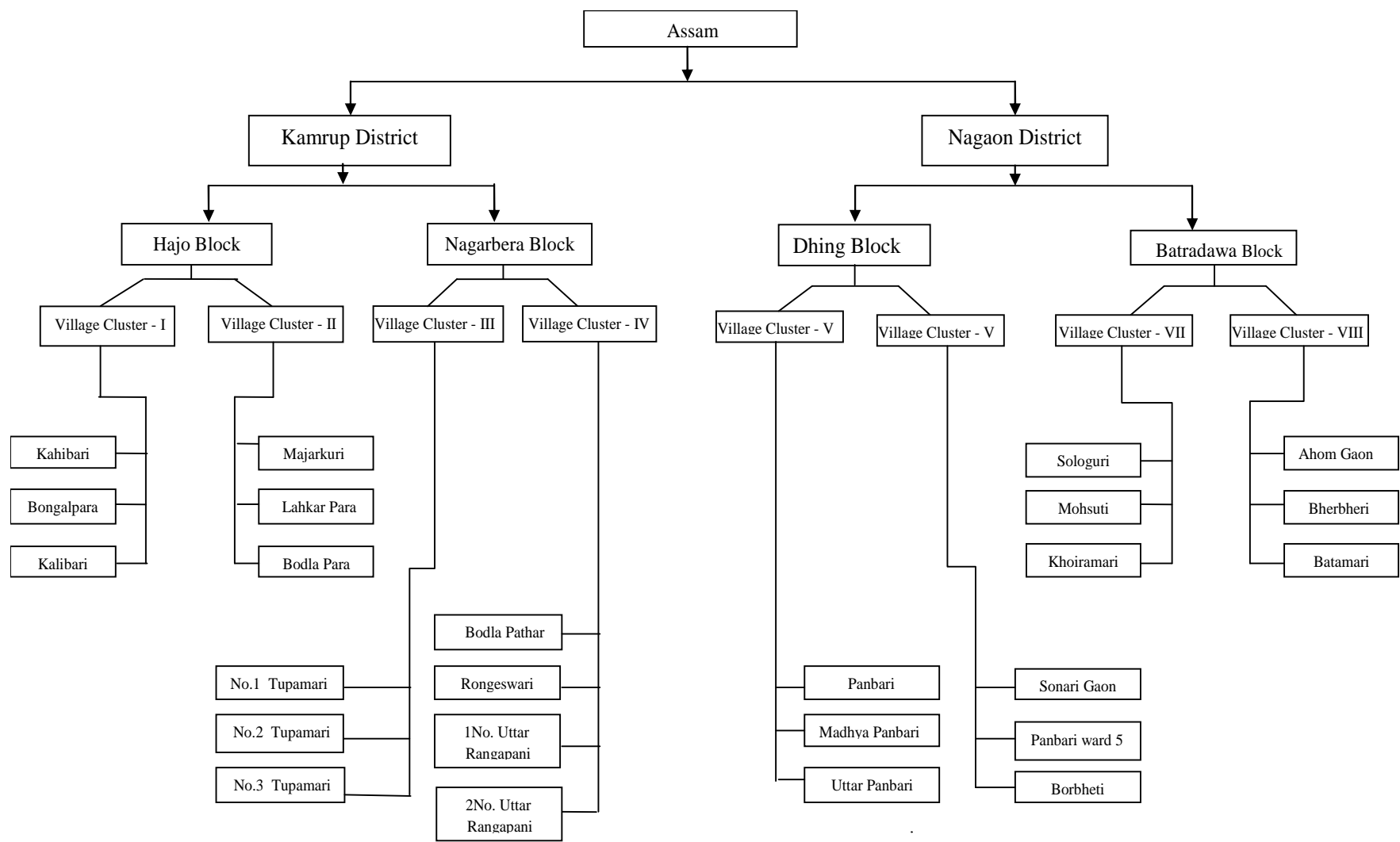
Lack of awareness about the usage of NCU is a major limitation in this study. It was observed from the investigation that majority of the farmers in the sample areas were not aware of the use of the NCU and so was the case of the Soil Health Card. This scheme covered only a limited number of farmers in the sample areas. Besides, the study has got its own limitation in the sense that the primary level information was collected through interactions with the sample farmers. The farmers do not have the habit of record keeping in black and white and as such, most of their information was memory based.

1.6. Data and Methodology

The present study was based on both primary and secondary level data. The reference period for the study was related to *Kharif* 2015 covering 2 crops *viz.*, paddy (irrigated) and Jute (un-irrigated). The primary level data were collected from 2 district (*viz.*, Kamrup & Nagaon) of Assam having highest urea usage. From each district 2 blocks were selected. From each block 2 clusters having 3 to 4 villages per cluster were selected. A sample of 50 farmers was selected for each crop from each of the village clusters. In doing so, the sum total of sample farmers in each block came to 100 comprising both the crops. In aggregate, 200 sample farmers were selected from each district. Altogether, the study covered 400 sample farmers in 2 districts comprising 200 for each crop.

Further, adequate care was taken to ensure that the selected crops are grown under chosen irrigated/un-irrigated condition in the state. The primary data were collected personally from the farmers using NCU and Non- NCU (normal urea) for each crop with the help of a specially designed schedule. Adequate attention was also paid to select and include the farmers of different farm size groups based on operational land holdings. The detailed flow chart of the sampling design has been presented in Fig-1

Flow Chart of Sampling Method



1.7 Organisation of the Report

This study was carried out in Karnataka, Maharashtra, Madhya Pradesh, Bihar, Punjab and Assam at the instance of the PMO, Government of India. The study was coordinated by the ADRTC, ISEC Bengaluru and was organised as per the guidelines developed by the coordinating centre. In consideration of the stated objectives, the study was divided into 7 Major chapters. Each chapter is further divided into some sub sections. As a whole, the organisation of the study is framed as follows:

Chapter I: INTRODUCTION

- 1.1 Background of the study
- 1.2 Review of Literature
- 1.3 Need for the Study
- 1.4 Objectives of the Study
- 1.5 Limitation of the study
- 1.6 Data and Methodology
- 1.7 Organization of the Report

Chapter II Trends in Urea Consumption in the State

- 2.1 Trends in Urea consumption and Price Variation
- 2.2 Trends in distribution of NCU since May 2015 (district-wise analysis)

Chapter III Socio-economic Characteristics of Sample Households

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- 3.2 Details of Operational Land Holdings
- 3.3 Cropping Pattern and Sources of Irrigation
- 3.4 Purchasing pattern and Sources of Purchasing
- 3.5 Usage of inputs and Profitability of reference crops
- 3.6 Details of Agriculture Credit Availed
- 3.7 Training Programmes Attended on Fertilizers Application

Chapter IV Status of Awareness and Application of Neem Coated Urea

- 4.1 Awareness & Sources of Information on NCU
- 4.2 Status of Application of Urea versus NCU
- 4.3 Perception of Farmers about NCU and its Benefits compared to Urea
- 4.4 Diversions of Urea & NCU Other than Crop Purposes

4.5 Constraints and Suggestions about NCU and its Adoption

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5.2 Awareness on Soil Testing

5.3 Details of Soil Testing

5.4 Reasons for Soil Testing or Not Testing

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

Chapter VI Impact of NCU Application on Crop Production and Soil Health

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6.2 Impact on Yield of Reference Crops among the Sample Households

6.3 Impact on the total input Cost of Reference Crops

6.4 Economic Feasibility of NCU

6.5 Impact on Soil Health and Crop growth

Chapter VII Summary, Conclusions and Policy Suggestions

7.1 Background

7.2 Summary of Findings

7.3 Conclusions

7.4 Policy Recommendations

Chapter VIII Executive Summary

Reference Year: 2015-16

Chapter-II

TRENDS IN UREA CONSUMPTION IN ASSAM

2.1 Trends in Urea Consumption and Price Variation

The crop season of the State is basically divided into two main seasons-*Kharif* from April to September and *Rabi* from October to March. The trend of consumption of fertilizer is always in higher side during *Rabi* season than that of the *Kharif* season. During *Kharif* season with heavy rainfall, link roads of the villages are not in smooth condition for supplying of fertilizers in the remote places and fear of wastage of fertilizer is quite rampant.

According to the State Agriculture Department, consumption of fertilizer in the State was 52.30 kg per hectare (in terms of NPK) in 2006-07 which was increased to 65.40 kg during 2013-14. Per hectare consumption of fertilizer in the State is still much lower than the all India average (128.08 kg/ha in 2014-15).

The trend of urea consumption and price variation during 2006-07 to 2015-16 in the State is presented in Table-2.1.1. It has been observed that urea consumption is showing an increasing trend from 194.10 thousand tonnes in 2006-07 to 392.39 thousand tonnes in 2015-16 with an Annual Compound Growth Rate (ACGR) of 3.38 per cent per annum during the period while price per Metric Tonne (MT) (Rs.5470.00) of urea remained same till 2014-15, and was found to increase to Rs.5750.00 per MT from some point of the year 2014-15 to 2015-16. Fig -2.1 & 2.2 showed an increasing trend of sales/consumption of Urea and its price in Assam during the reference period.

The per hectare consumption of urea was also found to increase from 51.58 kg in 2006-07 to 89.44 kg per hectare in 2015-16. During this period, the ACGR of the per hectare consumption of urea in the State grew at 2.56 per cent per annum. This increase in urea use in Assam cannot simply be interpreted as increased use of urea in field crops only as large section of the farmers in Assam have small tea gardens in which they use urea extensively.

Table-2.1.1
Trend of Urea Consumption & Price Variation in Assam during 2006-07 to 2015-16

Year	Sales/Consumption of Urea (in 000' tonnes)	Price per MT (In Rs.)	Gross cropped Area (in 000' ha)	Consumption of Urea per hectare (Kg/ ha)
2006-07	194.10	5470.00	37.63	51.58
2007-08	195.41	5470.00	38.39	50.90
2008-09	223.48	5470.00	39.99	55.88
2009-10	251.31	5470.00	40.99	61.31
2010-11	256.61	5470.00	41.60	61.69
2011-12	304.61	5470.00	41.74	72.98
2012-13	278.93	5470.00	41.97	66.46
2013-14	281.51	5470.00	*42.78	65.80
2014-15	299.53	5470.00/5750.00	*43.16	69.40
2015-16	392.39	5750.00	*43.87	89.44
ACGR	3.38	-	0.79	2.56

*indicates estimated gross cropped area

Source: Directorate of Agriculture, Govt of Assam

Note: For estimated data the exponential regression model was used as secondary level data were not available in the concerned department

Figure:2.1

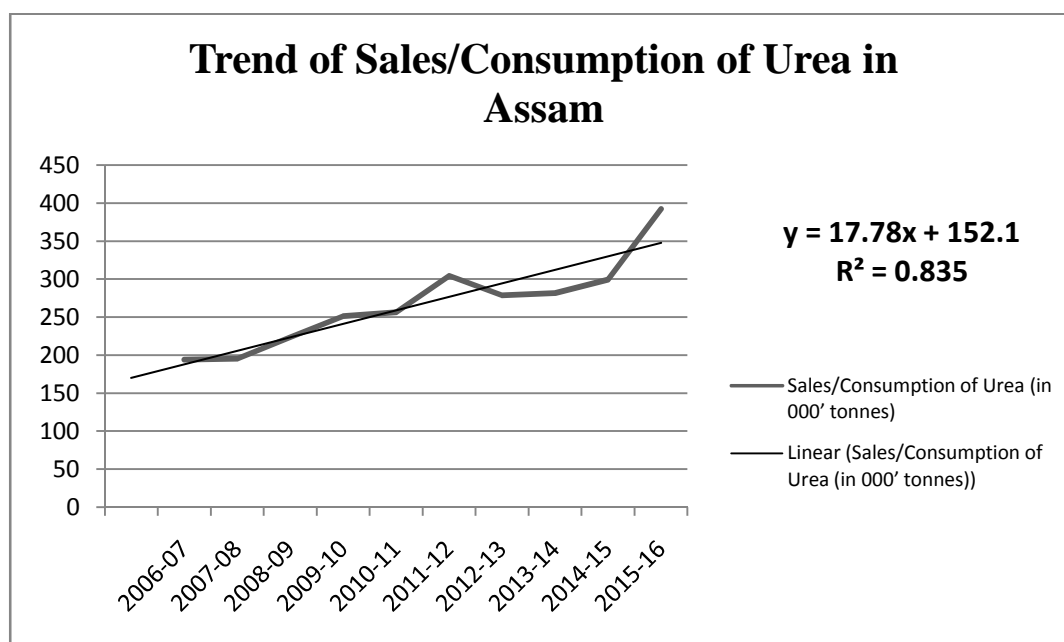


Figure:2.2

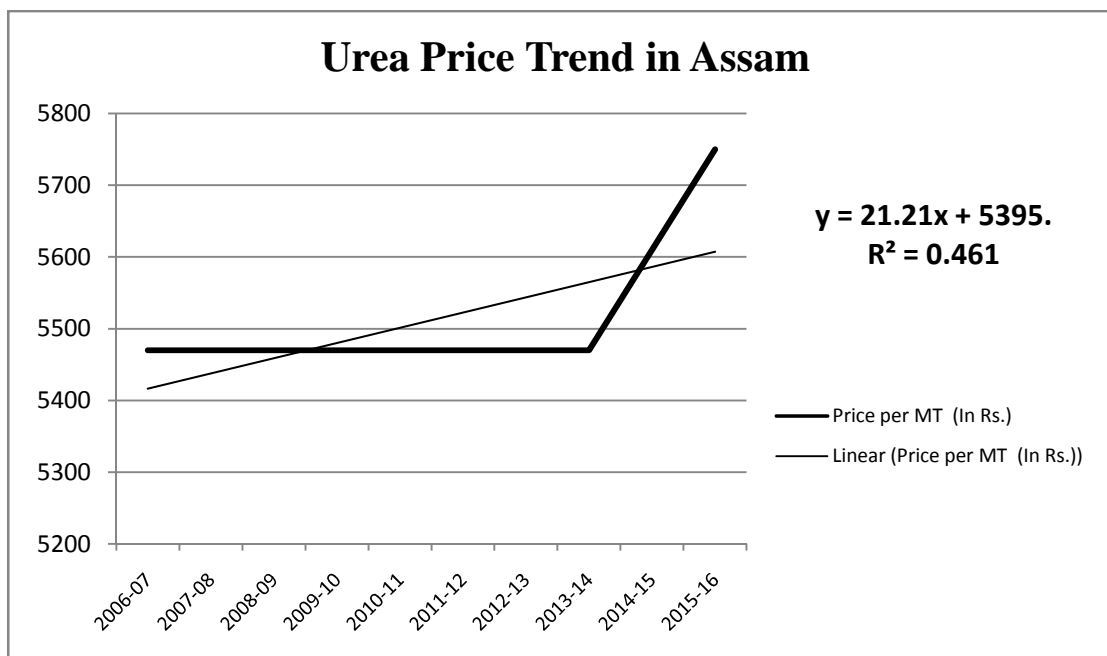


Table-2.1.2 reflects the picture of month-wise sales of NCU and Normal Urea (NU) in the State during 2015-16. Of the 3 Public Sector Undertakings(PSUs), 2 PSUs viz., [Indian Farmers Fertiliser Cooperative Limited](#) (IFFCO) and [Brahmaputra Valley Fertilizer Corporation Limited](#) (BVFCL) sale NCU and the other viz., [Indian Potash Limited](#) (IPL) sales plain urea in the State. During 2015-16 from April to March, the total sales of NCU were recorded at 351,420 MT and of the total sales, IFFCO and BVFCL sold 25.08 per cent and 64.48 per cent, respectively. The total sales of plain urea were recorded at 40,971 MT during year under reference. Combining both NCU and plain urea, the total urea consumption stood at 3,92,391 MT. Thus, the IPL could sale 10.44 per cent (plain urea only) while the other 2 PSUs sold 89.56 per cent of the total sales of urea in the state. The highest amount of sales of urea was found in March with 15.08 per cent and the lowest sales were recorded against September with 4.94 per cent of the total of sales in the reference year.

Table-2.1.2
Month-wise Sales of Neem Coated Urea & Plain Urea (NU) during 2015-2016 in Assam

(in MTs)

Month	Neem Coated Urea		Total Neem Coated Urea	Plain Urea	Total Qty of Urea	Month-wise percentage sale
	IFFCO	BVFCL		IPL		
April, 2015	0	19,128	19,128	6,645	25,773	6.57
May, 2015	0	23,489	23,489	2,323	25,812	6.58
June, 2015	6,523	18,231	24,754	0	24,754	6.31
July, 2015	10,583	15,685	26,268	1,307	27,575	7.03
August, 2015	12,277	15,862	28,139	1,305	29,444	7.50
September, 2015	8,722	10,647	19,369	0	19,369	4.94
October, 2015	7,670	25,722	33,392	0	33,392	8.51
November, 2015	5,360	18,375	23,735	4,182	27,917	7.11
December, 2015	5,022	26,230	31,252	6,398	37,650	9.60
January, 2016	7,830	24,206	32,036	3,066	35,102	8.95
February, 2016	12,650	22,422	35,072	11,352	46,424	11.83
March, 2016	21,784	33,002	54,786	4,393	59,179	15.08
Total (2015-16)	98,421	252,999	351,420	40,971	392,391	100.00
Company-wise percentage sale	25.08	64.48	89.56	10.44	100.00	

Note: 1. **IFFCO:** Indian Farmers Fertilizer Cooperative Limited
2. **BVFCL:** Brahmaputra Valley Fertilizers Corporation Limited
3. **IPL:** Indian Potash Limited

2.2 Trends in distribution of NCU since April 2015 (district-wise analysis)

The district-wise trend in distribution of NCU since April, 2015 is presented in Table-2.2.1 and the percentage distribution of the same is also worked out to see the amount of sales in the respective months in different districts of the state (Table 2.2.2).

It was observed that there was no record of sales of urea in Chirang, Dima Hasao and Udalguri districts during the reference period. No record of sales were found in April and May in Baksa district; there was no sales of urea during September in Cachar; April, May and June in Dhemaji district and during May, September and November in Hailakandi district. The highest sales of urea of 55,153 MT was recorded against Nagaon district followed by Kamrup combining Kamrup Metro and Kamrup Rural (54,656 MT), Tinsukia (48,948 MT), Barpeta (36,788 MT), Cachar (27,818 MT), Jorhat (26,280 MT), Dhubri (24,024 MT), Dibrugarh (16,967 MT), Bongaigaon (16,320 MT), Darrang (13,773 MT), Goalpara (11,908 MT), Golaghat (11,742 MT), Sivasagar (11,046 MT), Sonitpur (11,043 MT), Lakhimpur (5,876 MT), Karimgang (3,889 MT), Baksa (3,681 MT), Nalbari (3,630 MT), Hailakandi (3,482 MT), Morigaon (2,595 MT), Karbi-Anglong (1,842 MT), Kokrajhar (502 MT) and Dhemaji (429 MT).

Table-2.2.1
District-wise distribution of Urea [NCU and Plain Urea (NU) Combined] in different months (April 2015 to March 2016) in Assam
(in MTs)

Sl. No	Months →	April, 2015	May, 2015	June, 2015	July, 2015	Aug, 2015	Sep, 2015	Oct, 2015	Nov, 2015	Dec, 2015	Jan, 2016	Feb, 2016	Mar, 2016	2015-16
	Districts	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total
1	Baksa	0	0	324	83	567	335	194	276	123	409	421	948	3,681
2	Barpeta	347	2,218	1,468	1,974	2,022	2,822	3,419	637	5,589	3,831	5,117	7,344	36,788
3	Bongaigaon	857	1,609	997	773	1,174	910	1,215	1,291	1,906	1,903	1,313	2,372	16,320
4	Cachar	3,047	550	1,345	1,480	402	0	3,352	2,000	4,939	3,567	4,386	2,749	27,818
5	Chirang	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Darrang	815	675	1,640	832	980	1,088	520	1,165	1,490	1,058	565	2,945	13,773
7	Dhemaji	0	0	0	54	45	18	27	87	30	47	74	47	429
8	Dhubri	1,163	2,293	1,603	1,187	1,673	1,544	1,693	2,034	2,914	3,023	2,139	2,758	24,024
9	Dibrugarh	1,499	1,215	1,512	896	1,296	666	1,089	763	835	2,077	2,526	2,593	16,967
10	Goalpara	729	1,364	741	606	818	720	783	1,127	1,332	1,204	1,081	1,403	11,908
11	Golaghat	1,149	606	691	1,151	604	715	1,341	710	1,209	968	1,007	1,592	11,742
12	Hailakandi	240	0	210	230	60	0	600	0	535	907	300	400	3,482
13	Jorhat	3,970	1,341	1,395	2,944	2,130	1,202	2,675	1,828	2,081	1,360	2,990	2,363	26,280
14	K.Anlang	204	89	107	187	107	89	169	80	230	150	190	240	1,842
15	Kamrup	3,419	3,155	5,811	4,043	4,288	3,690	1,888	5,027	4,952	3,974	6,561	7,849	54,656
16	Karimganj	80	0	360	320	0	0	800	0	630	800	699	200	3,889
17	Kokrajhar	40	80	40	40	40	61	0	53	33	50	20	45	502
18	Lakhimpur	461	850	0	500	438	0	396	198	594	432	864	1,143	5,876
19	Morigaon	0	108	45	102	148	0	390	220	344	237	484	517	2,595
20	Dima Hasao	0	0	0	0	0	0	0	0	0	0	0	0	0
21	Nagaon	1,776	3,549	1,100	4,761	6,214	1,828	5,812	3,984	3,313	3,497	7,569	11,750	55,153
22	Nalbari	0	502	50	244	39	600	126	171	1,079	300	156	363	3,630
23	Sibsagar	1,483	665	805	1,412	911	776	1,338	330	640	449	826	1,411	11,046
24	Sonitpur	387	748	213	861	1,133	277	1,145	590	990	913	1,721	2,066	11,043
25	Tinsukia	4,107	4,195	4,296	2,895	4,355	2,030	4,420	5,346	1,864	3,947	5,417	6,077	48,948
26	Udalguri	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		25,773	25,812	24,754	27,575	29,444	19,369	33,393	27,918	37,651	35,102	46,425	59,174	392,391

Source: Directorate of Agriculture, Govt. of Assam

Table – 2.2.2
District-wise sales of Urea (NCU and Plain Urea combined) in different months (April 2015 to March 2016) in Assam
(in percentage)

Sl. No	Months	April, 2015	May, 2015	June, 2015	July, 2015	Aug, 2015	Sep, 2015	Oct, 2015	Nov, 2015	Dec, 2015	Jan, 2016	Feb, 2016	Mar, 2016	2015-16
	Districts	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total
1	Baksa	0.00	0.00	1.31	0.30	1.93	1.73	0.58	0.99	0.33	1.17	0.91	1.60	0.94
2	Barpeta	1.35	8.59	5.93	7.16	6.87	14.57	10.24	2.28	14.84	10.91	11.02	12.41	9.38
3	Bongaigaon	3.33	6.23	4.03	2.80	3.99	4.70	3.64	4.62	5.06	5.42	2.83	4.01	4.16
4	Cachar	11.82	2.13	5.43	5.37	1.37	0.00	10.04	7.16	13.12	10.16	9.45	4.65	7.09
5	Chirang	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Darrang	3.16	2.62	6.63	3.02	3.33	5.61	1.56	4.17	3.96	3.01	1.22	4.98	3.51
7	Dhemaji	0.00	0.00	0.00	0.20	0.15	0.09	0.08	0.31	0.08	0.13	0.16	0.08	0.11
8	Dhubri	4.51	8.88	6.48	4.30	5.68	7.97	5.07	7.29	7.74	8.61	4.61	4.66	6.12
9	Dibrugarh	5.82	4.71	6.11	3.25	4.40	3.44	3.26	2.73	2.22	5.92	5.44	4.38	4.32
10	Goalpara	2.83	5.29	2.99	2.20	2.78	3.72	2.34	4.04	3.54	3.43	2.33	2.37	3.03
11	Golaghat	4.46	2.35	2.79	4.17	2.05	3.69	4.02	2.54	3.21	2.76	2.17	2.69	2.99
12	Hailakandi	0.93	0.00	0.85	0.83	0.20	0.00	1.80	0.00	1.42	2.58	0.65	0.68	0.89
13	Jorhat	15.40	5.19	5.63	10.68	7.24	6.20	8.01	6.55	5.53	3.88	6.44	3.99	6.70
14	K. Anglang	0.79	0.34	0.43	0.68	0.36	0.46	0.51	0.29	0.61	0.43	0.41	0.41	0.47
15	Kamrup	13.27	12.22	23.47	14.66	14.56	19.05	5.65	18.01	13.15	11.32	14.13	13.26	13.93
16	Karimganj	0.31	0.00	1.45	1.16	0.00	0.00	2.40	0.00	1.67	2.28	1.51	0.34	0.99
17	Kokrajhar	0.16	0.31	0.16	0.15	0.14	0.31	0.00	0.19	0.09	0.14	0.04	0.08	0.13
18	Lakhimpur	1.79	3.29	0.00	1.81	1.49	0.00	1.19	0.71	1.58	1.23	1.86	1.93	1.50
19	Morigaon	0.00	0.42	0.18	0.37	0.50	0.00	1.17	0.79	0.91	0.68	1.04	0.87	0.66
20	Dima Hasao	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	Nagaon	6.89	13.75	4.44	17.27	21.10	9.44	17.40	14.27	8.80	9.96	16.30	19.86	14.06
22	Nalbari	0.00	1.94	0.20	0.89	0.13	3.10	0.38	0.61	2.87	0.85	0.34	0.61	0.93
23	Sibsagar	5.75	2.58	3.25	5.12	3.09	4.01	4.01	1.18	1.70	1.28	1.78	2.38	2.82
24	Sonitpur	1.50	2.90	0.86	3.12	3.85	1.43	3.43	2.11	2.63	2.60	3.71	3.49	2.81
25	Tinsukia	15.94	16.25	17.36	10.50	14.79	10.48	13.24	19.15	4.95	11.24	11.67	10.27	12.47
26	Udalguri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total Percentage of Sale		6.57	6.58	6.31	7.03	7.50	4.94	8.51	7.11	9.60	8.95	11.83	15.08	100.00
Seasons		<i>Kharif (38.92%)</i>						<i>Rabi (61.08)</i>						

Table-2.2.2 visualizes the district-wise percentage distribution of sales of Urea (NCU and Plain Urea combined) in different months (April 2015 to March 2016) in Assam. In *Kharif* season, sales of urea was recorded at 38.92 per cent while in *Rabi* season, it was recorded at 61.08 per cent. The highest sale of total urea in the month of April (15.94%) and May (16.25%) was reported in the district of Tinsukia. During June, the highest sales was observed in Kamrup (23.47%) while Nagaon district topped in sale in the month of July (17.27%), August (21.10%), February (16.30%) and March (19.86%). The district of Kamrup again recorded highest sales during the months of September (19.05%) and January (11.32%). For October, November & December, the highest sales of total urea were recorded in the districts of Nagaon (17.40%), Tinsukia (19.15%) and Barpeta (14.84%), respectively. This trend is indicative of the fact that there is a variation in the quantum of sales of urea over the months of the year. This might be due to growing of different crops in different seasons with differential fertilizer requirements.

Chapter III

SOCIO-ECONOMIC CHARACTERISTICS OF SAMPLE HOUSEHOLDS

This chapter deals with some important socio-economic characteristics of the sample farmers such as operational land holding, cropping pattern, sources of irrigation, sources of fertilizers and purchasing pattern, input uses, profitability of the reference crops (paddy and jute), details of agricultural credit availed and training programmes on fertilizers application, *etc.*

3.1 Socio-economic characteristics of Sample Households

General characteristics of the sample farmers against each of the reference crops are presented in Table-3.1.1. The average age of the sample respondents growing paddy was 43.13 years and that of jute growers was 44.01 years with an overall age 43.57 years. It indicates that all the respondent farmers were fully matured. For both the crops, all the respondents were males. The average number of family members engaged fully in farming was 2.38 persons for paddy and 2.32 persons for jute cultivation with an overall figure of 2.35 persons in each farm family. However, it has been observed that all the family members excluding minor children had some amount of contribution in the farming activities of the family as a whole. It has been observed that all the respondents were well experienced in farming activities. The respondent farmers cultivating paddy had 20.25 years of experience & the jute growers had an average experience of 21.84 years. The overall farming experience of the farmers stood at 21.04 years. The average family sizes of paddy and jute growers were recorded at 6.43 persons and 6.37 persons per family, respectively. Combining both the categories of farm families, the overall family size was computed at 6.40 persons per family.

Table- 3.1.1
General characteristics of sample farmers

Sl. No.	Particulars	Paddy	Jute	Overall
1	Average age of respondents (Years)	43.13	44.01	43.57
2	Male respondents (% to the total)	100.00	100.00	100.00
3	Average number of family members engaged fully in farming	2.38	2.32	2.35
4	Average number of years of farming experience	20.25	21.84	21.04
5	Average family size (No.)	6.43	6.37	6.40

Source: Primary Survey

The education level of the sample farmers were also studied during the field survey. The percentage of illiterate respondents was 19.50 per cent for paddy growers and 20.25 per cent for jute growers with an overall percentage of 20.00. About 40.50 per cent of the total respondents growing paddy crop studied up to primary standard (Class 1 to 4), as against 48.50 per cent in case of jute growers, with an average of 44.50 per cent in the category. Nearly 17.50 per cent of the paddy growers and 17.00 per cent of the jute growers were in the higher primary standard (5 to 9) with an average of 17.25 per cent. Further, 9.00 per cent of the paddy growers were in the matriculation (10) standard and the corresponding figure for jute growers was recorded at 6.00 per cent only, with an average of 7.50 per cent. And 13.50 per cent of the total paddy growers and 8.00 per cent of the total jute growers were educated up to pre-university (10+2) and above level, registering an overall average of 10.75 per cent. Summarily, the literacy rate (80 per cent) among the respondents was satisfactory in the study area as compared to the state level literacy (72.19 per cent, 2011). It also indicates the farmer's awareness towards educational value.

Table- 3.1.2
Education level of sample farmers

Sl. No	Education level	(% of farmers)		
		Paddy	Jute	Overall
1	Illiterates	19.50	20.50	20.00
2	Primary (1 to 4)	40.50	48.50	44.50
3	Higher primary (5 to 9)	17.50	17.00	17.25
4	Matriculation (10)	9.00	6.00	7.50
5	Pre University (10+2) & above	13.50	8.00	10.75
Total		100.00	100.00	100.00

Source: Primary Survey

As there is a distinct variation of social characteristics among the different social groups, an effort was also made to capture the caste structure of the sample households during the survey. Table- 3.1.3 was prepared on that line. In both the crops, the sample respondents were dominated by general caste people with 100 per cent in case of paddy cultivators and 94.50 per cent in case of jute growers. Only 5.50 per cent respondents belonged to OBC category amongst the jute growers.

Table- 3.1.3
Distribution of sample farmers based on their category

		(% of farmers)		
Sl.No	Particulars	Paddy	Jute	Overall
1	General	100.00	94.50	97.25
2	OBC	0.00	5.50	2.75
3	SC	0.00	0.00	0.00
4	ST	0.00	0.00	0.00
Total		100.00	100.00	100.00

Source: Primary Survey

Table-3.1.4 gives the details of the occupational distribution of the total sample farmers for each reference crop. A large majority of the sample farmers earned their livelihood by engaging themselves in agriculture & allied activities. As agricultural operation is a labour intensive job, the farmers usually do not have much spare time to opt for other activities. Of the total sample farmers in the respective category 84.50 per cent and 89.50 per cent farmers drew their sustenance from agriculture & allied activities and only 2.00 per cent of the sample farmers in each category could engage themselves as agricultural labourers during the lean period. Only 1.00 per cent paddy growers and 2.00 per cent of the jute growers were involved in small scale industries with an overall average of 1.50 per cent. Another 1.00 per cent of paddy growers and 0.50 per cent of jute growers were found to be self employed in different services, with an overall average of 0.75 per cent. The survey also revealed that 3.50 per cent of paddy farmers and 2.50 per cent of jute farmers offered their services as non –agricultural casual labour, with an overall average of 3.00 per cent. Besides farming, 5.50 per cent of the paddy farmers and 2.00 per cent of the jute farmers were engaged in some salaried jobs with an overall average of 3.75 per cent. No sample farmers were reported to be engaged in household economic activities and none was a pensioner in the study areas. Of the total farmers, 2.50 (paddy) and 1.50 (jute) per cent were found to involve in other occupational activities which include fishery, vegetable vendors, small grocery shops, cattle business and poultry farming, *etc.*

Table- 3.1.4
Occupational distribution of the sample farmers

Sl. No	Particulars	(% farmers)		
		Paddy	Jute	Overall
1	Agriculture & allied	84.50	89.50	87.00
2	Agricultural labour	2.00	2.00	2.00
3	Self employed in small scale industries	1.00	2.00	1.50
4	Self employed in services	1.00	0.50	0.75
5	Non-agricultural casual labour	3.50	2.50	3.00
6	Salaried work	5.50	2.00	3.75
7	Household	0.00	0.00	0.00
8	Pensioner	0.00	0.00	0.00
9	Other	2.50	1.50	2.00
	Total	100.00	100.00	100.00

Source: Primary Survey

3.2 Details of Operational Land Holding

The quantum of operational holding is an important indicator of the economic status of the farmers in the villages. Table-3.2.1 gives the status of the operational holdings with irrigation status for the crops under study across different farm size groups. In case of paddy growers, the average owned operational holding (per household) was recorded as 2.77 acres for marginal & small, 5.50 acres for medium and 11.24 acres for the large size groups with an aggregate average of 3.12 acres. In case of jute samples farmers, it was recorded at 2.75 acres for marginal & small, 6.06 acres for medium and 12.40 acres for the large size groups with an aggregate average of 3.28 acres. Only small area was reported to be uncultivated/fallow land in both categories of farmers. At overall average level, it stood at 0.13 acres per household. So was seen in case of leased-in land and leased-out land (excluding large farm size group). In aggregate, the average leased-in land area was 0.26 acres and leased-out land area was 0.16 acres. For paddy sample farmers, the average net operational area was recorded at 2.74 acres for marginal & small category, 5.69 acres for medium, 9.92 acres for the large size groups with an aggregate average of 3.12 acres, while in jute sample farmers, the average net operational area was recorded at 2.71 acres for marginal & small, 6.09 acres for medium, 10.33 acres for the large size groups with an aggregate average of 3.23 acres. Combining both the samples, the average net operational area was recorded at 2.73 acres for marginal &

small category, 5.90 acres for medium, 10.19 acres for the large size groups with an aggregate average of 3.17 acres per household which is higher than the state average (2.72 acres).

In the paddy samples, the highest (89.98 per cent) irrigated area was found against the medium size group of farmers and the lowest (79.80 per cent) in the marginal & small size group with an overall average of 82.10 per cent while in jute samples, the highest (88.00 per cent) irrigated area was found against the large farm size group and the lowest (73.16 per cent) in the marginal & small size group with an overall average of 75.61 per cent of the total net operated area. On combining both the samples, 78.80 per cent of the total net operated area was found under irrigation. The rental value of the leased-in and leased-out land usually depends upon the quality of products and the yield potential of the land. Therefore, rental value varies from area to area. In the paddy sample area, the highest rental value (Rs.8, 700.00 per acre) of leased-in area was recorded against the medium size group of farmers and the lowest (Rs.6, 600.00 per acre) against the large farm size group with an overall average of Rs.8,595.83 per acre. In jute sample, the highest rental value of leased-in land (Rs.8,987.50 per acre) was found against the medium size group and the lowest (Rs.8,100.00 per acre) against the marginal & small size group with an average aggregate of Rs.8,389.33 per acre. The rental value of leased-in land in aggregate was finally recorded at Rs.8, 443.33 per acre. The rental value of leased-out land in the study area was lower in aggregate than that of leased-in land. The highest rental value of Rs.8,500.00 per acre was recorded against the large farmers and the lowest (Rs.7,500.00 per acre) was found against the medium size group of farmers and in aggregate level, it stood at Rs. 7,777.14 per acre in respect of paddy sample while in jute sample, the highest amount of Rs. 8,666.67 per acre was found against the large farm size group of farmers and the lowest (Rs.7,916.67 per acre) was found against the marginal & small size group of farmers and in aggregate it stood at Rs. 8,009.09 per acre. Combining all the sample farmers, the overall rental value of leased-out land was recorded at Rs.7, 889.71 per acre.

Table- 3.2.1
Average size of operational land holdings of the sample farmers

(in acres)

Sl.No	Particulars		Paddy				Jute				Overall			
			Marginal & Small	Medium	Large	Total	Marginal & Small	Medium	Large	Total	Marginal & Small	Medium	Large	Total
No of HHs →			176	23	1	200	172	26	2	200	348	49	3	400
1	Owned land Total	Total	486.70	126.41	11.24	624.35	473.34	157.54	24.79	655.67	960.04	283.95	36.03	1280.02
		Average	2.77	5.50	11.24	3.12	2.75	6.06	12.40	3.28	2.76	5.79	12.01	3.20
2	Uncultivated/Fallow	Total	21.89	5.00	0.00	26.89	18.64	6.49	0.66	25.79	40.53	11.49	0.66	52.68
		Average	0.12	0.22	0	0.13	0.11	0.25	0.33	0.13	0.12	0.23	0.22	0.13
3	Leased-in	Total	49.55	12.00	0.33	61.88	32.06	11.99	0	44.05	81.61	23.99	0.33	105.93
		Average	0.28	0.52	0.33	0.31	0.19	0.46	0.00	0.22	0.23	0.49	0.11	0.26
4	Leased-out	Total	31.90	2.64	1.65	36.19	19.83	4.63	3.47	27.93	51.73	7.27	5.12	64.12
		Average	0.18	0.11	1.65	0.18	0.12	0.18	1.74	0.14	0.15	0.15	1.71	0.16
5	Net Operational Area (1-2+3-4)	Total	482.46	130.77	9.92	623.15	466.93	158.41	20.66	646.00	949.39	289.18	30.58	1269.15
		Average	2.74	5.69	9.92	3.12	2.71	6.09	10.33	3.23	2.73	5.90	10.19	3.17
6	% Irrigated		79.80	89.98	89.92	82.10	73.16	81.21	88.00	75.61	76.54	85.18	88.62	78.80
7	% Un Irrigated		20.20	10.02	10.08	17.90	26.84	18.79	12.00	24.39	23.46	14.82	11.38	21.20
Total			100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
8	Rental value of leased-in land (Rs/acre)		8,692.27	8,700.00	6,600.00	8,595.83	8,100.00	8,987.50	0.00	8,269.05	8,389.33	8,864.29	6,600.00	8,443.33
9	Rental value of leased-out land (Rs/acre)		7,780.65	7,500.00	8,500.00	7,777.14	7,916.67	8,050.00	8,666.67	8,009.09	7,840.00	7,866.67	8,625.00	7,889.71

Source: Primary Survey

3.3 Cropping Pattern and Sources of Irrigation

The soil type, the type of agro-climatic condition, the extent of rainfall, the irrigation status, social back ground, the food habits, the agricultural policies of the Government, the economic status of the farmers, the availability of required seeds on time and economic return or monetary gain per unit of area usually determine the cropping pattern of a region or a state. However, among all the factors, irrigation assumes much significance in the sense that it can play a vital role in changing the cropping pattern of a region as it encourages the farmers to grow more crops throughout the year. Table-3.3.1 shows the cropping pattern of paddy respondents during *Kharif* season in the irrigated and rain-fed conditions across the farm size groups in the study area. In both the situations, paddy was the dominant crop followed by other crops. In irrigated condition, the highest area (94.47%) of paddy was in the marginal & small size group followed by the medium (89.56%) and the large size group (85.20%). In rain-fed condition, the highest area (38.17%) of paddy was recorded in the medium size group, followed by the marginal & small size group of farmers (23.67%). No area of paddy was found in the large size group under rain-fed condition. Combining the areas of two different situations, the highest area of paddy was covered by the medium size group (84.41%) followed by the marginal & small (80.17%) and the large size group of farmers (76.90%). No area was found under irrigated condition in case of jute crop but in rain-fed condition, the highest area (74.00%) of jute was recorded against the small & marginal size group followed by the medium size group (60.53%). Combining both the situation, the highest area (15.11%) of jute was recorded in the marginal & small size group followed by the large size group (9.99%) and medium size group (6.06%). In case of irrigated vegetables (*Kharif*), the highest area (14.80%) was recorded against the large size group followed by medium size group (10.44 %) and the marginal & small size group (5.53%). In rain-fed condition, the highest area under *Kharif* vegetables was recorded against marginal & small size group (1.49%) followed by the medium size group (0.17%). There was no area under vegetables in large size group of farmers. Combining both the situation, the highest vegetables area was found against the large group (13.32%) followed by the medium (9.53%) and the marginal & small size group (4.72%).

Table 3.3.1
Cropping pattern of Paddy respondents during *Kharif* season

(Area in acres & % in parenthesis)

Sl. No	Name of the Crops	Irrigated			Rain-fed			Total		
		Marginal & Small	Medium	Large	Marginal & Small	Medium	Large	Marginal & Small	Medium	Large
1	Paddy	363.73	105.38	7.60	23.07	5.00	0.00	386.80	110.38	7.60
		(94.47)	(89.56)	(85.20)	(23.67)	(38.17)	(0.00)	(80.17)	(84.41)	(76.69)
2	Jute	0.00	0.00	0.00	72.89	7.93	0.99	72.89	7.93	0.99
		(0.00)	(0.00)	(0.00)	(74.80)	(60.53)	(100.00)	(15.11)	(6.06)	(9.99)
3	K. Vegetables	21.29	12.29	1.32	1.49	0.17	0	22.78	12.46	1.32
		(5.53)	(10.44)	(14.80)	(1.53)	(1.30)	0	(4.72)	(9.53)	(13.32)
Over all	Total Sown Area(Acres)	385.02	117.67	8.92	97.45	13.10	0.99	482.47	130.77	9.91
	Total (%)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

Source: Primary Survey

Table-3.3.2 shows the cropping patterns of jute respondents during *Kharif* season in irrigated and rain-fed conditions across different farm size groups. In both the situations, a similar picture was seen as that of the paddy respondents. Under irrigated condition, the highest area (96.67%) of jute was observed in the marginal & small size group followed by the large size group (92.74%) and medium (88.78%) size group. Under rain-fed condition, no areas of paddy were found in all the three size group of farmers. Combining the areas of the two different situations, the highest paddy area was covered by the large size group (81.61%) followed by medium size group (72.10 %) and marginal & small size group (70.66%). No jute area was found under irrigated condition, but in rain-fed condition, the highest area (99.86%) of jute was recorded against the marginal & small size group followed by the large size group (93.15%). Combining both the situations, the highest area (26.88%) of jute was recorded in the marginal & small size group followed by medium size group (18.79%) and large size group (11.18%). In case of irrigated vegetables (*Kharif*), the highest area (11.22%) was recorded against the medium size group followed by large size group (7.26%) and marginal & small size group (3.33%). In rain-fed condition, the highest area of vegetables was recorded against the large size group (6.85%) followed by marginal & small size group (0.14%). No vegetables area was found in the medium size group. Combining both the situation, the highest vegetables area was found against the medium size group (9.12 %) followed by large size group (7.21%) and marginal & small size group (2.47%).

Table- 3.3.2
Cropping pattern of the Jute respondents during *Kharif* season

(Area in acres & % in parenthesis)

Sl. No	Name of the Crops	Irrigated			Rainfed			Total		
		Marginal & Small	Medium	Large	Marginal & Small	Medium	Large	Marginal & Small	Medium	Large
1	Paddy	329.92	114.21	16.86	0.00	0.00	0.00	329.92	114.21	16.86
		(96.67)	(88.78)	(92.74)	(0.00)	(0.00)	(0.00)	(70.66)	(72.10)	(81.61)
2	Jute	0.00	0.00	0.00	125.49	29.76	2.31	125.49	29.76	2.31
		(0.00)	(0.00)	(0.00)	(99.86)	(100.00)	(93.15)	(26.88)	(18.79)	(11.18)
3	K. Vegetables	11.35	14.44	1.32	0.17	0.00	0.17	11.52	14.44	1.49
		(3.33)	(11.22)	(7.26)	(0.14)	(0.00)	(6.85)	(2.47)	(9.12)	(7.21)
Over all	Total Sown Area (Acres)	341.27	128.65	18.18	125.66	29.76	2.48	466.93	158.41	20.66
	Total (%)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

Source: Primary Survey

Table-3.3.3 presents the various sources of irrigation in the study area and it was found that all the respondents under reference had the access to Bore well irrigation only (100%).

Table- 3.3.3
Sources of irrigation of the sample farmers

(% of farmers)

Sl. No	Particulars	Paddy	Jute	Overall
1	Open/ Dug well	0.00	0.00	0.00
2	Bore well	100.00	100.00	100.00
3	Canal	0.00	0.00	0.00
4	Tank	0.00	0.00	0.00
5	Others	0.00	0.00	0.00
	Total	100.00	100.00	100.00

Source: Primary Survey

3.4 Purchasing Pattern and Sources of Purchasing

In the study areas, both the respondents purchased NCU and NU in bags (50 kg each) and in loose (kg) Table-3.4.1 gives the purchasing pattern of NCU/NU in terms of Kg as per requirement. Purchasing pattern mainly depends upon the economic conditions of the farmers. Most of the farmers could not afford to purchase the required amount of fertilizers as recommended in the package of practices. The quantity of NCU purchased per household was found to be much higher than that of the NU for both categories of respondents. It might be due to abundant availability of NCU as compared to NU in the market or might be due to farmer's enthusiasm on NCU application. In case of paddy respondents, each household bought 128.10 Kg of NCU while jute respondents bought 118.76 Kg of NCU per household and at overall level, it stood at 123.43 kg per

household. In case of NU, 9.75 kg per household was recorded against paddy and 21.13 kg per household against jute respondents. In overall, it stood at 15.44 kg per household. The overall market price of 50 kg of NCU bag was Rs.392.13 against Rs. 350.31 a bag in case of NU. The average distance from the farm to the market was about 3.26 Km for NCU and 2.12 Km for NU. Each household on an average had to incur Rs.9.85 for NCU and Rs. 9.79 for NU as transportation cost per bag. Finally, each household had to spend Rs.401.98 per bag for NCU and Rs.360.10 per bag for NU.

Table-3.4.1
Purchasing pattern of NCU/NU for the reference year

Sl. No	Particular	Paddy		Jute		Overall	
		NCU	NU	NCU	NU	NCU	NU
1	Quantity bought (Kg)	128.10	9.75	118.76	21.13	123.43	15.44
2	Price Rs per bag of 50kg	391.28	350.48	392.97	350.14	392.13	350.31
3	Distance from farm (Kms)	3.64	2.12	2.88	2.11	3.26	2.12
4	Transport cost (Rs per bag of 50kg)	9.97	9.70	9.73	9.87	9.85	9.79
	Total cost (Rs per bag of 50kg)	401.25	360.18	402.70	360.01	401.98	360.10

Table-3.4.2 presents different sources of purchase of NCU and NU and it clearly indicates that the entire quantity of NCU and NU were supplied by the private fertilizer dealers only to all the respondents.

Table-3.4.2
Sources of purchase of NCU/Normal Urea

Sl. No	Particulars	Paddy		Jute		Overall	
		NCU	NU	NCU	NU	NCU	NU
1	Private fertilizer dealers	100.00	100.00	100.00	100.00	100.00	100.00
2	Cooperative societies (GPSS)	0.00	0.00	0.00	0.00	0.00	0.00
3	Agriculture Department	0.00	0.00	0.00	0.00	0.00	0.00
4	Others (Specify)	0.00	0.00	0.00	0.00	0.00	0.00
5	Total	100.00	100.00	100.00	100.00	100.00	100.00

Source: Primary Survey

3.5 Usage of Inputs and Profitability of Reference Crops

Usage of inputs and profitability of reference crops are analyzed here in terms of net return per acre. Table-3.5.1 demonstrates the cost incurred for each input use and realization of net return per acre across different farm size groups for paddy farmers for the years 2014 and 2015. It is seen, in the study area, no bullock power was used for ploughing the crop field. In 2015, the highest expenditure of Rs.2,718.49 per acre was

incurred on ploughing and sowing by the marginal and small size group which was higher than that of the marginal and small size group (Rs.2,548.44/acre) in 2014. At average level, the expenditure incurred on ploughing and sowing was Rs.2, 533.44 per acre in 2015 and Rs. 2,364.55 per acre in 2014. The overall per acre expenditure incurred on seeds and seedlings were Rs.690.62 in 2015 and Rs.583.02 in 2014 with a marginal variation among various size groups of farmers. In 2015, the cost on organic /FYM varied between Rs.201.27 per acre (medium size group) and Rs.215.09 per acre (large size group) with an overall average of Rs. 205.17 per acre while in 2014, it varied between Rs.192.80 per acre (medium size group) and Rs.200.09 per acre (large size group) with an overall average of Rs. 193.62 per acre. The per acre expenditure on urea/NCU was less in 2015 as compared to the expenditure in 2014. During 2014, the farmers used urea only but in 2015, a large majority of the farmers opted for NCU instead of NU. The interactions with the respondents indicate that the farmers used less amount of NCU in 2015 for which the overall cost on urea / NCU per acre came down as compared to the previous year. As such, the per acre expenditure incurred by the paddy farmers, varied between Rs.368.47 per acre (medium size group) and Rs.337.89 per acre (large size group) with an overall average of Rs. 360.09 per acre during 2015 while in 2014, it varied between Rs.501.16 per acre (large size group) and Rs.485.12 per acre (marginal & small size group) with an overall average of Rs. 488.79 per acre. No expenditure was incurred on micro-nutrients by the large farm size group in both the years. The overall expenditure on micronutrient was Rs.209.32 per acre in 2015 and Rs. 178.47 per acre in 2014. The expenditure on plant protection chemicals mainly depends upon the extent of attack by the pests and diseases and also on the price level. Therefore, the expenditure on it may vary from year to year. The overall expenditure on plant protection chemicals was Rs.223.25 per acre in 2015 which was marginally less than the previous year cost (Rs.231.26). Variations in irrigation charges generally depend upon the distance between the boring points to the actual field. During 2015, the highest irrigation charge of Rs. 756.25 per acre was found against the large farm size group and the lowest (Rs.643.09 per acre) was found in small and marginal size group with an overall average of Rs.650.09 per acre. In 2014, the highest amount of irrigation charge of Rs.618.92 per acre was found against the medium size group and the lowest (Rs.566.51

per acre) was found against the small and marginal size group with an aggregate of Rs 578.82 per acre. As reported by the farmers, they rarely apply weedicides in the crop field and, usually, weeding is done manually. In 2015, the labour cost of weeding ranged between Rs.1,362.79 and Rs.1,150.50 per acre across the farm size groups with an overall average of Rs.1,314.16 per acre while in 2014, it ranged between Rs.1,385.05 and Rs. 1,289.47 per acre across the farm size groups with an overall average of Rs.1,342.25 per acre. At overall level, the expenditure on harvesting & threshing stood at Rs.1, 696.51 in 2015 and Rs.1, 502.06 per acre during 2014. The cost of hired labour (including ploughing charges till planting, cost of sowing/ transplanting) ranged between Rs.1,965.85 and Rs.1,963.87 per acre among the farm size groups and the overall average recorded at Rs.1,964.14 during 2015 while in 2014, it varied between Rs.1,790.78 and Rs.1,786.87 in different size groups with an overall average of Rs.1,787.63 per acre. The cost of imputed family labour ranged between Rs.2,088.39 and Rs.1,938.18 per acre among different farm size groups and the overall average was recorded at Rs.1,973.70 per acre during 2015 while in 2014, it varied between Rs.2,020.38 and Rs.1,835.88 per acre in different size groups with an overall average of Rs.1,879.03 per acre. The cost of hired labour for other agricultural operations ranged between Rs. 1,447.14 and Rs.1,260.28 in different size groups and the overall average was recorded at Rs.1,404.91 per acre in 2015 while in 2014, it was recorded between Rs.1,356.20 and Rs.1,210.62 per acre with an overall average of Rs.1,322.95 per acre. The overall maintenance cost on assets used for the reference crop was Rs. 92.25 in 2015 and Rs.85.72 per acre in 2014. The total paid-out costs including imputed value of own labour for the reference crop was recorded at Rs.14,618.01 for the marginal & small size group, Rs.13,218.85 for the medium size group and Rs. 14,375.55 per acre for the large size group and in aggregate, the overall average stood at Rs.14,304.84 during 2015 while in 2014, it was recorded at Rs.13,853.98 for the marginal & small size group, Rs.12,782.74 for medium size group and Rs. 13,603.69 per acre for the large size group with an overall average of Rs.13,611.08 per acre during 2014. It has been observed that the paid-out cost in 2015 was on a higher side against each cost component across the farm size groups as compared to 2014 except for a decline in expenditure on

Table- 3.5.1
Input use, output and returns per acre realized by Paddy farmers

(Rs. per acre)

Sl. No.	Particulars	2015				2014			
		Marginal & Small	Medium	Large	Overall average	Marginal & Small	Medium	Large	Overall average
1	Ploughing and sowing charges (only machinery)	2,718.49	1,963.80	1,640.71	2,534.48	2,548.44	1,800.81	1,480.64	2,364.55
2	Seed cost/ purchase of seedlings	706.50	624.49	847.37	690.62	582.74	584.11	581.05	583.02
3	Organic/FYM	206.09	201.27	215.09	205.17	193.72	192.80	200.09	193.62
4	Urea/NCU	358.13	368.47	337.89	360.09	485.12	500.44	501.16	488.79
5	Chemical fertilizers (Other than Urea/NCU)	1,029.88	814.65	1,271.05	986.15	1,099.84	957.57	1,398.16	1,072.91
6	Micro-nutrients	203.72	243.75	0.00	209.32	175.56	201.26	0.00	178.47
7	Plant protection chemicals	224.08	220.58	220.10	223.25	230.98	231.55	240.10	231.26
8	Irrigation charges	643.09	666.60	756.58	650.09	566.51	618.92	605.26	578.82
9	Weeding/ Weedicides	1,303.50	1,362.79	1,150.50	1,314.16	1,330.83	1,385.05	1,289.47	1,342.25
10	Harvesting & threshing charges	1,781.88	1,351.75	2,390.79	1,696.51	1,574.67	1,207.63	2,148.68	1,502.06
11	Hired labour charges (including ploughing charges till planting, cost or sowing/ transplanting)	1,963.87	1,964.96	1,965.85	1,964.14	1,786.87	1,789.97	1,790.78	1,787.63
12	Imputed value of family labour	1,938.18	2,088.39	2,083.62	1,973.70	1,835.88	2,020.38	1,961.05	1,879.03
13	Hired labor (amount paid)	1,447.14	1,260.28	1,389.08	1,404.91	1,356.20	1,210.62	1,307.37	1,322.95
14	Maintenance costs on assets used for the reference crop	93.47	87.05	105.92	92.25	86.62	81.64	99.87	85.72
	Total paid-out costs including imputed value of own labour	14,618.01	13,218.85	14,374.55	14,304.84	13,853.98	12,782.74	13,603.69	13,611.08
	Returns								
1	Output (Main product)	15,524.91	16,039.23	14,953.25	15,629.49	14,372.25	14,549.71	14,205.59	14,409.14
2	By product	3,115.53	3,179.21	3,106.73	3,129.47	2,775.74	2,775.44	2,840.43	2,776.71
3	Gross returns	18,640.44	19,218.44	18,059.98	18,758.96	17,147.99	17,325.14	17,046.02	17,185.85
4	Net returns	4,022.43	5,999.59	3,685.42	4,454.12	3,294.00	4,542.40	3,442.33	3,574.77

Source: Primary Survey

FYM, urea, other chemical fertilizers and weedicides. The medium size group accounted for highest gross return (main product + by-product) of Rs.19,218.44 per acre followed by the marginal & small (Rs.18,640.44) and large farms (Rs.18,059.98 per acre) with an overall gross return of Rs.18,758.96 per acre during 2015 while in 2014, the medium size group accounted for highest gross return of Rs.17,325.14 per acre followed by the marginal & small (Rs.17,147.99 per acre) and the large size group (Rs.17,046.02 per acre) with an overall gross return of Rs.17,185.85 per acre. In case of net return, the highest amount of Rs.5,999.59 per acre was recorded against the medium size group followed by the marginal & small (Rs.4,022.43 per acre) and the large size group (Rs.3,685.42 per acre) with an overall total net return Rs.4,454.12 per acre during 2015 while in 2014, the highest net return of Rs.4,542.40 per acre was found against the medium size group followed by the large (Rs.3,442.33) and the marginal & small farm size group (Rs.3,294.00 per acre) with an overall net return of Rs. 3,5574.77 per acre.

Table-3.5.2 presents input wise cost incurred and realization of net return per acre across various farm size groups for jute farmers during 2014 and 2015. In the study area, no bullock power was used for ploughing the crop field. On ploughing and sowing (undertaken by machines only), minor variations in expenditure were noticed across the different farm size groups in 2015 and 2014. In 2015, the aggregate per acre expenditure on this count stood at Rs.1,146.44 and Rs. 1,131.11 in 2014. The overall per acre expenditure incurred on seeds and seedlings were found at Rs.268.38 in 2015 and Rs.233.87 in 2014 with a marginal variation from the marginal & small size group to the large size group. The overall per acre cost incurred on organic and FYM in 2015 was Rs. 526.54 and Rs. 703.86 in 2014. In case of expenditure on NU and NCU, the per acre expenditure was less in 2015 as compared to the expenditure in 2014. During 2014, the farmers used urea only but in 2015, a large majority of farmers started using NCU besides NU. It was observed that the farmers used less amount of NCU during 2015 for which the overall cost of urea per acre in the year came down as compared to the year 2014. The per acre expenditure on NCU and NU incurred by the jute farmers, varied between Rs. 228.79 per acre (large group) and Rs. 251.62 per acre (marginal & small group) with an overall average of Rs. 249.00 during 2015 while in 2014, it varied between Rs.303.51 per acre (marginal & small group) and Rs.305.71 per acre (medium

group) with an overall average of Rs. 303.92. No expenditure was incurred on micro-nutrient by the large farm size group in the reference years. However, marginal increase on expenditure on micro-nutrient was recorded in 2015 over 2014 in other two size groups. The overall expenditure on micronutrient was Rs.76.52 per acre in 2015 and Rs. 74.60 per acre in 2014. The overall expenditure on plant protection chemicals was Rs.126.06 per acre in 2015 as against Rs.137.14 per acre in the previous year. In 2015, the labour cost of weeding ranged from Rs.1,208.32 to Rs.1,225.00 per acre across the different farm size groups of farmers with an overall average of Rs.1211.20 per acre while in 2014, the labour cost of weeding stood at (Rs.1200.00 per acre) across different farm size groups. No variations in expenditure were found on harvesting & threshing across the farm size groups in 2015 and it stood at Rs.7,200.00 per acre across the group and so was observed in case of the year 2014 as well with an amount of Rs.7,000.00 per acre for each farm size group. Harvesting and extraction of jute fibre from the sticks is more labour intensive and hence the expenditure on harvesting & threshing is always on higher side in case of jute than any other field crops. The cost of hired labour charges (including ploughing charges till planting, cost of sowing / transplanting) ranged between Rs.393.25 and Rs.411.13 per acre among different farm size groups with an overall average of Rs. 405.65 per acre during 2015 while in 2014, marginal variations were observed across the farm size groups with an overall average of Rs.362.90 per acre. The cost of imputed family labour ranged between Rs.1,915.03 and Rs.2,345.49 per acre among the different farm size groups and the overall average was recorded at Rs.1,994.30 per acre during 2015 while in 2014, it occurred between Rs.1,789.51 and Rs.2,195.22 per acre with an average of Rs.1,865.48 per acre. The cost of hired labour for other agricultural operation, ranged between Rs.1,453.07 and Rs.1,873.84 per acre among different farm size groups with an overall average of Rs.1,795.68 per acre in 2015 while in 2014, it occurred between Rs.1,413.40 and Rs.1,816.01 per acre among the different size groups with an overall average of Rs.1,740.75 per acre. The overall maintenance cost on assets used for the reference crop was of Rs. 54.70 per acre in 2015 and Rs.46.16 per acre in 2014. The total paid-out costs including imputed value of own labour for the reference crop was recorded at Rs.15,716.24 per acre for

Table- 3.5.2
Input use, output and returns per acre realized by Jute farmers

(Rs. per acre)

Sl. No.	Particulars	2015				2014			
		Marginal & Small	Medium	Large	Total in average	Marginal & Small	Medium	Large	Total in average
1	Ploughing and sowing charges (only machinery)	1,133.36	1,193.66	1,296.43	1,146.44	1,129.50	1,131.85	1,210.00	1,131.11
2	Seed cost/ purchase of seedlings	266.91	276.00	257.13	268.38	233.05	238.16	226.88	233.87
3	Organic/FYM	528.94	508.27	614.08	526.53	701.05	712.53	752.79	703.85
4	Urea/NCU	251.52	239.19	228.39	249.00	303.51	305.71	304.77	303.92
5	Chemical fertilizers (Other than Urea/NCU)	684.18	664.87	680.63	680.70	563.49	504.48	586.85	553.36
6	Micro-nutrients	67.56	141.34	0.00	79.65	65.91	120.33	0.00	74.60
7	Plant protection chemicals	126.70	122.78	130.56	126.06	140.04	125.38	120.00	137.14
8	Irrigation charges	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	Weeding/ Weedicides	1,211.58	1,208.32	1,225.00	1,211.20	1,200.00	1,200.00	1,200.00	1,200.00
10	Harvesting & threshing charges	7,200.00	7,200.00	7,200.00	7,200.00	7,000.00	7,000.00	7,000.00	7,000.00
11	Hired labour charges (including ploughing charges till planting, cost or sowing/ transplanting)	404.67	411.13	393.25	405.65	363.32	360.99	363.00	362.90
12	Imputed value of family labour	1,915.03	2,345.49	2,118.24	1,994.30	1,789.51	2,195.22	2,055.52	1,865.48
13	Hired labor (amount paid)	1,873.84	1,453.07	1,629.42	1,795.68	1,816.01	1,413.40	1,560.88	1,740.75
14	Maintenance costs on assets used for the reference crop	51.94	67.07	57.48	54.70	43.50	57.66	52.94	46.15
	Total paid-out costs including imputed value of own labor	15,716.24	15,831.19	15,830.59	15,738.29	15,348.91	15,365.72	15,433.62	15,353.14
	Returns								
1	Output (Main product)	18,077.45	17,726.69	20,303.80	18,047.98	16,933.42	16,409.63	18,601.78	16,864.95
2	By product	771.76	769.21	825.83	772.11	760.47	748.44	796.71	758.87
3	Gross returns	18,849.21	18,495.90	21,129.63	18,820.09	17,693.89	17,158.07	19,398.49	17,623.82
4	Net returns	3,132.97	2,664.70	5,299.04	3,081.80	2,344.98	1,792.36	3,964.87	2,270.68

Source: Primary Survey

the marginal & small size group, Rs.15,831.19 per acre for the medium size group and Rs. 15,830.59 per acre for the large size group and in aggregate, the paid-out cost stood at Rs.15,738.29 during 2015 while in 2014, it was recorded at Rs.15,348.91 per acre for the marginal & small size group, Rs.15,365.72 per acre for the medium size group and Rs. 15,433.62 per acre for the large size group and in aggregate, the paid-out cost stood at Rs.15,353.14 per acre during 2014. It has been observed that the paid-out cost against the most of the cost components were on higher side across the farm size groups in 2015 over 2014 except for a marked decline in expenditure on ploughing and sowing (through machinery only), FYM, urea, micro-nutrients and weeding. The large size group accounted for highest gross return (main product + by-product) of Rs.21,129.63 per acre followed by the marginal & small (Rs.18,849.21 per acre) and medium size group (Rs.18,495.90 per acre) with an overall gross return of Rs.18,820 per acre during 2015 while in 2014, the large size group accounted for highest gross return of Rs.19,398.49 per acre followed by the marginal & small (Rs.17,693.89 per acre) the medium size group (Rs.17,158.07) and with an overall total gross return of Rs.17,623.82 per acre. In terms of net return, the highest amount of Rs.5,299.04 per acre was recorded against the large size group followed by the marginal & small (Rs.3,132.97 per acre) and the medium size group (Rs. 2,664.70 per acre) with an overall net return of Rs3,081.80 during 2015 while in 2014, the highest net return of Rs.3,964.87 per acre was found against the large size group followed by the marginal & small (Rs.2,344.98 per acre) and the medium farm size group (Rs.1,792.36 per acre) with an overall net return of Rs. 2,270.68 per acre.

Combining paddy and jute farmers, the usage of inputs and return per acre in terms of rupees across the farm size groups during 2014 and 2015 are presented in Table-3.5.3. Amongst the farmers, marginal & small size group accounted for the highest expenditure of Rs.2, 307.48 per acre in 2015 and Rs.2, 178.11 per acre in 2014 on ploughing and sowing operations (accomplished by machines only). The lowest expenditure of Rs.1, 560.35 per acre and Rs.1,417.47 per acre were found in 2015 and 2014, respectively against the large size group. At overall level, it stood at Rs.2,189.67 per acre in 2015 and Rs.2,056.62 per acre in 2014. The cost incurred on seeds and seedlings remained almost same across the farm size groups in the reference years. At overall level, the seeds and seedling cost stood at Rs.585.73 per acre in 2015 and

Rs.495.85 per acre in 2014. The large farm size group accounted for highest expenditure of Rs.308.22 per acre in 2015 and Rs.329.09 per acre in 2014 on organic and FYM. At overall total, the cost on organic & FYM was Rs.285.00 per acre in 2015 and Rs.321.00 per acre in 2014. The cost incurred on urea/ NCU was between Rs.312.33 per acre and Rs.341.39 per acre with an overall average of Rs.332.49 per acre in 2015 while in 2014, it was between Rs. 437.72 and Rs.459.65 per acre with an overall average of Rs.442.64 per acre, revealing higher expenditure over 2015. The highest expenditure of Rs.1,133.33 per acre was recorded on chemical fertilizer other than urea and NCU against the large farm size group in 2015 and the corresponding figure for 2014 was Rs.1, 208.79 per acre against the same size group. The lowest expenditure of Rs. 783.28 and Rs.862.66 per acre for chemical fertilizers were recorded in 2015 and 2014, respectively against medium size group. At overall level, the expenditure on chemical fertilizer stood at Rs.910.27 per acre in 2015 and Rs.943.45 per acre in 2014. No expenditure was incurred on micro-nutrient by the large farm size group in the reference years. The overall expenditure on micronutrient was Rs.177.11 per acre in 2015 and Rs. 152.44 per acre in 2014. The overall expenditure on plant protection chemicals was Rs.199.10 per acre in 2015 which was less than the previous year cost (Rs.207.76). During 2015, the highest irrigation charges of Rs. 579.98 per acre was found against the large farm size group and the lowest (Rs.476.34 per acre) was found against the small & marginal size group with an overall average of Rs.488.60 per acre. In 2014, the highest amount of irrigation charges (Rs.489.27 per acre) was found against the medium size group and the lowest (Rs.418.66 per acre) against the small & marginal size group and at aggregate level, it stood at Rs 434.32 per acre which was little lower than that of the following year (2015).

In 2015, the labour cost of weeding ranged from Rs.1,167.89 to Rs.1,330.43 per acre across the farm size groups with an overall average of Rs.1,288.59 per acre while in 2014, it ranged from Rs.1,268.59 to 1,346.28 per acre across the farm size groups with an overall average of Rs.1,306.74 per acre. At overall level, the expenditure on harvesting & threshing stood at Rs.3,063.66 per acre in 2015 and Rs.2,874.62 per acre in 2014. The cost of hired labour charges (including ploughing charges till planting, cost of sowing/transplanting) ranged between Rs.1,559.58 and Rs.1,639.48 per acre among different

Table- 3.5.3
Input use, output and returns per acre realized by paddy and jute farmers together

(Rs. per acre)

Sl. No.	Particular	2015				2014			
		Marginal & Small	Medium	Large	On average	Marginal & Small	Medium	Large	On average
1	Ploughing and sowing charges (only machinery)	2,307.48	1,802.48	1,560.35	2,189.67	2,178.11	1,660.68	1,417.47	2,056.62
2	Seed cost/ purchase of seedlings	592.52	551.49	709.60	585.73	491.47	511.65	498.38	495.85
3	Organic/FYM	289.80	265.58	308.22	285.00	326.13	301.66	329.09	321.00
4	Urea/NCU	330.49	341.39	312.33	332.49	437.72	459.65	455.32	442.64
5	Chemical fertilizers (Other than Urea/NCU)	940.24	783.28	1,133.24	910.27	959.86	862.66	1,208.79	943.20
6	Micro-nutrients	168.42	222.30	0.00	177.11	146.94	184.31	0.00	152.54
7	Plant protection chemicals	198.83	200.10	199.20	199.10	207.25	209.31	212.07	207.76
8	Irrigation charges	476.34	526.97	579.98	488.60	418.66	489.27	463.99	434.32
9	Weeding/ Weedicides	1,279.67	1,330.43	1,167.89	1,288.59	1,296.68	1,346.28	1,268.59	1,306.74
10	Harvesting & threshing charges	3,186.75	2,576.78	3,513.31	3,063.66	2,990.63	2,420.96	3,281.04	2,874.62
11	Hired labour charges (including ploughing charges till planting, cost or sowing/ transplanting)	1,559.58	1,639.48	1,598.79	1,576.99	1,415.34	1,490.64	1,457.52	1,431.94
12	Imputed value of family labour	1,932.18	2,142.24	2,091.70	1,978.82	1,823.78	2,057.00	1,983.10	1,875.65
13	Hired labor (amount paid)	1,557.78	1,300.67	1,445.18	1,501.98	1,476.20	1,253.10	1,366.54	1,427.26
14	Maintenance costs on assets used for the reference crop	82.70	82.87	94.61	82.92	75.37	76.62	88.91	75.84
	Total paid-out costs including imputed value of own labour	14,902.77	13,766.06	14,714.41	14,660.93	14,244.14	13,323.80	14,030.82	14,045.99
	Returns								
1	Output (Main product)	16,186.76	16,392.70	16,202.13	16,230.28	15,040.69	14,939.30	15,231.71	15,022.23
2	By product	2,507.81	2,674.39	2,574.34	2,543.86	2,249.78	2,350.84	2,363.41	2,272.96
3	Gross returns	18,694.57	19,067.09	18,776.47	18,774.14	17,290.46	17,290.15	17,595.12	17,295.19
4	Net returns	3,791.80	5,301.03	4,062.06	4,113.21	3,046.32	3,966.35	3,564.30	3,249.20

Source: Primary Survey

farm size groups with an overall average of Rs. 1,576.99 during 2015 while in 2014, it was recorded between Rs.1,415.34 and Rs.1,490.64 per acre among different farm size groups with an overall average of Rs.1,431.94 per acre. The cost of imputed family labour ranged between Rs.1,932.18 and Rs.2,142.24 per acre among different farm size groups, with an overall average of Rs.1,978.82 during 2015 while in 2014, it occurred between Rs.1,823.78 and Rs.2,057.00 per acre among different farm size groups, with an overall average of Rs.1,875.65 per acre. The cost of hired labour other than the family labour charges, was recorded between Rs.1,300.67 and Rs.1,557.78 per acre among different farm size groups with an overall average of Rs.1,501.98 per acre in 2015 while in 2014, it ranged between Rs.1,253.10 and Rs.1,476.20 per acre with an overall average of Rs.1,427.26 per acre. The overall maintenance cost on assets used for the reference crop was Rs. 82.92 in 2015 and Rs.75.84 in 2014. The total paid-out costs including imputed value of own labour for the reference crop was recorded at Rs.14,902.77 for the marginal & small size group, Rs.13,766.06 per acre for medium group and Rs. 14,714.41 per acre for the large size group with an overall average of Rs.14,660.93 per acre during 2015 while in 2014, it was recorded at Rs.14,244.14 for the marginal & small size group, Rs.13,323.80 for the medium size group and Rs. 14,030.82 per acre for the large size group with an overall average of Rs.14,045.99 per acre. It has been observed that the total paid-out cost was higher in 2015 across the farm size groups as compared to the year 2014.

The medium size group accounted for highest gross return (main product + by-product) of Rs.19,067.09 per acre followed by the large size group (Rs.18,776.47 per acre) and marginal & small size group (Rs.18,694.57 per acre) with an overall gross return of Rs.18,774.14 per acre during 2015 while in 2014, the large size group accounted for the highest gross return (Rs.17,595.12 per acre) followed by marginal & small (Rs.17,290.46 per acre) and the medium size group (Rs.17,290.15 per acre) with an overall gross return of Rs.17,295.19 per acre. The highest amount of net return (Rs. 5,301.03 per acre) was recorded against the medium size group followed by large (Rs.4,062.06 per acre) and the small & medium size group (Rs. 3,791.80 per acre) with an overall net return of Rs. 4,113.21 during 2015 while in 2014, the highest net return of Rs.3,966.35 per acre was found against the medium size group followed by the large

size group (Rs.3,564 per acre) and the marginal & small farm size group (Rs.3,046.32 per acre) with an overall net return of Rs. 3,249.20 per acre.

The overall quantity of inputs and value thereof, together with net return realized per acre in paddy and jute by the sample farmers during 2014 and 2015 are presented in Table-3.5.4.

In case of paddy during 2014, the amount of cost incurred was Rs.2,364.55 per acre on ploughing and Rs.583.02 per acre (20.14 kg per acre) on seeds/seedling, Rs.193.62 per acre on organic/FYM, Rs.488.79 per acre (68.86 kg) on urea/NCU, Rs.1,072.91 per acre (74.31 kg) on chemical fertilizer other than urea/NCU, Rs.178.47 per acre (4.96 kg) on micro-nutrient, Rs.231.26 per acre on plant protection chemical, Rs.578.82 per acre on irrigation charges, Rs.1,342.25 per acre on weeding and weedicides, Rs.1502.06 per acre on harvesting & threshing, Rs.1,879.03 per acre (11.74 man-days per acre) on imputed value of family labour, Rs. 1,322.95 per acre (8.27 man-days) on hired labour and Rs. 85.72 per acre on maintenance of assets used for reference crop. The sum total of paid-out cost stood at Rs.13, 611.08 per acre. The quantity of main product was 1334.95 kg per acre and the by-product amounts to 867.72 kg per acre. The gross return from paddy (main product +by-product) stood at Rs. 17,185.85 per acre and the net return at Rs.3, 574.77 per acre during the year.

In 2015, the cost incurred in paddy was Rs.2,534.48 per acre on ploughing, Rs.690.62 per acre (19.73 kg) on seeds/seedling, Rs.205.17 per acre on organic/FYM, Rs.360.09 per acre (46.56 kg) on urea/NCU, Rs.986.15 per acre (64.43 kg) on chemical fertilizer other than urea/NCU per acre, Rs.209.32 per acre (5.61 Kg) on micro-nutrient per acre, Rs.223.25 per acre on plant protection chemical, Rs.650.09 per acre on irrigation charges, Rs.1,314.16 per acre on weeding and weedicides, Rs.1,696.51 per acre on harvesting & threshing, Rs.1,964.14 per acre on hired labour, Rs.1,973.70 per acre (10.97 man days) on imputed value of family labour, Rs. 1,404.91 per acre (7.81 man days) on hired labour and Rs. 92.15 per acre on maintenance of assets used for reference crop. The sum total of paid-out cost stood at Rs.14,304 per acre. The gross return from jute stood at Rs. 18,758.96 (main product 1375.59 kg per acre + by product 894.13 kg per acre) and the net return at Rs.4,454.12 per acre during 2014. In 2015, increase

Table -3.5.4
Input use, output and returns per acre realized by Paddy & Jute farmers

(Rs. per acre)

Sl. No.	Particular	Paddy				Jute			
		2014		2015		2014		2015	
	Input use and their costs	Qty (in Kg)	Value (in Rs.)	Qty (in Kg)	Value (in Rs.)	Qty (in Kg)	Value (in Rs.)	Qty (in Kg)	Value (in Rs.)
1	Ploughing and sowing charges (only machinery)		2,364.55		2,534.48		1,131.11		1,146.44
2	Seed cost/ purchase of seedlings	20.14	583.02	19.73	690.62	3.12	233.87	3.14	268.38
3	Organic/FYM		193.62		205.17		703.85		526.53
4	Urea/NCU	68.86	488.79	46.56	360.09	42.88	303.92	32.55	249.00
5	Chemical fertilizers (Other than Urea/NCU)	74.31	1,072.91	64.43	986.15	49.48	553.36	57.52	680.70
6	Micro-nutrients	4.96	178.47	5.61	209.32	2.07	74.60	2.07	79.65
7	Plant protection chemicals		231.26		223.25		137.14		126.06
8	Irrigation charges		578.82		650.09		0.00		0.00
9	Weeding/ Weedicides		1,342.25		1,314.16		1,200.00		1,211.20
10	Harvesting & threshing charges		1,502.06		1,696.51		7,000.00		7,200.00
11	Hired labour charges (including ploughing charges till planting, cost or sowing/ transplanting)		1,787.63		1,964.14		362.90		405.65
12	Imputed value of family labour	11.74	1,879.03	10.97	1,973.70	11.66	1,865.48	11.08	1,994.30
13	Hired labor (amount paid)	8.27	1,322.95	7.81	1,404.91	10.88	1,740.75	9.98	1,795.68
14	Maintenance costs on assets used for the reference crop		85.72		92.25		46.15		54.70
	Total paid-out costs including imputed value of own labor		13,611.08		14,304.84		15,353.14		15,738.29
Returns									
1	Output (Main product)	1334.95	14,409.14	1375.59	15,629.49	867.29	16,864.95	882.42	18,047.98
2	By product	867.72	2,776.71	894.13	3,129.47	303.55	758.87	308.85	772.11
3	Gross returns		17,185.85		18,758.96		17,623.82		18,820.09
4	Net returns		3,574.77		4,454.12		2,270.68		3,081.80

Source: Primary Survey

was seen on input cost and output over 2014 except for Urea/NCU, chemical fertilizer other than urea/NCU and plant protection (Table-3.5.4).

In 2014, in case of jute, the amount of cost incurred per acre was Rs.1,131.11 on ploughing, Rs.233.87 (3.12 kg per acre) on seeds/seedling, Rs.703.85 on organic/FYM, Rs.303.92 (42.88 kg per acre) on urea/NCU, Rs.553.36 (49.48 kg per acre) on chemical fertilizer other than urea/NCU, Rs.74.60 per acre (2.07 kg) on micro-nutrient, Rs.137.14 per acre on plant protection chemical, Rs.1,200.00 per acre on weeding and weedicides, Rs.7,000.00 per acre on harvesting & threshing, Rs.362.90 per acre on hired labour charges, Rs. 1,865.48 per acre (11.66 man-days) on imputed family labour, Rs. 1,740.75 per acre (10.88 man days) on hired labour and Rs. 46.15 per acre on maintenance of assets used for reference crop. The sum total of paid-out cost stood at Rs.15, 353.14 per acre. The quantity of main product was 867.29 kg per acre and the by-product 303.55 kg per acre. The gross return from jute (main product +by-product) stood at Rs. 17,623.82 per acre and the net return at Rs.2, 270.68 per acre during the year.

In 2015 for jute crop, the paid-out cost & productivity of main product and by product per acre were found to be higher than the previous year (2014) for which gross return and net return were recorded in higher side. The amount of cost incurred was Rs.1,146.44 per acre on ploughing, Rs.268.38 per acre (3.14 kg per acre) on seeds/seedling, Rs.526.53 per acre on organic/FYM, Rs.249.00 per acre (32.55 kg) on urea/NCU, Rs.680.70 per acre (57.52 kg) on chemical fertilizer other than urea/NCU, Rs.79.65 per acre (2.07 kg) on micro-nutrient, Rs.126.06 per acre on plant protection chemicals, Rs.1,211.20 per acre on weeding and weedicides, Rs.7,200.00 per acre on harvesting & threshing, Rs.405.65 per acre on hired labour charges, Rs. 1,994.30 per acre (11.08 man-days) on imputed family labour, Rs. 1,795.68 per acre (9.98 man days) on hired labour and Rs. 54.70 per acre on maintenance of assets used for reference crop. The sum total of paid-out cost stood at Rs.15,738.29 per acre. The production of main product was 882.42 kg per acre and the by-product was 308.85 kg per acre. The gross return from jute (main product +by-product) stood at Rs. 18,820.09 per acre and the net return at Rs.3, 081.80 per acre during the year.

3.6 Details of Agricultural Credit Availed

Table-3.6.1 indicates different sources of credit and the amount of credit availed by the sample households in the study area.

Tables- 3.6.1
Credit details of farmers during the reference period

(Rs per household)

Sl. No	Sources	Paddy	Jute	Overall
Institutional sources				
1	Commercial Banks	755.00	595.00	675.00
2	Co-operative societies	2,180.00	1,605.00	1,892.50
3	Regional Rural Bank	720.00	397.50	558.75
4	Non-Institutional sources	0.00	0.00	0.00
5	Money lenders	0.00	0.00	0.00
6	Friends & relatives	0.00	0.00	0.00
7	Traders/commission agent	0.00	0.00	0.00
8	Others	0.00	0.00	0.00
	Total	3,655.00	2,597.50	3,126.25

Source: Primary Survey

From the table 3.6.1, it has been observed that some of the sample households availed credit from 3 different institutional sources viz., Commercial Banks, Co-operative Societies and Regional Rural Bank. In paddy sample farmers, on an average, the amount of credit per household was of Rs.755.00 under the Commercial Banks, Rs.2,180.00 under the Co-operative Societies and Rs.720.00 under the Regional Rural Bank. In jute sample farmers, on an average, the amount of credit per household was of Rs.595.00 under the Commercial Banks, Rs.1,605.00 under the Co-operative Societies and Rs.397.50 under the Regional Rural Bank. Combining paddy and jute samples, the overall amount of credit was of Rs.675.00, Rs.1,892.50 and Rs.558.75 under the Commercial Banks, Co-operative Societies and Regional Rural Bank, respectively. In aggregate per household credit stood at Rs.3,665.00 against the paddy sample farmers and Rs.2,597.50 against the jute sample farmers with an overall credit amount of Rs.3,126.25. The analysis indicates that institutional credit was easily accessible to the sample farmers who were in need of credit and there was no report of non-institutional credit among the farmers in the study areas.

Table- 3.6.2 indicates the purpose of borrowing loan by the paddy and jute sample farmer during the reference period. The one and only purpose of borrowings, as reported by the sample farmers was for seasonal crop cultivation.

Table-3.6.2
Purpose of borrowing loans during the reference period
 (% of farmers & % of amount (Rs/HH))

Sl.No.	Purpose	Paddy	Jute	Overall
1	Seasonal crop cultivation	100.00	100.00	100.00
2	Purchase of tractor and other implements	0.00	0.00	0.00
3	Purchase of livestock-	0.00	0.00	0.00
4	Consumption expenditure	0.00	0.00	0.00
5	Marriage and social ceremonies	0.00	0.00	0.00
6	Non-farm activity	0.00	0.00	0.00
7	Other expenditure	0.00	0.00	0.00

Source: Primary Survey

3.7 Training Programmes Attended on Fertilizers Application

In course of field investigation, questions were asked to know from the sample farmers if they attended any training programme on application of fertilizers organised by any agency. To this query, all of them responded in the negative. It indicates that no training programme or awareness campaign was organised in the study area by any agency, including the State Agriculture Department on application of NCU till the date of survey.

Chapter IV

STATUS OF AWARENESS AND APPLICATION OF NEEM COATED UREA

This chapter deals with the status of awareness and application of the NCU among the paddy and jute respondents across the different farm size groups along with overall observations thereon.

4.1 Awareness & Sources of Information on NCU

Level of awareness among the sample respondents and different sources of information about Neem Coated Urea in different farm size groups are presented in Table-4.1.1. In case of paddy respondents, about 88.07 per cent of the respondents were aware of the use of NCU in the marginal & small size group and in other two groups *i.e.* medium and large size groups, the level of awareness was 100 per cent. In jute sample, nearly 79.65 per cent of the respondents knew all of about NCU in the marginal & small size group while awareness was recorded to be 100 per cent in case of medium and large size groups. Combining both the respondent groups, the level of awareness on NCU was recorded to be 83.91 per cent for marginal & small farmers and 100 per cent in case medium and large size group of farmers.

The main sources of information on the usage of NCU in case of marginal & small size group was reported to be the Agricultural Officers (45.89 per cent) followed by input shop (30.14%), fellow farmers (15.75%), farmer's facilitator (5.48%) and KVK official (2.74%). In case of medium farmers, the principal source of awareness on NCU use was recorded against the Agricultural Officer with 38.78 per cent, followed by input shop (34.69%), fellow farmers (18.37%) and farmer's facilitator (8.16 %) while input shop (100%) was the only source of information on usage of NCU for the large size group of respondents. In the study area, the other sources of information such as, Print & Visual Media, Wall writing, KVK officials, Agricultural University and Company did not play any significant role for bringing awareness on the use of NCU among the sample respondents.

Table – 4.1.1
Awareness and sources of information about
Neem Coated Urea among the sample respondents

(% of farmers)

Sl. No	Sources of Information	Paddy			Jute			Overall		
		Marginal & Small	Medium	Large	Marginal & Small	Medium	Large	Marginal & Small	Medium	Large
	Total no. of sample farmers ->	176	23	1	172	26	2	348	49	3
	No. of farmers aware of NCU ->	155	23	1	137	26	2	292	49	3
	% of farmers aware	88.07	100.00	100.00	79.65	100.00	100.00	83.91	100.00	100.00
Sources of awareness										
1	Agricultural Officer	44.52	39.13	0.00	47.45	38.46	0.00	45.89	38.78	0.00
2	Farmer Facilitator	6.45	8.70	0.00	4.38	7.69	0.00	5.48	8.16	0.00
3	Fellow Farmers	16.13	17.39	0.00	15.33	19.23	0.00	15.75	18.37	0.00
4	Print & Visual media	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Wall Writing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	KVK official	5.16	0.00	0.00	0.00	0.00	0.00	2.74	0.00	0.00
7	Agricultural University	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Input shop	27.74	34.78	100.00	32.85	34.62	100.00	30.14	34.69	100.00
9	Company (suppliers)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Any other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Primary Survey

The respondent farmers differentiated NCU from normal urea based on certain factors, and are presented in Table 4.1.2. At overall level, about 73 per cent of the respondents in the marginal & small size group could mark the differences, where as in case of medium and large size groups, all the sample respondents noticed the differences. To distinguish between NCU and Normal urea, a number of factors were usually considered by the sample farmers, viz., colour difference, price difference and leaf figure on the bag. At overall level, colour difference was the most significant factor for a large majority of the respondents of all the size groups. The colour difference in NCU was identified by 65.41 per cent of the respondents in marginal & small size group. The corresponding figures for medium and large size

groups were responded at 77.55 per cent and 66.67 per cent, respectively. About 18.49 per cent of the respondents in marginal size group and 10.20 per cent of the respondents in medium size group could notice the price differences between the two sets of fertilizers. However, the farmers in the large size group could not ascertain the prices difference. Further, about 16.10 per cent of the respondents in marginal & small size group, 12.24 per cent in medium size group and 33.33 per cent of the respondents in large size group differentiated the NCU from Normal Urea by looking at the leaf (neem) figure printed on the NCU bag. There were no other distinguishing factors to differentiate NCU from Normal Urea as reported by the respondents.

Table- 4.1.2
Differentiating factors of NCU & NU

Sl. No.	Particulars	Paddy			Jute			Overall		
		Marginal & Small	Medium	Large	Marginal & Small	Medium	Large	Marginal & Small	Medium	Large
	% of farmers who could mark the difference	88.07	100.00	100.00	79.65	100.00	100.00	73.00	100.00	100.00
Factors										
1	Colour difference	66.45	69.57	100.00	64.23	84.62	50.00	65.41	77.55	66.67
2	Price difference	22.58	17.39	0.00	13.87	3.85	0.00	18.49	10.20	0.00
3	Leaf figure on the bag	10.97	13.04	0.00	21.90	11.54	50.00	16.10	12.24	33.33
4	Any other (Specify)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Primary Survey

4.2 Status of Application of Urea *vis-a-vis* NCU

Application of NCU in different crops before 2015-16 and after 2015-16 in respect of paddy respondents during *Kharif* season is presented in Table-4.2.1. Out of 200 paddy respondents, 117 sample households also cultivated jute and another 93 cultivated vegetables during the season. It has been observed that no

Table- 4.2.1
Application of NCU across different Crops by Paddy Respondents
(% of farmers)

Sl. No	Name of the crops	Before 2015-16		After 2015-16	
		No	%	No	%
1	Paddy (200)	0	-	179	89.50
2	Jute (117)	0	-	98	83.76
3	Kharif Vegetables (93)	0	-	92	98.92

Source: Primary Survey

Note: Figures in parentheses indicate the total no. of farmers

respondents applied NCU in their crop fields prior to 2015-16 as it was not available in the markets. It entered the market only after 2015-16. Among the paddy respondents, application of NCU was found to the extent of 89.50 per cent in paddy, 83.76 per cent in jute and 98.92 per cent in *Kharif* vegetables during the post 2015-16 period.

Table- 4.2.2
Application of NCU across different Crops by Jute Respondents
(% of farmers)

Sl. No	Name of the crops	Before 2015-16		After 2015-16	
		No	%	No	%
1	Jute (200)	0	-	165	82.50
2	Paddy (200)	0	-	165	82.50
3	<i>Kharif</i> Vegetables (66)	0	-	60	90.91

Source: Primary Survey

Note: Figures in parentheses indicate the total no. of households

The status of application of NCU in different crops before 2015-16 and after 2015-16 in respect of the Jute respondents during *Kharif* season is presented in Table 4.2.2. Of the 200 Jute samples, all households also cultivated Paddy and 66 sample households cultivated Vegetables as well during the reference season. There was no report of using NCU prior to 2015-16 by any of the respondents in case of Jute sample as well. During post 2015-16, 82.50 per cent of the Jute respondents applied NCU in jute and paddy crop each and nearly 90.91 per cent of the vegetable growers applied NCU in their crop field.

Table- 4.2.3
Split doses of NCU / Normal Urea application by sample respondents

(Kgs/Acre)

Sl. No		Paddy				Jute				Overall			
		NCU	%	NU	%	NCU	%	NU	%	NCU	%	NU	%
1	Basal application	13.70	30.00	14.17	23.07	9.35	30.00	2.75	6.58	12.68	30.00	7.20	13.60
2	Vegetative growth	20.09	44.02	20.96	34.13	15.82	50.76	17.60	42.23	20.01	47.33	20.53	38.78
3	After weeding	11.86	25.98	24.59	40.05	6.00	19.24	20.10	48.22	9.58	22.67	23.68	44.74
4	Maturity	0.00	0.00	1.69	2.75	0.00	0.00	1.24	2.97	0.00	0.00	1.52	2.88
5	Any other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	45.65	100.00	61.41	100.00	31.17	100.00	41.69	100.00	42.27	100.00	52.94	100.00

Source: Primary Survey

Table-4.2.3 presents the status of application of NCU/NU in split doses by the sample respondents at different points of time. Combining paddy and jute samples, at overall level, about 30.00 per cent of the total consumption of NCU were

applied at the rate of 12.68 kg per acre as basal application, 47.33 per cent were applied at the rate of 20.01 kg per acre in vegetative growth stage and the rest 22.67 per cent were applied at the rate of 9.58 kg per acre after weeding operations. There was no report of application of NCU at maturity stage. In aggregate, the rate of application of NCU was 42.27 kg per acre.

In case of NU, 13.60 per cent of the total consumption were applied at the rate of 7.20 kg per acre as basal application, 38.78 per cent were applied at the rate of 20.53 kg per acre in vegetative growth stage of the crops, 44.74 per cent were applied at the rate of 23.68 kg per acre after weeding and only 2.88 per cent were applied at the rate of 1.52 kg per acre at maturity stage. In aggregate, application of NU was 52.94 kg per acre.

Table – 4.2.4
Method of Application of NCU/Normal Urea

(Kgs/Acre)

Sl. No	Method of application	Paddy				Jute				Overall			
		NCU qty	%	NU qty	%	NCU qty	%	NU qty	%	NCU qty	%	NU qty	%
1	Broadcasting	45.65	100.00	61.41	100.00	31.17	100.00	41.69	100.00	42.27	100.00	52.94	100.00
2	Spraying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	Fertigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	Drilling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	45.65	100.00	61.41	100.00	31.17	100.00	41.69	100.00	42.27	100.00	52.94	100.00

Source: Primary Survey

Generally, there are 4 different methods of application of NCU and Normal Urea viz., Broadcasting, Spraying, Fertigation and Drilling (Table-4.2.4). Among the four methods, all the sample respondents (100%) applied NCU & NU by adopting broadcasting method only. The rate of application of NCU was 42.27 kg per acre and the rate of application of NU was 52.94 kg per acre.

Table -4.2.5
Comparative Use of NCU versus Normal Urea

(Kgs/acre)

Sl. No.	Particulars	2014			2015		
		Paddy	Jute	Overall	Paddy	Jute	Overall
1	NCU quantity applied	0.00	0.00	0.00	45.65	31.17	42.27
2	NU quantity applied	68.83	42.88	62.35	61.41	41.69	52.94
3	Productivity on application of NCU (kg/acre)	-	-	-	1,379.60	885.79	1,264.27
4	Productivity on application of NU (kg/acre)	1,334.33	867.30	1,217.78	1,309.95	860.12	1,116.74
5	Output per unit of NCU or NU applied	19.39	20.22	19.53	30.22	28.42	29.91
		NU			NCU		

Source: Primary Survey

Table-4.2.5 gives the relative use of NCU versus Normal Urea in paddy and jute crop during 2014 and 2015. There was no use of NCU in 2014 as it was not available in the markets in the sample areas. Only normal urea was applied at the rate of 68.86 kg per acre in paddy and 42.88 kg per acre in jute crop during 2014. In 2015, farmers applied both NCU as well as NU in their crop fields. In 2015, the rate of application of NCU was 45.65 kg per acre in paddy and 31.17 kg per acre in jute crop with an overall average of 42.27 kg per acre. As against this, the rate of application of NU was 61.41 kg per acre in paddy and 41.69 kg per acre in jute with an overall figure of 52.94 kg per acre. Obviously, the amount NCU was much less than that of NU. On use of NCU the productivity of paddy was recorded at 1,379.60 kg per acre and that of jute was 885.79 kg per acre with an overall productivity of 1,264.27 kg per acre during 2015, while by using NU, the productivity of paddy was recorded at 1,334.33 kg per acre and 867.30 kg per acre in case of jute with a productivity of 1,217.78 kg per acre during 2014. In 2015 by using NU, the productivity attained was 1,309.95 kg per acre in paddy and 860.12 kg per acre in jute with an overall average 1,116.74 kg per acre. The output per unit of NU was 19.39 kg for paddy and 20.22 kg for jute with an aggregate of 19.53 kg per acre in 2014. In 2015, the output per unit of NCU was 30.22 kg for paddy and 28.42 kg for jute with an overall average of at 29.91 kg per acre.

4.3 Perception of Farmers about NCU and its Benefits as compared to Normal Urea

Table-4.3.1 highlights the perceptions of the farmers about NCU and its benefit as compared to normal urea. In this regard, considered opinions of the respondents were obtained and all these attributes were expressed in terms of percentage to grasp the farmers' perception on NCU and its benefits. Accordingly, about 15.08 per cent of the paddy respondents found the quality of NCU to be very good; 78.77 per cent reported to be good only; 2.79 per cent reported as bad and 3.35 per cent reported that there was no change in quality. In case of jute respondents, nearly 15.15 per cent of the sample farmers found the quality of NCU to be very good; 75.76 per cent reported as good; 3.64 per cent as bad and 5.45 per cent commented that there was no change in quality. At overall level, about 15.12 per cent of the farmers reported as very good; 77.33 per cent reported as good; 3.20 per cent commented as bad and 4.36 per cent reported as no change in quality. On the availability of NCU in the market, at overall level, only 12.79 per cent of the

respondents faced the problem of inadequacy or shortage. About 87.21 per cent sample respondents opined that NCU was made available on time.

The price of NCU, at overall level, was not found to be very high, as reported by the sample farmers. About 32.56 per cent of the respondents found it to be high and 67.44 per cent found it to be not very high.

Table – 4.3.1
Perception about NCU versus Normal Urea

Sl. No	Particulars	Paddy		Jute		Overall	
		No	%	No	%	No	%
1	Neem Coated Urea quality						
	Very good	27	15.08	25	15.15	52	15.12
	Good	141	78.77	125	75.76	266	77.33
	Bad	5	2.79	6	3.64	11	3.20
	No change	6	3.35	9	5.45	15	4.36
2	Neem Coated Urea availability						
	Adequate	155	86.59	145	87.88	300	87.21
	Inadequate	24	13.41	20	12.12	44	12.79
	No change	0	0.00	0	0.00	0	0.00
3	Timely availability of Neem Coated Urea						
	Yes	155	86.59	145	87.88	300	87.21
	No	24	13.41	20	12.12	44	12.79
4	Neem Coated Urea Price						
	Very high	0	0.00	0	0.00	0	0.00
	High	52	29.05	60	36.36	112	32.56
	Not very high	127	70.95	105	63.64	232	67.44
	Same as urea	0	0.00	0	0.00	0	0.00
5	Benefits of NCU in terms of total fertilizer usage						
	Increased	54	30.17	4	2.42	58	16.86
	Decreased	125	69.83	161	97.58	286	83.14
	No Change	0	0.00	0	0.00	0	0.00
6	Benefits of NCU in terms of Urea usage over NU						
	Increased	0	0.00	0	0.00	0	0.00
	Decreased	179	100.00	165	100.00	344	100.00
	No Change	0	0.00	0	0.00	0	0.00
7	Pest and diseases attack						
	Increased	0	0.00	30	18.18	30	8.72
	Decreased	91	50.84	89	53.94	180	52.33
	No Change	88	49.16	46	27.88	134	38.95
8	NCU is more easily accessible in the market compared to normal Urea						
	Yes (reason)	179.00	100.00	165.00	100.00	344.00	100.00
	No	0.00	0.00	0.00	0.00	0.00	0.00

Source: Primary Survey

Only 16.86 percent of the sample respondents reported that the total fertilizer usage was increased with the application of NCU. As against this, 83.14 per cent of the sample farmers observed that the total fertilizer requirement/ usage

declined with the use of NCU. Further, all the sample households (100 per cent) reported that there was a marked decrease in quantity requirement when NCU was used in the field. Only 8.72 per cent of the respondents reported that the application of NCU increased the incidence of pests & diseases in their crop field. As against this, about 52.33 per cent of the respondent farmers opined that use of NCU, had decreased the incidence of pests & diseases. However, 38.95 per cent farmers reported that there were no changes in disease/ pest incidence status.

The field survey also reflects that NCU was readily available in the market, and was corroborated by all the sample respondents.

Table-4.3.2 presents the comparative advantages of NCU over Normal Urea in the cases of paddy and jute crop. It is seen from the table that with the application of NCU there was an increase in the yield rate of both the crops. About 54.75 per cent of the paddy farmers observed an increase in yield rate while 45.25 per cent could not find any change in yield rate. In case of jute, about 63.03 per cent of jute farmers reported increase in yield rate while about 36.97 per cent could not find any change in yield rate. The extent of increase in yield was recorded at 3.82 per cent for paddy and 2.99 per cent for jute. For both the crops, all the farmers (NCU users) derived extra benefit through reduction in the cost of pest and disease control, weed management and cost of NCU and other fertilizers. With the application of NCU, the cost involved in pest & disease control was reduced substantially as reported by the majority of the farmers (50.84 per cent for paddy and 54.03 per cent for jute respondents). And the extent of decline in cost was 7.34 and 20.03 per cent, respectively. Similarly, the cost of weed management was also reported to be reduced in case of paddy with the application of NCU. In final analysis, the cost of NCU was found to be lower as compared to normal urea (NU) for both the crops as observed by all the sample households (100 per cent). Similar trend was witnessed in case of other fertilizers as well.

However, the respondents did not visualize any change in soil health, grain quality (grain) or market acceptability of grains, *etc.*,

Table 4.3.2
Comparative Benefits of NCU (2015) over Normal Urea (2014)

(% of farmers)

Sl. No	Particulars	Paddy					Jute				
		Increased	Decreased	No change	Extent of Increase (%)	Extent of Decrease (%)	Increased	Decreased	No change	Extent of Increase (%)	Extent of Decrease (%)
1	Yield (quintals)	54.75	0.00	45.25	3.82	-	63.03	0.00	36.97	2.99	-
2	Cost of pest and disease control (Rs)	-	50.84	49.16	-	7.34	18.18	53.94	27.88	9.24	20.03
3	Weed management (Rs)	18.99	49.16	31.84	5.20	6.15	24.85	0.00	75.15	4.17	-
4	Cost of NCU compared to Urea (Rs)	0.00	100.00	0.00	-	27.16	-	100.00	-	-	26.33
5	Cost of other fertilizers (Rs)	30.17	69.83	0.00	2.45	8.22	2.42	97.58	0.00	12.43	4.52
6	Improvement in soil health	0.00	0.00	100.00	-	-	0.00	0.00	100.00	-	-
7	Quality of grain	0.00	0.00	100.00	-	-	0.00	0.00	100.00	-	-
8	Market acceptability of grain	0.00	0.00	100.00	-	-	0.00	0.00	100.00	-	-

Source: Primary Survey

4.4 Diversions of Urea & NCU Other than Crop Purposes

Diversion of Normal Urea & NCU for other uses (other than crop purposes) is a major issue before the Government. It is a fact that normal urea can be used for other industrial purposes also. It can be used as Silages (Feed preparation for animals), also can be used for mixing with weedicides, fish feed preparation and a number of other purposes. But in the study area, there was no such report of diversion of Urea & NCU other than crop purposes.

4.5 Constraints and Suggestions about NCU and its Adoption

About 46.93 per cent of the paddy farmers and 76.97 per cent of the jute farmers expressed their ignorance about the recommended doses of NCU. Also, 53.07 per cent of the paddy farmers and 23.05 per cent of the jute farmers lacked knowledge on comparative advantages of NCU over NU.

Table -4.5.1
Major problems faced in adoption of NCU fertilizer

Sl. No	Problems	(% of farmers)		
		Paddy	Jute	Overall
1	Lack of information about recommended dose of NCU	46.93	76.97	61.34
2	Lack of knowledge of the farmers on advantages of NCU over NU	53.07	23.03	38.66

Source: Primary Survey

Since NCU is a recent introduction to the crop field of Assam, it is natural to come across a number of problems and difficulties by the farmers. On the basis of the feedback obtained from the sample farmers, one can readily identify two major areas of concern *viz.* information gap and lack of motivation.

To overcome the above constraints, some suggestions were put forwarded by the sample respondents presented in Table-4.5.2. In aggregate about 59.21 per cent of respondents opined to hold awareness training camp on benefits of NCU and its use

Table 4.5.2: Major suggestions for improving the NCU fertilizers usage

Sl.No	Suggestions	(% of farmers)		
		Paddy	Jute	Overall
1	Awareness training camp on benefits of NCU and its use is a must among the farmers by the Agri. Deptt.	61.45	56.97	59.21
2	Price of NCU should be decreased	27.37	35.76	31.57
3	NCU Should be made available in all the seasons	11.17	7.27	9.22

Source: Primary Survey

amongst the farmers by the State Agri. Deptt. About 31.57 per cent of the respondents suggested for reducing the price of NCU and about 9.22 per cent of the sample respondent suggested for making NCU readily available in all seasons of the year.

As the normal urea is being replaced gradually by NCU in the market, the farmers of the study area have to adopt the changes sooner or later. But they need to be educated on

scientific application of NCU. Once they come to know the comparative advantages of NCU, they would automatically get motivated to go ahead with the new package of practices.

Chapter V

AWARENESS AND ADOPTION LEVEL OF SOIL TESTING TECHNOLOGY

5.1 Soil Health Related Programmes and Schemes - Implementation and Performance in the State

“Earth needs to be nurtured with mother’s care because Earth gives us everything for sustaining life”. So any kind of torture on it is a sin.

The soils of Assam are acidic in nature. The productivity potential of soil generally is limited. Together with cultivation of crops for years, the soils need to be replenished periodically. As such, soil scientists have already developed suitable strategy to overcome the

natural constraints of soil in order to maintain and improve the productivity potential. It simply needs proper implementation of those lines of action put forwarded by the soil scientists in order to reap a good harvest year after year.

Soil health, in recent time, has become an important consideration throughout the globe for sustainable agricultural development. Knowing the status of soil condition, on the part of the farmers, therefore, bears much significance in the present day context. In excess and inadequate usage of fertilizer has a negative impact on crop production and soil health as well. In this regard, introduction of Soil Health Card Programme is an important initiative for better crop productivity without causing much disturbance to the natural soil structure. Food security of the country is strictly associated with soil health. Prior to the nation-wide programme on SHC launch by the GOI, the State Department of Agriculture implemented the soil testing programme in the state owned and privately owned soil testing laboratories. As per report of the Economic Survey of Assam, these soil testing laboratories have the capacity of analyzing 9000 soil samples in a year. Available records indicate that the Directorate of Agriculture, Govt. of Assam and the Department of Soil Science, Assam Agricultural University have also implemented the soil testing scheme under the RKVY(Rashtriya Krishi Vikash Yojana) as well.

As per report of the Directorate of Agriculture, Government of Assam has so far issued 64,168 Soil Health Card (SHC) up to Aug/2016 to the farmers of different districts of Assam under the new policy of the Government of India. The district wise distribution of SHC is presented in Table-5.1.1

Table- 5.1.1
Soil Health Card Status

Sl. No.	District	Soil Health Card Distributed (Nos.)	Soil Health Card Distributed (Nos.)	Soil Health Card Distributed (Nos.)
		(up to April, 2016 from April, 2015)	(up to August, 2016 from April, 2016)	(up to August, 2016 from April, 2015)
1	Kokrajhar	750	1,501	2,251
2	Chirang	500	1,250	1,750
3	Karimganj	250	1,500	1,750
4	Hailakandi	50	11	61
5	Nalbari	250	1,518	1,768
6	Baksa	250	1,250	1,500
7	Kamrup(M)	50	408	458
8	Morigaon	250	1,058	1,308
9	Barpeta	250	1,715	1,965
10	Kamrup(R)	750	1,635	2,385
11	Dhubri	276	1,250	1,526
12	Goalpara	951	0	951
13	Bongaigaon	250	1,343	1,593

14	Darrang	250	1,692	1,942
15	Nagaon	1,050	1,924	2,974
16	Sonitpur	1,502	2,752	4,254
17	Lakhimpur	250	1,013	1,263
18	Dhemaji	250	1,250	1,500
19	Tinsukia	750	1,602	2,352
20	Dibrugarh	750	1,498	2,248
21	Sibsagar	250	1,304	1,554
22	Jorhat	2,250	16,188	18,438
23	Golaghat	754	1,672	2,426
24	Karbi Anglong	754	1,500	2,254
25	Dima Hasao (N.C. Hills)	248	0	248
26	Cachar	252	1,549	1,801
27	Udalguri	250	1,398	1,648
Total		14,387	49,781	64,168

Source : Directorate of Agriculture, Govt. of Assam

The SHCs are prepared on the basis of soil test undertaken on 14 parameters *viz.*, Zn, Cu, Fe, Mn, S, B, pH, Organic carbon, N, P, K, Minerals (Soluble), structure of the soil and lime requirement. In consideration of poor infrastructure facilities particularly in Govt. owned soil testing laboratories, the State Govt. has decided to outsource the entire job to the private players to expedite the process. It is seen from the table that the highest number of SHCs (18,438) were distributed in Jorhat district and the lowest (61) in Hailakandi district of Assam up to August, 2016 from April, 2015. Clearly, the State has to do a lot to accomplish the herculean task of covering 37.31 lakh farmers of the State.

In addition to this, Assam Agricultural University, Jorhat has distributed 37,000 SHCs (as on August, 2016) through 23 KVKs across the State under the RKVY programme. The cards were prepared based on 9 different parameters *viz.*, N, P, K, S, Zn, B, Organic Carbon (OC), pH and Lime Requirement.

5.2 Awareness on Soil Testing

To see the awareness on soil testing, the sample farmers were interviewed to know the sources of information for such initiative, if any, and the responses obtained are presented in Table-5.1.2. It has been observed that the common sources *viz.*, State Agricultural Universities (SAUs), Krishi Vigyan Kendras (KVKs), Private Companies, Friends and Neighbours did not play any significant role to make the farmers aware of the benefits of soil testing in the study area. The Department of Agriculture (100%) was the only source of information about soil testing, as reported by the farmers. Out of a total sample of 200 farmers for each crop, only 22 paddy respondents and 13 jute respondents went for soil testing in the study area.

Table 5.1.2
Different sources of information about soil testing and soil sample collection

[% of farmers who got tested their soil (opinion based on 22 farmers for paddy and 13 farmers for Jute)]

Sl. No	Sources of information about soil testing	Paddy	Jute	Overall
1	State Agricultural Universities (SAUs)	0.00	0.00	0.00
2	Krishi Vigyan Kendras (KVKs)	0.00	0.00	0.00
3	Private Companies	0.00	0.00	0.00
4	Friends	0.00	0.00	0.00
5	Neighbors	0.00	0.00	0.00
6	Agriculture Department	100.00	100.00	100.00
	Who collected the soil Sample			
7	Self	4.55	0	2.86
8	Officials of the State Department of Agriculture	63.64	53.85	60.00
9	Farmer Facilitator	31.82	46.15	37.14
10	Other (Specify)	0.00	0.00	0.00

Source: Primary Survey

In course of field investigation, it was revealed that in case of paddy respondents, 4.55 per cent of the farmers collected the soil sample by themselves. But no jute farmers were reported to collect the samples on their own. The officers in the State Department of Agriculture collected about 63.64 per cent samples in paddy crop and 53.85 per cent in jute crop with an overall average 60.00 per cent of the total farmers. Farmer Facilitators in the study area also collected soil samples to the extent of 31.82 per cent in paddy and 46.15 per cent in jute crop, with an overall average of 37.14 per cent across the crops.

5.3 Details of Soil Testing

Despite knowing the importance of soil testing techniques, only a small portion of the farmers got their soils tested in the study area and that too, was done within last 3 years only. Other details of the soil testing status are presented in Table-5.3.1. From the table, it has been observed that during last 3 years, only 11 per cent of the paddy farmers and 6.50 per cent of the jute farmers got their soil testing done. And the entire sample farmers for both the crops went for the soil testing only for once. Further, there was no report of incurring any cost towards soil testing by the farmers in the study area.

Table- 5.3.1
Details of soil testing done by the respondents

(% of farmers who tested their soil)

Sl. No	Particulars	Within 3 yrs		Before 3 yrs	
		Paddy	Jute	Paddy	Jute
	Number of farmers who have done soil testing	22	13	0	0
	% of farmers who opted for soil testing	11.00	6.50	0.00	0.00
1	Number of times soil testing done	1.00	1.00	0.00	0.00
3	Cost of soil testing (Rs/sample)	0.00	0.00	0.00	0.00
4	Distance from field to soil testing lab (Avg. Km)	141.73	141.08	0.00	0.00
5	Samples taken for soil testing (Nos.)	33.00	21.00	0.00	0.00
6	Area covered under soil test (all plots) (Acres)	23.47	16.03	0.00	0.00

Source: Primary Survey

On an average, the distance to the soil testing laboratory from the field was nearly 141 km for both the sample respondents. The number of soil samples taken for soil testing was 33 in case of paddy and 21 in case of jute and the area covered under soil test was 23.17 and 16.03 acres for paddy and jute samples, respectively.

5.4 Reasons for Soil Testing or Not Testing

The reasons to go for soil testing as cited by the sample respondents are presented in Table-5.4.1. In this regard, the farmers' perceptions for soil testing were graded as, most important, important and least important. In case of paddy samples about 68.18 per cent considered it as most important and 31.82 per cent considered it as important. In case of jute samples, about 76.92 per cent and 23.08 per cent considered it as most important and important, respectively. At overall level 71.43 per cent considered soil testing is most important and the remaining 28.57 per cent deemed it to be important. It was noted that none of the farmers in the locality considered the soil testing to be least important despite the fact that they did not know the intricacies of soil testing at the time of field survey. Lack of awareness was the main reason of not going for soil testing as responded by them. The farmers who got tested their soil, all of them (100%) considered it to be the most important for availing benefit under subsidy schemes. Poor crop yield was cited as an important reason of adopting soil test by 81.82 per cent of paddy

Table – 5.4.1
Reasons for Soil testing by the respondents

[% of farmers who tested their soil (opinion based on 22 farmers for paddy and 13 farmers for Jute)]

Sl. No	Reasons	Paddy			Jute			Overall		
		Most imp	important	least imp	Most imp	important	least imp	Most imp	important	least imp
1	Not aware of anything about Soil testing and its use	68.18	31.82	0.00	76.92	23.08	0.00	71.43	28.57	0.00

2	For availing benefit under subsidy schemes	100.00	0.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00
3	Poor crop yield	0.00	81.82	18.18	0.00	76.92	23.08	0.00	80.00	20.00
4	Motivation from village demonstration/training/exposure visits to places with best farming practices	100.00	0.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00
5	Peer farmers' group pressure	0.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00	100.00
6	To understand fertilizer requirement for the crop	72.73	27.27	0.00	53.85	46.15	0.00	65.71	34.29	0.00
Source: Primary Survey										

respondents and 76.92 per cent of the jute respondents. Motivation from village demonstration / training and exposure visits to the places with best farming practices were considered to be the most important reason for resorting to soil testing by all the farmers (100%). Peer pressure was not at all an important reason of going for soil testing, as reported by all the sample respondents. Assessment of fertilizer requirement for a particular plot was the key to judicious fertiliser management and as such 65.71 per cent of the farmers, at aggregate level, considered it to be the most important reason of soil testing. And the remaining (34.29 per cent) farmers also considered it to be an important reason to go for soil testing.

Table- 5.4.2
Soil Sample collection and the details of Soil Health Cards (SHC)
among Respondents

[% of farmers who tested their soil (opinion based on 22 farmers for paddy and 13 farmers for Jute)]

Sl. No	Particulars	Paddy	Jute	Overall
1	% of farmers aware of correct method of soil sampling	4.55	0.00	2.28
	Training sources for soil sample collection			
2	i. Agricultural Officer	100.00	0.00	100.00
3	ii. Farmer Facilitator	0.00	0.00	0.00
4	iii. Fellow Farmers	0.00	0.00	0.00
	Information on soil health card			
5	i. Number of farmers received soil health card	100.00	100.00	100.00
6	ii. Number of farmers who understand the information given in the soil health card	100.00	100.00	100.00
7	iii. Number of persons who did not understand the information given in the soil health card for the reasons			
	a) Cannot read	0.00	0.00	0.00
	b) Can read, but not able to understand the information given	0.00	0.00	0.00
9	% of farmers who were explained about soil health card details	100.00	100.00	100.00
	Sources of education on soil health card			
10	i. Agriculture Officer	100.00	100.00	100.00

11	ii. Farmer Facilitator	0.00	0.00	0.00
12	iii. Family Member	0.00	0.00	0.00
13	iv. Fellow farmer	0.00	0.00	0.00
14	v. Friends	0.00	0.00	0.00
15	vi. KVK official	0.00	0.00	0.00

Source: Primary Survey

The farmers who got tested their soil and got the soil health card issued against their names, were interviewed and the results are presented in Table-5.4.2. It was observed that only 4.55 per cent of the farmers in the paddy sample were aware of the correct method of taking soil samples, while in case of jute crop, no farmers knew the correct sampling technique. For collection of soil samples, usually training is imparted to the farmers by the Agricultural Officer, Farmer Facilitator and by the fellow farmers. But in the sample area, the Agricultural Officer from the State Agriculture Department was the only source of training and education for all the farmers (100%). So far as issuance of soil health cards was concerned, all the farmers (100%) who got tested their soils had officially received the soil health cards. In both the sample category, all the farmers (100%) understood the information given in the soil health card. Also, the farmers in possession of SHC were capable of interpreting the information contained in it.

In course of field investigation, it was marked that the soils of the crop field were not tested in case of a large number of sample respondents in the study area and the underlying reasons as perceived by the farmers are presented in Table-5.4.3. In the table reasons were categorized as most important, important and least important to indicate the level of intensity. About 89.00 per cent of the paddy respondents and 93.50 per cent of the jute respondents with an overall average of 91.25 per cent sample farmers did not go for soil testing. A section of the farmers (24.16 per cent paddy farmers and 29.41 per cent

Table – 5.4.3

Reasons for not testing soil by the respondents

[% of farmers who not tested their soil, (Opinion based on 178 farmers for Paddy and 187 farmers for Jute)]

Sl. No	Reasons	Paddy			Jute			Overall		
		Most imp	Important	Least imp	Most imp	Important	Least imp	Most imp	Important	Least imp
	% of farmers not tested their soil	89.00			93.50			91.25		
1	Do not know whom to contact for details on testing	24.16	20.22	55.62	29.41	17.65	52.94	26.85	18.90	54.25
2	Do not know how to take soil samples	0.00	16.29	83.71	0.00	24.60	75.40	0.00	20.55	79.45
3	Soil testing laboratories are	43.82	35.96	20.22	42.78	39.57	17.65	43.30	37.81	18.90

	located far away									
4	Soil testing not required for my field as crop yield is good	64.61	29.78	5.62	59.36	40.64	0.00	61.92	35.34	2.74

Source: Primary Survey

Jute farmers) reported that they did not know the persons to be contacted for getting their soil tested. However, more than fifty percent of the sample respondents considered it to the least important factor to reckon with. A part of the sample farmers in the study area did not know how to take soil samples. This was ascribed to be an important reason of not going for soil testing as communicated by 20.55 per cent of the farmers. This however, was considered as least important by remaining 79.45 per cent of the total farmers. Some farmers did not get their soil tested, simply because soil testing laboratories were located at far off distance. About 43.29 per cent of the farmers considered it to be the most important reason and another 37.81 per cent considered it to be an important reason for not testing their soil. In majority of the cases, soil testing was not done by the farmers because they thought that their crop fields were fertile and crop yield was good enough. This was the most important reason of not taking up soil testing, during the year, as expressed by 61.92 per cent of the farmers. Another 35.34 per cent farmers considered it to be an important reason of not going to the practice of soil testing.

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

Table-5.5.1 elucidates the recommended doses of fertilizers on reference crops after soil testing. Among the different agencies operating in the field, the officials of the State Department of Agriculture and fellow farmers only educated the sample farmers on the recommended doses of fertilizers. About 77.27 per cent in paddy sample and 84.62

Table 5.5.1

Elucidation of Recommended Doses of Fertilizers (RDF) on reference crops

[% of farmers who tested their soil (opinion based on 22 farmers for paddy and 13 farmers for Jute)]

Sl. No	Who explained to you	Paddy	Jute	Overall
1	Department of Agriculture	77.27	84.62	80.00
2	Agriculture University	0.00	0.00	0.00
3	Cooperatives/ Growers'	0.00	0.00	0.00
4	Association	0.00	0.00	0.00
5	Private dealers/retailers	0.00	0.00	0.00
6	Fellow Farmers	22.73	15.38	20.00
7	NGO	0.00	0.00	0.00
8	Others	0.00	0.00	0.00

Source: Primary Survey

per cent in jute sample with an overall average of 80.00 per cent of the farmers used to get necessary advice and support from the Department of Agriculture. As against this, about 22.73

per cent of the paddy sample and 15.38 per cent of the jute sample with an overall average of 19.06 per cent of the total respondents got advices from the fellow farmers on different doses of fertilizers. The role of other agencies on this count was found to be non-significant in the study area.

The Recommended Doses of Fertilizer (RDF) as adopted by the sample respondents without soil testing and after soil testing are presented in Table- 5.5.2. Two sets of information *i.e*, based on farmers' response and based on soil test report, are indicated in the table to see the difference, if any. It was noted that without going through soil testing, about 47.50 per cent of the farmers in paddy sample and 19.00 per cent of the farmers in jute sample were aware of RDF. As against this, the farmers who got their soil tested, all (100.00 per cent) knew about the RDF

Table 5.5.2
Recommended Doses of Fertilizer adopted by the respondents

Sl. No	Particulars	Paddy		Jute	
		As per Farmer opinion	As per Soil Test Report	As per Farmer opinion	As per Soil Test Report
	% of farmers aware of RDF	47.50		19.00	
1	FYM (ton/acre)	3.83	3.39	4.07	3.30
2	Urea(kg/ acre)	62.46	65.24	35.50	37.70
3	DAP(Kg/ acre)	57.05	0.00	73.87	0.00
4	MOP (Kg/ acre)	16.57	27.23	30.25	19.55
5	MgSO ₄ (Kg/ acre)	0.00	0.00	0.00	0.00
6	Zn SO ₄ (kg/ acre)	8.50	0.00	0.00	0.00
7	FeSO ₄ (kg/ acre)	0.00	0.00	0.00	0.00
8	Others –Lime(kg/ acre)	308.76	308.00	0.00	0.00
9	Others- SSP(kg/ acre)	56.47	54.45	72.60	72.60

Source: Primary Survey

for both categories of sample respondents. As per farmers' opinion, RDF in paddy sample were FYM @ 3.83 ton /acre, Urea @62.46 kg/acre, DAP@ 57.05Kg/acre, MOP @16.57kg/acre, Zn SO₄ @8.50 kg/acre, others, means lime @308.76kg/acre and SSP @56.47 kg/ acre. No RDF was reported against MgSO₄ and FeSO₄ by the farmers. As per soil testing report, RDF in paddy sample was recorded at FYM @3.39 ton /acre, Urea @65.24 kg/acre, MOP @27.23kg/acre, lime @ 308kg/acre and SSP @54.45 kg/ acre. No RDF was traced for DAP, MgSO₄, Zn SO₄, FeSO₄ as per the soil test report.

As per farmers' opinion, RDF recorded in jute sample was FYM @4.07 ton /acre, Urea @35.50kg/acre, DAP@73.87Kg/acre, MOP@ 30.25kg/acre and SSP @72.60kg/ acre. No RDF was reported for MgSO₄, Zn SO₄, FeSO₄ and lime by the farmers. As per soil testing report, the

RDF in jute sample were FYM @3.30 ton /acre, Urea @ 37.70kg/acre, MOP @19.55kg/acre and SSP @54.45 kg/ acre. No record of RDF was reported for DAP, MgSO₄, Zn SO₄, Zn SO₄, and lime in the soil test report.

Marked difference between the farmers opinion and soil test report could be observed specially for DAP application in both the crops. However, the farmers are using it continuously @ 57.05 kg/acre in paddy and @ 73.87 kg/acre in Jute samples without any recommendations.

Chapter VI

IMPACT OF NCU APPLICATION ON CROP PRODUCTION AND SOIL HEALTH

6.1 Background

Nitrogenous fertilizer is an important ingredient for increasing production of crops. The most common Nitrogenous fertilizer, urea is extensively used by all the farmers. As per research findings, a major portion of nitrogen in case of urea is lost due to various reasons for which crops suffer a lot from inadequacy of required nitrogen. The farmers are quite ignorant

about the amount of loss and subsequently they observed slow growth of plants. As a result, they have to go for additional doses of N-fertilizer which involve extra cost. On the other hand, extra doses of fertilizer application always have a bad effect on the natural soil structure together with the possibility of contamination of underground water. It is reported that the Neem Coated Urea (NCU) has the resistance against pest attack and the NCU cannot easily be diverted to other industrial uses. As such, resorted to NCU can be an immediate panacea to the inherent problems of using plain urea. In this backdrop, the study was taken up to see the impact of the NCU on crop production and soil health.

6.2 Impact on yield of reference Crops among the Sample Households

Impact of Neem Coated Urea (NCU) and Normal Urea (NU) on production and marketing of Paddy is presented in Table-6.2.1. With NCU usage, the average yield (13.80 qtl/acre) of the main product was found to be higher than that of those farmers using NU (13.10 qtl/acre). In case of by-product, the average yield was recorded at 8.97 per cent and 8.51 qtl per acre with NCU and NU uses, respectively

The percentage of change in yield of main product (paddy) due to application of NCU over NU was worked out at 5.34 per cent and in case of by-product it stood at 5.41 per cent. There was no significant difference in prices of the main products and by-products when paddy was produced using NCU and NU. With NCU use, the price of the main product was found to be Rs. 1,137.00 per qtl. and with NU use, the same was recorded at Rs.1, 122.39 per qtl registering an increase of 1.30 per cent. The price of the by-product (Rs.350.00 / qtl) was found to remain same for both the situation. The per acre value of the main product (Rs.15,686.10) and by-product (Rs.3,138.59) of paddy with NCU were found in the higher side as compared to the value of the main product (Rs. 14,702.70) and by-product (Rs.2,980.10) with NU use. The yield of main product, by-product, and the value of the main product and the value of by-product were found significant at 1% per cent probability level while the price of main product was found statistically significant at 5% probability level. The price of by-product was found statistically non-significant.

Table 6.2.1
Impact of NCU on production and marketing of Paddy

(Reference Year 2015)

Sl. No	Particular	NCU	NU	t- value	% Change in NCU over NU
1	Main product yield (qtl./acre)	13.80	13.10	7.08*	5.34
2	By product Yield (qtl./acre)	8.97	8.51	8.82*	5.41
3	Price of main product	1,137.00	1,122.39	1.73**	1.30

	(Rs./Qtl.)				
4	Price of by product (Rs./Qtl.)	350.00	350.00	.00002Ns	0.00
5	Value of main product (Rs./acre)	15,686.10	14,702.70	5.91*	6.69
6	Value of by product (Rs./acre)	3,138.59	2,980.10	8.17*	5.32

Note: * & ** indicate significant level at 1% and 5%, respectively.

Source: Primary Survey

Similarly the impact of Neem Coated Urea (NCU) and Normal Urea on production and marketing of jute is presented in Table-6.2.2. With NCU usage, the yield of the main Product (jute) was worked out at 8.86 qtl. per acre while with NU usage, the same was worked out at 8.60 qtl. per acre registering an increase of 3.02 per cent. With usage of NCU, the yield of the by-product of jute was 3.10 qtl per acre and with the usage of NU; the same was recorded at 3.01qtl per acre indicating an increase of 2.99 per cent. With usage of NCU, the price of main product (jute) was recorded at Rs. 2,043.90 per acre which increased marginally to Rs. 2,054.99 per qtl. for NU users. The price of the by- product (Rs.250 / qtl) remained same for both the situation. In case of jute crop as well, there was no much difference in prices of the main product & by- product produced

Table- 6.2.2
Impact of NCU on production and marketing of Jute

(Reference Year 2015)

Sl. No	Particular	NCU	NU	t- value	% Change in NCU over NU
1	Main product yield (qtl./acre)	8.86	8.60	3.22*	3.02
2	By product Yield (qtl./acre)	3.10	3.01	3.34*	2.99
3	Price of main product (Rs./Qtl.)	2,043.90	2,054.99	0.01Ns	-0.54
4	Price of by product (Rs./Qtl.)	250.00	250.00	0.0001Ns	0.00
5	Value of main product (Rs./acre)	18,104.67	17,675.27	2.26**	2.43
6	Value of by product (Rs./acre)	775.07	752.61	2.97*	2.98

Note: * & ** indicate significant level at 1% and 5%, respectively.

Source: Primary Survey

by using NCU and NU. The per acre value of main product (Rs. 18,104.67) and by-product (Rs. 775.07) of jute with NCU were found marginally higher than the value of main product (Rs. 17,675.27) and the value of by-product (Rs. 752.61) with NU. The yield of main

product, by-product and the value of by-product were found statistically significant at 1% percent probability level while the price of main product was found statistically significant at 5% probability level. The price of by-product was found statistically non-significant.

6.3 Impact on the total input Cost of Reference Crops

The impact of Neem Coated Urea on input cost of paddy over normal urea is presented in Table-6.3.1. It has been observed that the cost of pest and disease control, cost of weed management, cost of NCU and other costs per acre were found to be less for the farmers who applied NCU than that of the farmers who applied normal urea. For NCU users, the cost incurred on pest and disease was Rs.222/acre sharing 7.24 per cent of the total cost (Rs.3, 068.38/acre) and for NU users, it was Rs.243.59 sharing 7.12 per cent of the total cost (Rs.3, 423.29/ acre). The percentage change in NCU over NU on pest and disease management was worked out at (-) 8.86 per cent. The cost of weed management was recorded at Rs.1, 311.96 per acre for NCU users sharing 42.76 per cent of the total cost and for NU users it was recorded at Rs.1,350.22 per acre sharing 39.44 per cent of the total cost with (-)2.83 per cent change in NCU over NU.

For NCU users, the cost incurred on NCU was Rs.355.72/acre, sharing 11.59 per cent of the total cost (Rs.3,068.38/acre) while the cost incurred on NU was Rs.431.59 per acre, sharing 12.61 per cent of the total cost. The percentage of change was worked out at (-) 17.58 for NCU over NU. For NCU users, the cost of other fertilizers was at Rs. 1,178.70 per acre, sharing 38.41 per cent of the total cost while in case of NU users, the cost of other fertilizers was at Rs. 1,397.89 per acre sharing 40.83 per cent of the total cost and percentage of change was worked out at (-) 15.68 per cent in NCU over NU. The percentage of change in aggregate cost for NCU over NU was recorded at (-) 10.37 per cent. In order to study the impact of NCU on input cost of paddy under different components, t-values were worked out to draw statistical inference. The cost of pest and disease control, cost of NCU/NU and total were found statistically significant at 1% probability level while the cost of other fertilizers was found statistically significant at 5% probability level. The cost of weed management was found statistically non-significant.

Table 6.3.1
Impact of NCU on input cost of Paddy

(Rs./ acre)

Sl. No	Particular	NCU (Area 449.27 acre)		Normal Urea (Area 27.44 acre)		t- Value	% Change in NCU over NU
		Value (Rs)	%	Value (Rs)	%		
1	Cost of pest and disease control	222.00	7.24	243.59	7.12	5.51*	-8.86
2	Cost of weed	1,311.96	42.76	1,350.22	39.44	0.90 Ns	-2.83

	management						
3	Cost of NCU/ NU	355.72	11.59	431.59	12.61	16.43*	-17.58
4	Cost of other fertilizers	1,178.70	38.41	1,397.89	40.83	1.98**	-15.68
5	Total Cost	3,068.38	100.00	3,423.29	100.00	2.68*	-10.37

Note: * & ** indicate significant level at 1% and 5%, respectively.

Source: Primary Survey

Similarly, the impact of Neem Coated Urea on input cost of jute was also assessed and is presented in Table 6.3.2. It has been observed that the farmers who applied NCU incurred lesser amount of cost on different inputs under observation.

For NCU users, the cost incurred on pest and disease was Rs.126.56/acre, sharing 4.55 per cent of the total cost (Rs.2, 781.27 per acre) and for NU users, it was Rs.122.75 per acre sharing 4.33 per cent of the total cost (Rs.2, 836.21 per acre). The cost of weed management for NCU users stood at Rs. 1211.16 per acre, constituting 43.55 per cent of the total cost. As against this, NU users spent Rs. 1211.67 per acre on this count, which constituted 42.72 per cent of the total cost. The percentage change was (-) 0.04 per cent in NCU over NU users. The cost of NCU was Rs.242.58 per acre sharing 8.72 per cent of the total cost and that of NU was Rs. 291.58 per acre, which constituted 10.28 per cent of the total cost. The percentage change was worked out at (-) 16.80 per cent in NCU over NU.

For NCU users, the cost incurred on other fertilizers was recorded at Rs.1, 200.97 per acre, constituting 43.18 per cent of the total cost and for NU users, it was recorded at Rs. 1, 210.21, sharing 42.67 per cent of the total cost. The percentage of change was worked out at (-) 0.76 per cent in NCU over NU. At overall level, the percentage of change was worked out at (-) 1.94.

In case of jute, the cost of NCU/NU per acre was found statistically significant at 1% while the cost of pest and diseases control was found statistically significant at 5% probability level. The cost of weed management and the cost of other fertilizers were found statistically non-significant.

Thus, the analysis clearly indicates that the NCU – users, were benefitted in terms of reduced cost.

Table – 6.3.2
Impact of Neem Coated Urea (NCU) on input cost of Jute

(Rs./ acre)

Sl. No	Particular	NCU (Area 449.27 acre)		Normal Urea (Area 27.44 acre)		t- Value	% Change in NCU over NU
		Value (Rs)	%	Value (Rs)	%		
1	Cost of pest and disease control	126.56	4.55	122.75	4.33	2.33**	3.10
2	Cost of weed	1,211.16	43.55	1,211.67	42.72	0.41Ns	-0.04

	management						
3	Cost of NCU/ NU	242.58	8.72	291.58	10.28	13.75*	-16.80
4	Cost of other fertilizers	1,200.97	43.18	1,210.21	42.67	0.05Ns	-0.76
5	Total Cost	2,781.27	100.00	2,836.21	100.00	1.74**	-1.94

Note: * & ** indicate significant level at 1% and 5%, respectively.

Source: Primary Survey

6.4 Economic Feasibility of NCU:

The partial budgeting technique was used to work out the Economic Feasibility of NCU for paddy and jute and is presented in Table-6.4.1 (paddy) and 6.4.2 (Jute). The additional return from NCU is about Rs.1, 311.81 per acre for paddy and Rs.615.96 per acre for jute.

Table 6.4.1
Economic Feasibility of NCU in Paddy (using a partial budgeting framework)
(Per acre)

A			B		
Sl.No.	Added Cost due to NCU	Cost (Rs./acre)	Sl.No.	Reduced cost due to NCU	Return (Rs./acre)
1	Cost of Pest and disease control	-	1	Cost of Pest and disease control	22
2	Cost of weed management	-	2	Cost of weed management	38
3	Cost of NCU	-	3	Cost of NCU	76
4	Cost of other fertilizers	-	4	Cost of other fertilizers	219
Total added Cost		0	Total reduced Cost		355
Sl.No.	Reduced return due to NCU	Cost (Rs./acre)	Sl.No.	Added return due to NCU	Return (Rs./acre)
1	Main product	-	1	Main product 0.70 quintal @ Rs.1137/-	796
2	By-product yield	-	2	Bye product yield 0.46 quintal @ Rs.350/-	161
	Total reduced return	-		Total of added returns	957
	Total (A)	0		Total (B)	1,312
	B-A	1,311.81			
Additional return from NCU is about Rs. 1311.81 per acre					
An Added return per acre is Rs. 1311.81					

Table 6.4.2
Economic Feasibility of NCU in Jute (using a partial budgeting framework)

(Per acre)

A			B		
Sl.No.	Added Cost due to NCU	Cost (Rs./ acre)	Sl.No.	Reduced cost due to NCU	Return (Rs./acre)
1	Cost of Pest and disease control	-	1	Cost of Pest and disease control	4
2	Cost of weed management	0.51	2	Cost of weed management	-
3	Cost of NCU	-	3	Cost of NCU	49
4	Cost of other fertilizers	-	4	Cost of other fertilizers	9
Total added Cost		0.51	Total reduced Cost		62
Sl.No.	Reduced return due to NCU	Cost (Rs./ acre)	Sl.No.	Added return due to NCU	Return (Rs./acre)
1	Main product	-	1	Main product 0.26 quintal @ Rs.2,043.90/-	531
2	By-product yield	-	2	Bye product yield 0.09 quintal @ Rs.250/-	23
Total reduced return		-	Total of added returns		554
Total (A)		0.51	Total (B)		616
B-A		615.45			
Additional return from NCU is about Rs. 615.45 per acre An Added return per acre is Rs. 615.96					

6.5 Impact on soil heath and crop growth

In course of field investigation, it was tried to assess the impact of NCU-usage on soil health and crop growth and accordingly, queries were posed before the sample respondents on a select group of soil characteristics, viz., soil texture, soil moisture retention, capacity, water infiltration, soil softness and soil compaction, etc.,

However, the sample farmers could not furnish any objective replies on these attributes. There is a reason to believe that one cannot draw any inference on those lines, merely on the basis of visual observation and it needs a separate study in more scientific lines.

Chapter VII

SUMMARY, CONCLUSIONS AND POLICY SUGGESTIONS

7.1 Background

Among all the fertilizers, urea is used extensively by all the farmers throughout the state. Research findings suggest that, there are some disadvantages of Urea application. It is easily soluble in water and decomposes even at room temperature resulting in huge losses. Further, it has adverse effect on seed germination, seedling growth and early plant growth in soil (Bremer & Krogmeir, 1988). Excess nitrogen which is not absorbed by the plants flows into the rivers and also a portion of it percolates down with water, resulting in contamination of ground water and enters human body with drinking water, resulting in health disorders (Maunder and Gupta, 2000). Excessive air and water-borne nitrogen from fertilizers may cause respiratory ailments, cardiac disease, and several cancers. It can inhibit crop growth and affect the dynamics of several vector-borne diseases (Townsend et.al, 2003). Besides these problems, normal urea is used by the industries for a number of product such animal feed, commercial products, glue, resin, cosmetics, pharmaceuticals, dish soaps, hair conditioners, tooth whitener and so on. The diversion of urea for other purposes creates the problem of shortage at the peak time of the crop seasons.

To increase the Nitrogen Use Efficiency of urea and to stop its diversion to industrial use, normal urea is coated with neem oil. In this endeavor, the National Fertilizer Limited standardized the technique of production of Neem Coated Urea (NCU) in 2002. The Government of India accepted the proposal of production the NCU in different fertilizer production units and it came to the market of Assam fully through BVFCL (Brahmaputra Valley Fertilizers Corporation Limited)/ Indian Farmers Fertilizer Cooperative LTD (IFFCO) by the end of 2014.

For sustainable agricultural development, judicious use of chemical fertilizer is must. It is possible only when the farmers know the natural health of soil of their crop field. Otherwise, the farmers suffer from two possibilities, viz., over doses and lower doses of fertilizers. Overdoses of fertilizers always have a bad affect on natural soil structure and on natural environment and lower doses of fertilizers result in low productivity of crops. Both the situations are equally important for all the stakeholders. Therefore, soil testing programme was started at the behest of all the State Governments of the country, but the programme remained confined amongst of limited number of farmers only. As such, a proper diagnostic analysis was deemed necessary for the farmers to know the strength and weaknesses of their farm land to improve the soil quality. With this end in view, the Government of India launched a new programme for issuance of Soil Health Card (SHC) in February, 2015 last. Under this scheme, all the farmers of the country will receive Soil Health Card in which the recommended doses of fertilizers and micronutrients will be mentioned for information of all concerned. As

per the guidelines, a new or a modified card will be given to the farmers once in 3 years, because the level of soil nutrients may undergo changes during the period. In Assam, as per report of the Directorate of Agriculture, the Government of Assam has already issued 64,168 Soil Health Cards under this new initiative as on August, 2016 to the farmers of different districts of Assam.

In this back drop, this study was taken up to assess the impact of NCU on crop production and productivity in the state as compared to normal urea (NU) and also to evaluate the benefits of Soil Health Cards issued to the respondent farmers.

The specific objectives of the study are as under:

1. to analyze the trends in usage and prices of Urea versus NCU in Assam.
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 and implementation of SHCs scheme in the state.

To fulfil the objectives primary and secondary data were collected. The reference period for the study was related to *Kharif* 2015 covering 2 crops *viz.*, paddy (irrigated) and Jute (un-irrigated). The primary level data were collected from 2 districts (*viz.*, Kamrup & Nagaon) of Assam having highest urea usage. From each district 2 blocks were selected based on the same criteria. From each district, 100 samples were collected randomly for each crop. In doing so, 200 sample farmers were collected from each selected districts. Altogether, the study covered 400 sample farmers in 2 districts comprising 200 respondents for each crop.

7.2 Summary of findings

The summary of findings, on the basis of the observations and analysis of the secondary and primary level data are presented as follows:

7.2.1 Trends in Urea Consumption and Price Variation

It has been observed that urea consumption is showing an increasing trend from 194.10 thousand tonnes in 2006-07 to 392.39 thousand tonnes in 2015-16 with an ACGR of 3.38 per cent per annum during the period while price per MT (Rs.5470.00) of urea remained the same during 2006-07 to the last a few months of 2014-15, and was increased to Rs.5750.00 per MT from some point of the year 2014-15 to 2015-16. The per hectare consumption of urea was also found to increase from 51.58 kg in 2006-07 to 89.44 kg per hectare in 2015-16. During this period, the ACGR of the per hectare consumption of urea in the State grew at 2.56

per cent per annum. This increase in urea use in Assam cannot simply be interpreted as increased use of urea in field crops only as large section of the farmers in Assam have small tea gardens in which they use urea extensively.

7.2.2 Socio-economic characteristics

The average age of the sample respondents growing paddy was of 43.13 years and that of jute growers was 44.01 years with an overall age 43.57 years. It indicates that all the respondent farmers were fully matured. Also, all the respondents for both the crops were males. The overall average number of family members engaged fully in farming was 2.35 persons in each farm family. And the respondents had the farming experience of 21.04 years. The overall family size was computed at 6.40. The literacy rate (80 per cent) of the sample respondents was higher in the study area as compared to the state level literacy (72.19 per cent, 2011). In case of caste, the sample respondents (overall) were dominated by general caste people (97.25%) and only 2.75 per cent of the respondents belonged to OBC.

The main occupation of the respondent farmers was agriculture & allied enterprises (87.00%) followed by salaried work (3.75%), non-agricultural casual labour (3.00%), agricultural labour (2.00%), self employed in small scale industries (1.50%) and self employed in services (0.75%). Of the total sample farmers (overall), only 2.00 per cent were involved in other occupational activities like fishery, vegetable vendors, small grocery shops, cattle business, small poultry farming, *etc.*, .

7.2.3 Operational Land Holding

The size of operational holding is an important indicator of the economic standing of the farmers. In case of paddy sample, the average size of net operational holding (per household) was recorded at 3.12 acres while in Jute sample it was recorded at 3.23 acre with an overall average of 3.17 acre per household. Out of the total net operated area (1269.15 acre) of the sample households, 78.80 per cent area were irrigated, as reported by the sample respondents. The bore well (shallow tube well) was the only source of irrigation for both the respondents (paddy and jute). The overall rental value of leased-in land and leased-out land in the study area stood at Rs. 8,443.33 and Rs. 7,889.71 per acre, respectively.

7.2.4 Cropping Pattern and Sources of Irrigation

Paddy was the dominant crop followed by jute and kharif vegetables in case of paddy respondents. Under irrigated condition, the highest area (94.47%) of paddy was in the marginal & small size group followed by the medium (89.56%) and the large size group (85.20%). In rain-fed condition, the highest area (38.17%) of paddy was recorded in the medium size group, followed by the marginal & small size group of farmers (23.67%). No area of paddy was found

in the large size group under rain-fed condition. Combining the areas of two different situations, the highest area of paddy was covered by the medium size group (84.41%) followed by the marginal & small (80.17%) and the large size group of farmers (76.90%). No area was found under irrigated condition in case of jute crop but in rain-fed condition, the highest area (74.00%) of jute was recorded against the small & marginal size group followed by the medium size group (60.53%). Combining both the situation, the highest area (15.11%) of jute was recorded in the marginal & small size group followed by the large size group (9.99%) and medium size group (6.06%). In case of irrigated vegetables (*Kharif*), the highest area (14.80%) was recorded against the large size group followed by medium size group (10.44 %) and the marginal & small size group (5.53%). In rain-fed condition, the highest area under *Kharif* vegetables was recorded against marginal & small size group (1.49%) followed by the medium size group (0.17%). There was no area under vegetables in large size group of farmers. Combining both the situation, the highest vegetables area was found against the large group (13.32%) followed by the medium (9.53%) and the marginal & small size group (4.72%).

The cropping patterns of jute respondents during *Kharif* season in irrigated and rain-fed conditions across different farm size groups showed a similar picture as that of the paddy respondents. Under irrigated condition, the highest area (96.67%) of jute was observed in the marginal & small size group followed by the large size group (92.74%) and medium (88.78%) size group. There was no paddy area under rain-fed condition in any of the groups. Combining the areas of two different situations, the highest paddy area was covered by the large size group (81.61%) followed by medium size group (72.10 %) and marginal & small size group (70.66%). No jute area was found under irrigated condition, but in rain-fed condition, the highest area (99.86%) of jute was recorded against the marginal & small size group followed by the large size group (93.15%). Combining both the situations, the highest area (26.88%) of jute was recorded in the marginal & small size group followed by medium size group (18.79%) and by large size group (11.18%). In case of irrigated vegetables (*Kharif*), the highest area (11.22%) was recorded against the medium size group followed by large size group (7.26%) and marginal & small size group (3.33%). Under rain-fed condition, the highest area of vegetables was recorded against the large size group (6.85%) followed by marginal & small size group (0.14%). No vegetables area was found in the medium size group. Combining both the situation, the highest vegetables area was found against the medium size group (9.12 %) followed by large size group (7.21%) and marginal & small size group (2.47%).

Among the various sources of irrigation, it was found that all the respondents under reference had the access to Bore well irrigation only (100%).

7.2.5 Purchasing Pattern and sources of Purchase

Both the respondents purchased NCU and NU in bags (50 kg each) and in loose (kg). Purchasing pattern mainly depends upon the economic conditions of the farmers. Most of the farmers could not afford to purchase the required amount of fertilizers as recommended in the package of practices. The quantity of NCU purchased per household was found to be much higher than that of the NU for both categories of respondents. It might be due to abundant availability of NCU as compared to NU in the market or might be due to farmer's own interest for NCU application. In case of paddy respondents, each household bought 128.10 Kg of NCU while jute respondents bought 118.76 Kg of NCU and at overall level; it stood at 123.43 Kg per household. In case of NU, 9.75 Kg per household was recorded against paddy and 21.13 Kg per household against jute respondents. In overall, it stood at 15.44 Kg per household. The overall market price of 50 kg of NCU bag was Rs.392.13 against Rs. 350.31 a bag in case of NU. The average distance from the farm to the market was about 3.26 Km for NCU and 2.12 Km for NU. Each household on an average had to incur Rs.9.85 for NCU and Rs. 9.79 for NU as transportation cost per bag. Finally, each household had to spend Rs.401.98 per bag for NCU and Rs.360.10 per bag for NU.

In the study area all sample respondents purchased of NCU and NU from the private fertilizer dealers only.

7.2.6 Usage of Inputs and Profitability of reference Crops

The overall quantity of inputs and value thereof, together with net return realized per acre in paddy and jute by the sample farmers during 2014 and 2015 were also estimated across the different farm size groups. The total paid-out costs per acre including imputed value of own labour was marginally on higher side in 2014 over 2015 for both the crops and the net return per acre was recorded to be higher side in 2015 as compared to 2014 for both the crops.

In case of paddy during 2014, the amount of cost incurred was Rs.2,364.55 per acre on ploughing and Rs.583.02 per acre (20.14 Kg per acre) on seeds/seedling, Rs.193.62 per acre on organic/FYM, Rs.488.79 per acre (68.86 Kg) on urea/NCU, plant protection, Rs.1,072.91 per acre (74.31 Kg) on chemical fertilizer other than urea/NCU, Rs.178.47 per acre (4.96 Kg) on micro-nutrient, Rs.231.26 per acre on plant protection chemical, Rs.578.82 per acre on irrigation charges, Rs.1,342.25 per acre on weeding and weedicides, Rs.1502.36 per acre on harvesting & threshing, Rs.1,879.03 per acre (11.74 man-days) on imputed value of family labour, Rs. 1,322.95 per acre (8.27 man-days) on hired labour and Rs. 85.72 per acre on maintenance of assets used for reference crop. The sum total of paid-out cost stood at Rs.13,611.08 per acre. The quantity of main product was 1334.95 kg per acre and the by-product

amounts to 867.72 Kg per acre. The gross return from paddy (main product +by-product) stood at Rs. 17,185.85 per acre and the net return at Rs.3, 574.77 per acre during the year.

In 2015, the cost incurred in paddy was Rs.2,534.48 per acre on ploughing, Rs.690.62 per acre (19.73 Kg) per acre on seeds/seedling, Rs.205.17 per acre on organic/FYM per acre, Rs.360.09 per acre (46.56 Kg) on urea/NCU per acre, Rs.986.15 per acre (64.43 Kg) on chemical fertilizer other than urea/NCU per acre, Rs.209.32 per acre (5.61 Kg) on micro-nutrient, Rs.223.25 on plant protection chemical per acre, Rs.650.09 per acre on irrigation charges per acre, Rs.1,314.16 per acre on weeding and weedicides, Rs.1,696.51 per acre on harvesting & threshing, Rs.1,964.14 per acre on hired labour, Rs.1,973.70 per acre (10.97 man days) on imputed value of family labour per acre, Rs. 1,404.91 per acre (7.81 man days) on hired labour and Rs. 92.15 per acre on maintenance of assets used for reference crop. The sum total of paid-out cost stood at Rs.14,304 per acre. The gross return from jute stood at Rs. 18,758.96 (main product 1375.59 Kg per acre + by product 894.13 Kg per acre) and the net return at Rs. 4,454.12 per acre on paddy during 2015. In 2015, increase was seen on input cost and output over 2014 except for Urea/NCU, chemical fertilizer other than urea/NCU and plant protection.

In 2014, in case of jute, the amount of cost incurred per acre was Rs.1,131.11 on ploughing, Rs.233.87 (3.12 Kg per acre) on seeds/seedling, Rs.703.85 on organic/FYM, Rs.303.92 per acre (42.88 Kg) on urea/NCU, Rs.553.36 per acre (49.48 Kg) on chemical fertilizer other than urea/NCU, Rs.74.60 per acre (2.07 Kg) on micro-nutrient, Rs.137.14 per acre on plant protection chemical, Rs.1,200.00 per acre on weeding and weedicides, Rs.7,000.00 per acre on harvesting & threshing, Rs.362.90 per acre on hired labour charges, Rs. 1,865.48 per acre (11.66 man-days) on imputed family labour, Rs. 1,740.75 per acre (10.88 man days) per acre on hired labour and Rs. 46.15 on maintenance of assets used for reference crop. The sum total of paid-out cost stood at Rs.15, 353.14 per acre. The quantity of main product was 867.29 Kg per acre and that of by-product was 303.55 Kg per acre. The gross return from jute (main product + by-product) stood at Rs. 17,623.82 per acre and the net return at Rs.2, 270.68 per acre during the year.

In 2015 for jute crop, the paid-out cost & productivity of main product and by product per acre were found to be higher than the previous year (2014) for which gross return and net return was recorded in higher side. The amount of cost incurred was Rs.1,146.44 per acre on ploughing, Rs.268.38 per acre (3.14 Kg per acre) on seeds/seedling, Rs.526.53 per acre on organic/FYM, Rs.249.00 per acre (32.55 kg) on urea/NCU, plant protection, Rs.680.70 per acre (57.52 Kg) on chemical fertilizer other than urea/NCU, Rs.79.65 per acre (2.07 Kg) on micro-

nutrient, Rs.126.06 per acre on plant protection chemical, Rs.1,211.20 per acre on weeding and weedicides, Rs.7,200.00 per acre on harvesting & threshing, Rs.405.65 per acre on hired labour charges, Rs. 1,994.30 per acre (11.08 man-days) on imputed family labour, Rs. 1,795.68 per acre (9.98 man days) on hired labour and Rs. 54.70 per acre on maintenance of assets used for reference crop. The sum total of paid-out cost stood at Rs.15,738.29 per acre. The production of main product was 882.42 Kg per acre and the by-product was 308.85 Kg per acre. The gross return from jute (main product +by-product) stood at Rs. 18,820.09 per acre and the net return at Rs.3, 081.80 per acre during the year.

7.2.7 Agricultural Credit Availed

There was no report of non-institutional credit in the study area. The farmers availed credit from 3 institutional sources viz., Commercial Banks, Co-operative Societies and Regional Rural Banks. At aggregate level, per household credit stood at Rs.3, 665.00 against the paddy sample farmers and Rs. 2,597.50 against the jute sample farmers with an overall average of Rs.3,126.25 per household. All the farmers applied for loan for seasonal crop cultivation only.

7.2.8 Training Programmes on Fertilizers Application

As reported by the sample respondents, no training was organised by the State Agriculture Department or any other organization on application of NCU and its relative advantages.

7.2.9 Status of Awareness and Application of Neem Coated Urea

Combining both the respondent groups, the level of awareness on NCU was recorded to be 83.91 per cent for marginal & small farmers and 100 per cent in case medium and large size group of farmers.

The sources of information on usage of NCU were studied during the field survey and it was revealed that at aggregate level, in case of marginal & small size group was the Agricultural Officers (45.89 per cent) followed by input shop (30.14%), fellow farmers (15.75%), farmer's facilitator (5.48%) and KVK official (2.74%). In case of medium farmers, the principal source of awareness on NCU use was recorded against the Agricultural Officer with 38.78 per cent, followed by input shop (34.69%), fellow farmers (18.37%) and farmer's facilitator (8.16 %); while input shop (100%) was the only source of information on usage of NCU for the large size group of respondents. In the study area, the other sources of information such as, Print & Visual Media, Wall writing, Agricultural University and Company did not play any significant role for bringing awareness on NCU-usage among the sample respondents.

7.2.10 Status of Application of NU *vis-a-vis* NCU

It was observed that the sample respondents did not use NCU at all in their crop fields prior to 2015-16 as it was not available in the markets. It was further noted that among the sample paddy farmers, about 89.50 per cent, 83.76 per cent of farmers and 98.92 per cent of the respondents farmers applied NCU in paddy, jute and vegetables, respectively after 2015-16. Similarly, in case of jute sample respondents, about 82.50 per cent each of the farmers applied NCU in Jute and Paddy and 90.91 per cent of farmers applied NCU in Vegetables after 2015-16.

The sample respondents applied NCU/NU in split doses at different points of time. On Combining both categories of sample, one can see that paddy and jute samples, about 30.00 per cent of the total consumption of NCU were applied at the rate of 12.68 Kg per acre as basal application, 47.33 per cent were applied at the rate of 20.01 Kg per acre in vegetative growth stage and the rest 22.67 per cent were applied at the rate of 9.58 Kg per acre after weeding operations. There was no report of application of NCU at maturity stage. In aggregate, the rate of application of NCU was 42.27 Kg per acre, as against 52.94 Kg per acre in case of NU.

Generally, there are 4 methods of applications of NCU and Normal Urea *viz.*, Broadcasting, Spraying, Fertigation and Drilling. Among the four methods, all the sample respondents (100%) applied NCU & NU by adopting broadcasting method only.

The relative use of NCU versus Normal Urea in paddy and jute crop during 2014 and 2015 was also assessed. There was no use of NCU in 2014 as it was not available in the markets in the sample areas. Only normal urea was applied at the rate of 68.86 Kg per acre in paddy and 42.88 Kg per acre in jute crop with an overall average of 62.35 Kg per acre during 2014. In 2015, farmers applied both NCU as well as NU in their crop fields. In 2015, the rate of application of NCU was 45.65 Kg per acre in paddy and 31.17 Kg per acre in jute crop with an overall average of 42.27 kg per acre. As against this, the rate of application of NU was 61.41 Kg per acre in paddy and 41.69 kg per acre in jute with an overall figure of 52.94 kg per acre. Obviously, the amount of NCU was much less than that of NU. On usage of NCU, the productivity of paddy was recorded at 1,379.60 Kg per acre and that of jute was 885.79 kg per acre with an overall productivity of 1,264.27 kg per acre during 2015, while by using NU, the productivity of paddy was recorded at 1,334.33 Kg per acre and 867.30 kg per acre in case of jute with an over all productivity of 1,217.78 kg per acre during 2014. In 2015 by using NU, the productivity attained was 1,309.95 Kg per acre in paddy and 860.12 Kg per acre in jute with an overall average of 1,116.74 Kg per acre. The output per unit of NU was 19.39 Kg for paddy and 20.22 Kg for jute with an aggregate of 19.53 Kg per acre in 2014. In 2015, the output per unit of NCU was 30.22 Kg for paddy and 28.42 Kg for jute with an overall average of at 29.91 Kg per acre.

The overall perception of the sample respondents about NCU application was found to be good as compared to NU.

The comparative advantage of NCU over Normal Urea in the case of paddy and jute crop was assessed in course of investigation. About 54.75 per cent of the paddy farmers found an increase in yield rate while 45.25 per cent could not find any changes in yield rate. In case of jute, about 63.03 per cent of jute farmers reported increase in yield rate while about 36.97 per cent could not find any change in the yield rate. The extent of increase in yield was recorded at 3.82 per cent for paddy and 2.99 per cent for jute. For both the crops, all the farmers (NCU users) derived extra benefit through reduction in the cost of pest and disease control, weed management and cost of NCU and other fertilizers. With the application of NCU, the cost involved in pest & disease control was reduced substantially as reported by the majority of the farmers (50.84 per cent for paddy and 54.03 per cent for jute respondents). And the extent of decline in cost was 7.34 and 20.03 per cent, respectively. Similarly, with the application of NCU, the cost of weed management was also reduced in case of paddy respondents. In final analysis, the cost of NCU was found to be much lower as compared to NU for both the crops, as observed by all the sample households (100 per cent). Similar trend was witnessed in case of other fertilizers as well.

However, the respondents did not visualize any change in soil health improvement, quality (grain) improvement or market acceptability of grains, *etc*,

There was no report of diversion of Urea or NCU, other than the crop purposes in the study area.

Since NCU is a recent introduction to the crop field of Assam, it is natural to come across a number of problems and difficulties by the farmers. On the basis of the feedback obtained from the sample households, one can readily identify two major area of concern *viz.* information gap (61.34 per cent) and lack of motivation (38.66 per cent).

7.2.11 Economic Feasibility of NCU

The partial budgeting technique was used to work out the Economic Feasibility of NCU for paddy and jute. The additional return from NCU is about Rs.1, 311.81 per acre for paddy and Rs.615.96 per acre for jute.

7.2.12 Soil Health Related Programmes and Schemes - Implementation and Performance in the State

The Government of India has launched a nation-wide programme on Soil Health Card (SHC) in February, 2015 last. As per report of the Directorate of Agriculture, Government of Assam has so far issued 64,168 Soil Health Card (SHC) to the farmers of different districts of Assam up to Aug/2016.

. The SHCs are prepared on the basis of soil test undertaken on 14 parameters *viz.*, Zn, Cu, Fe, Mn, S, B, pH, Organic carbon, N, P, K, Minerals (Soluble), structure of the soil and lime requirement. Clearly, the State has to do a lot to accomplish the herculean task of covering 37.31 lakh farmers of the State.

In addition to this, Assam Agricultural University, Jorhat has distributed 37,000 SHCs (as on August, 2016) through 23 KVKs across the State under the RKVY (Rashtriya Krishi Vikash Yojana). The cards were prepared based on 9 different parameters *viz.*, N, P, K, S, Zn, B, Organic Carbon(OC), pH and lime requirement.

It has been observed that the common sources *viz.*, State Agricultural Universities (SAUs), Krishi Vigyan Kendras (KVKs), Private Companies, Friends and Neighbours had no role to make the farmers aware of the benefits of soil testing in the study area. The Department of Agriculture (100%) was the only source of information about soil testing, as reported by the farmers. Out of a total sample of 200 farmers for each crop, only 22 paddy respondents and 13 jute respondents went for soil testing in the study area.

During last 3 years, only 11 per cent of the paddy farmers and 6.50 per cent of the jute farmers got their soil testing done. All the sample farmers went for soil testing only for once. Further, there was no report of incurring any cost towards soil testing by the farmers in the study area.

On an average, the distance to the soil testing laboratory from the field was nearly 141 km for both the categories of sample respondents. The number of soil samples taken for testing was 33 in case of paddy and 21 in case of jute and the area covered under soil test was 23.17 and 16.03 acres for paddy and jute samples, respectively.

Motivation from village demonstration/training / exposure visits to places with best farming practices were considered to be the most important reasons for resorting to soil testing by all the farmers (100%). Peer pressure was not at all an important reason of going for soil testing, as reported by all the sample respondents. Assessment of fertilizer requirement for a particular plot is the key to judicious fertiliser management and as such 65.71 per cent of the farmers, at aggregate level, considered it to be the most important reason of soil testing. And the remaining (34.29 per cent) farmers also opined it to be an important reason to go for soil testing.

It was further observed that only 4.55 per cent of the farmers in the paddy sample were aware of the correct method of taking soil samples, while in case of jute crop, the farmers did not know the correct sampling technique. For collection of soil samples, usually training is imparted to the farmers by the Agricultural Officer, Farmer Facilitator and by the fellow

farmers. But in the sample area, the Agricultural Officer from the State Agriculture Department was the only training source for all the farmers (100%). So far as issuance of soil health cards was concerned, all the farmers (100%) who got tested their soils had officially received the soil health cards. In both the sample, all the farmers (100%) understood the information given in the soil health card. Also, all the farmers in possession of SHC were capable of interpreting the information contained in it in right perspective.

In course of field investigation, it was marked that the soils of the crop field were not tested in case of a large number of sample respondents in the study area. The underlying reasons were categorized as most important, important and least important to indicate the level of intensity. About 89.00 per cent of the paddy respondents and 93.50 per cent of the jute respondents with an overall average of 91.25 per cent sample farmers did not go for soil testing. A section of the farmers (24.16 per cent paddy farmers and 29.41 per cent Jute farmers) reported that they did not know the persons to be contacted for getting their soil tested. However, more than fifty percent of the sample respondents considered it to be the least important factor to reckon with. A part of the sample farmers in the study area did not know how to take soil samples. This was ascribed to be an important reason of not going for soil testing as communicated by 20.55 per cent of the farmers. This however, was considered as least important by remaining 79.45 per cent of the total farmers. Some farmers did not get their soil tested, simply because soil testing laboratories were located at far off distance. About 43.29 per cent of the farmers considered it to be the most important reason and another 37.81 per cent considered it to be an important reason for not testing of their soil. In majority of the cases, soil testing was not done by the farmers because they thought that their crop fields were fertile and crop yield was good enough. This was the most important reason of not taking up soil testing, during the year, as expressed by 61.92 per cent of the farmers. Another 35.34 per cent farmers considered it to be an important reason of not going for the practice of soil testing.

About 77.27 per cent in paddy sample and 84.62 per cent in jute sample with an overall average of 80.00 per cent of the farmers used to get necessary advice and support from the Department of Agriculture. As against this, about 22.73 per cent of the paddy sample and 15.38 per cent of the jute sample with an overall average of 20.00 per cent of the total got advices from the fellow farmers on different doses of fertilizers. The role of other agencies on this count was found to be non-significant in the study area.

About 47.50 per cent of the farmers in paddy sample and 19.00 per cent of the farmers in jute sample were aware of the RDF (Recommended Doses of Fertilizer) even without resorting to soil testing. As against this, all the farmers who got their soil tested (100 per cent)

all knew all about the RDF for both categories of sample respondents. As per farmers' opinion, the RDF in paddy sample were FYM @ 3.83 ton /acre, Urea @62.46 Kg /acre, DAP@ 57.05 Kg/acre, MOP @16.57 Kg /acre, Zn SO₄ @8.50 Kg /acre, others means lime @308.76 Kg /acre and SSP @56.47 Kg / acre. No RDF was reported against MgSO₄ and FeSO₄ by the farmers'. As per soil testing report, RDF in paddy sample was recorded at FYM @3.39 ton /acre, Urea @65.24 kg/acre, MOP @27.23 Kg /acre, lime @ 308 Kg /acre and SSP @54.45 Kg / acre. No RDF was traced for DAP, MgSO₄, Zn SO₄, FeSO₄ as per the soil test report.

As reported by the farmers, the RDF recorded in jute sample was FYM @4.07 ton /acre, Urea @35.50 Kg /acre, DAP@73.87 Kg/acre, MOP@ 30.25 Kg /acre and SSP @72.60 Kg / acre. No RDF was reported for MgSO₄, Zn SO₄, FeSO₄ and lime by the farmers'. As per soil testing report, RDF in jute sample were FYM @3.30 ton /acre, Urea @37.70 Kg /acre, MOP @19.55 Kg /acre and SSP @54.45 Kg / acre. No record of RDF was found for DAP, MgSO₄, Zn SO₄, Zn SO₄, and lime in the soil test report.

Marked difference between the farmers opinion and soil test report could be observed specially for DAP application in both the crops. The farmers had been using @ 57.05 Kg /acre DAP in paddy and @ 73.87 Kg /acre in Jute samples without any recommendations.

7.2.13 Impact on Yield of Reference Crops amongst the Sample Households

With NCU usage, the average yield (13.80 qtl/acre) of the main crop (paddy) was found to be higher than that of those farmers using NU (13.10 qtl/acre). In case of by-product, the average yield was recorded at 8.97 and at 8.51 qtl per acre with NCU and NU use, respectively

The percentage of change in yield of main product (paddy) due to application of NCU over NU was worked out at 5.34 per cent and in case of by- product it stood at 5.41 per cent. There was no significant difference in prices of the main products and by- products when paddy was produced using NCU and NU. With NCU use, the price of the main product was found to be Rs. 1,137.00 per quintal and with NU use, the same was recorded at Rs.1, 122.39 per qtl registering an increase of 1.30 per cent. The price of the by -product (Rs.350.00 / qtl) was found to be remained same for both the situation.

With NCU usage, the yield of the main product (jute) out at 8.86 qtl per acre while with NU usage, the same was worked out was worked out at 8.60 qtl per acre registering an increase of 3.02 per cent. With usage of NCU, the yield of the by-product of jute was 3.10 qtl per acre and with the usage of NU, the same was recorded at 3.01qtl per acre indicating an increase of 2.99 per cent. With usage of NCU, the price of the main product (jute) was recorded at Rs. 2,043.90 per qtl which increased marginally to Rs. 2,054.99 per qtl. for NU users. The

price of the by- product (Rs.250 / qtl) remained same for both the situation. In case of jute crop as well, there was no much difference in prices of the main product & by- product produced by using NCU and NU.

7.2.14 Impact on the Total Input Cost of Reference Crops

It has been observed that the cost of pest and disease control, cost of weed management, cost of NCU and other costs (per acre) were found to be less for the NCU-users as compared to those who applied NU in case of paddy crop. For NCU users, the cost incurred on pest and disease was Rs.222/acre sharing 7.24 per cent of the total cost (Rs.3, 068.38/acre) and for NU users, it was Rs.243.59 per acre sharing 7.12 per cent of the total cost (Rs.3, 423.29 per acre). The percentage change in cost of NCU over NU on pest and disease management was worked out at (-) 8.86 per cent. The cost of weed management was recorded at Rs.1, 1311.96 per acre for NCU users (42.76 per cent of the total cost) and Rs.1, 350.22 per acre for NU-users sharing 39.44 per cent of the total cost with (-) 2.83 per cent change in NCU over NU.

For NCU users, the cost incurred on NCU was Rs.355.72/acre, sharing 11.59 per cent of the total cost (Rs.3,068.38/acre) while the cost incurred on NU was Rs.431.59 per acre, sharing 12.61 per cent of the total cost (Rs. 3,423.29) The percentage change was worked out at (-) 17.58 for NCU over NU. For NCU users, the cost of other fertilizers was recorded at Rs. 1,178.70 per acre, sharing 38.41 per cent of the total cost while in case of NU users, the cost of other fertilizers was found at Rs. 1,397.89 per acre sharing 40.83 per cent of the total cost and the percentage of change was worked out at (-) 15.68 per cent in NCU over NU. The percentage of change in aggregate cost for NCU over NU was recorded at (-) 10.37 per cent.

Similarly, the impact of Neem Coated Urea on input cost of jute was also assessed. It has been observed that the farmers who applied NCU incurred lesser amount of cost on different inputs use.

For NCU users, the cost incurred on pest and disease was Rs.126.56/acre, sharing 4.55 per cent of the total cost (Rs.2, 781.27 per acre) and for NU users, it was Rs.122.75 per acre sharing 4.33 per cent of the total cost (Rs.2, 836.21 per acre). The cost of weed management for NCU users stood at Rs. 1211.16 per acre, constituting 43.55 per cent of the total cost. As against this, NU users spent Rs. 121167 per acre on this count, which constituted 42.72 per cent of the total cost. The percentage change was (-) 0.04 per cent in NCU over NU users. The cost of NCU was recorded at Rs.242.58 per acre, sharing 8.72 per cent of the total cost and that of NU, was Rs. 291.58 per acre, which constituted 10.28 per cent of the total cost. The percentage change was worked out at (-) 16.80 per cent in NCU over NU.

For NCU users, the cost incurred on other fertilizers was recorded at Rs.1, 200.97 per acre, constituting 43.18 per cent of the total cost and for NU users; it was recorded at Rs. 1, 210.21, sharing 42.67 per cent of the total cost. The percentage of change was worked out at (-) 0.76 per cent in NCU over NU. At overall level, the percentage of change in cost was worked out at (-) 1.94 for NCU over NU

Thus, the analysis clearly indicates that the NCU – users were benefitted in terms of reduced cost.

7.2.15 Impact on soil health and crop growth

In course of field investigation, it was tried to assess the impact of NCU-usage on soil health and crop growth and accordingly, queries were posed before the sample respondents on a select group of soil characteristics, *viz.*, soil texture, soil moisture retention capacity, water infiltration, soil softness and soil compaction, *etc.*,

However, the sample farmers could not furnish any objective replies on these attributes. There is a reason to believe that one cannot draw any inference on those lines, merely on the basis of visual observation and it needs a separate study in more scientific lines.

7.3 Policy Recommendations

On the basis of the field survey and observations made by the investigators, the following recommendations and policy suggestions can be drawn

1. A large chunk of farmers and even some of the officials in the line Department did not know the intricacies of the new policy of the Govt. for introduction of the Neem Coated Urea. Therefore the Govt. may come with mass awareness campaign at village level to educate the farmers on application of NCU and its advantages. To do away with the apprehension of a section of the farmers, some field trials may also be taken up at village level to instil confidence among the farmers. This will help in hastening the process of adoption by the farmers.
2. Undertaking an impact study of NCU in Assam seems to be little earlier in the sense that a sizeable section of the farmers are yet to go for NCU usage. The study can be carried out one year hence, so that the impact can be assessed.
3. As evidenced from the research findings, the merits & demerits of normal urea *vis-a-vis* NCU and their mode of action should be made known to the farmers by the Govt. machineries so that the farmers on its own can take judicious decision.
4. Appropriate doses of NCU needs to be defined/ recommended for each crop grown by the farmers..
5. The pace of achieving target for issuance of SHC was found to be very slow in Assam, reason being that the Govt. Department does not have adequate infrastructure. The job

of collecting soil samples has therefore been assigned to three private agencies recently. As such, the Govt. should develop a kind of supervisory mechanism to see that the scheme being implemented in right spirit.

6. The price of NCU is needed to be monitored weekly at distributor's and retailer's levels so that no unscrupulous forces can take undue advantages.
7. Supply of NCU at right time and right place needs focussed attention and should be ensured by all possible means.

7.4 Conclusions

Introduction of NCU (Neem Coated urea) is a new initiative by the Union Government primarily intended to replace the NU from the crop field in consideration of its comparative advantages. Added to this is yet another new programme launched by the Govt. is the Soil Health Card Scheme (SHC) initiated in Feb/ 2015. As a matter of fact, both the schemes complement each other with the ultimate objective of benefitting the farming community.

From the field study undertaken in the state of Assam, one can readily observe that the NCU-users are in a better off position as compared to NU-users, in terms of production, productivity & income. Diversion of NU for industrial purpose and the artificial shortage often encountered was found to be fast disappearing at the advent of NCU. If both the schemes (NCU & SHC) go hand in hand, with regular monitoring and supervision by the Govt. agencies, it can be a happy augury to bring about a desired change in Indian agriculture as conceived by the Union Government. And for this to happen, the need of the hour would be a dedicated approach on the part of the implementing agencies and a responsive farming community to move forward.

Chapter VIII

EXECUTIVE SUMMARY

Among all the fertilizers, urea is used extensively by all the farmers throughout Assam. Research findings suggest that, there are some disadvantages of Normal Urea (NU) application. It is easily soluble in water and decomposes even at room temperature resulting in huge losses. In order to increase the Nitrogen Use Efficiency of urea and to stop its diversion to industrial use, normal urea is coated with neem oil. In this endeavor, the National Fertilizer Limited standardized the technique of production of Neem Coated Urea (NCU) in 2002 and the Government of India decided in January, 2015 to make it mandatory for all the indigenous NU producers to produce a minimum of 75 per cent NCU out of the total domestic production. This cap was then raised to 100 per cent from May, 2015 onwards so that the farmers harvest benefits from NCU usage. The NCU came to the market of Assam by the end of 2015; per favour of Brahmaputra Valley Fertilizers Corporation Limited (BVFCL) and Indian Farmers Fertilizer Cooperative Ltd. (IFFCO).

For sustainable agricultural development, judicious use of chemical fertilizer is a must. It is possible only when the farmers know the natural health of soil of their crop field. Otherwise, the farmers suffer from two possibilities, *viz.*, over doses and lower doses of fertilizers. Overdoses of fertilizers always have a bad affect on natural soil structure and on natural environment and lower doses of fertilizers result in low productivity of crops. Both the situations are equally important for all the stakeholders. Therefore, soil testing programme was started at the behest of all the State Governments across the country, but the programme remained confined amongst a limited number of farmers only. As such, a proper diagnostic analysis was deemed necessary for the farmers to know the strength and weaknesses of their farm land to maintain the soil quality. With this end in view, the Government of India launched a new programme for issuance of Soil Health Card (SHC) in February, 2015 last. Under this scheme, all the farmers of the country will receive Soil Health Card in which the recommended doses of fertilizers and micronutrients will be mentioned for information of all concerned. As per the guidelines, a new or a modified card will be given to the farmers once in 3 years, because the level of soil nutrients may undergo changes during the interim period. In Assam, as per report of the Directorate of Agriculture, the Government has already issued 64,168 Soil Health Cards under this new initiative as on August / 2016 to the farmers of different districts of Assam.

In this back drop, this study was taken up to assess the impact of Neem Coated Urea (NCU) on crop production and productivity in the state as compared to normal urea (NU) and

also to document the status of implementation of Soil Health Cards issued to the respondent farmers.

The specific objectives of the study are as under:

1. to analyze the trends in usage and prices of Urea versus NCU in Assam.
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 and implementation of SHCs scheme in the state.

Summary of Findings and Policy Suggestions

The present study was based on both primary and secondary level data. The reference period for the study was related to *Kharif* 2015 covering 2 crops *viz.*, paddy (irrigated) and Jute (un-irrigated). The primary level data were collected from 2 districts (*viz.*, Kamrup & Nagaon) of Assam having highest urea usage. From each district, 100 sample farmers were selected randomly for each crop. In aggregate, 200 sample farmers were selected from each district. Altogether, the study covered 400 sample farmers in 2 selected districts.

The summary of findings, on the basis of the observations and analysis of the secondary and primary level data are presented under the two headings as follows:

Impact of NCU on Production, Productivity, Farmers' Income and Soil health in Assam

It has been observed that urea consumption is showing an increasing trend from 194.10 thousand tonnes in 2006-07 to 392.39 thousand tonnes in 2015-16 with an ACGR of 3.38 per cent per annum during the period while price per MT (Rs.5470.00) of urea remained the same during 2006-07 to the last a few months of 2014-15, and was increased to Rs.5750. 00 per MT from some point of the year 2014-15 to 2015-16. The per hectare consumption of urea was also found to increase from 51.58 kg in 2006-07 to 89.44 kg per hectare in 2015-16. During this period, the ACGR of the per hectare consumption of urea in the State grew at 2.56 per cent per annum. This increase in urea use in Assam cannot simply be interpreted as increased use of urea in field crops only as large section of the farmers in Assam have small tea gardens in which they use urea extensively.

- Of the 400 sample farmers, about 86 per cent of the farmers were aware of NCU usage and its advantages. The highest (100 per cent) awareness was noticed in medium and large farm size group while about 83.91 per cent awareness was found against marginal & small size group farmers. To make it 100 per cent a special effort is needed for these two groups.

Increase in awareness was mainly due to the efforts of the State Agricultural Officers, farmers' facilitators, fellow farmers, KVK officials and input shops.

- About 77 per cent of the total NCU user farmers could mark the differences between the NCU and NU. The major factors in differentiating NCU from NU are colour difference (69.87 per cent), followed by leaf figure on the bag (20.56 per cent) and price difference (9.56 per cent).
- Regarding the perceptions of farmers about NCU *vis-a-vis* NU, about 77.33 per cent of the sample respondents indicated that the quality of NCU was good. About 87.21 per cent of the respondents expressed their satisfaction on timely availability of NCU. The price of NCU as not very high as reported by 67.44 per cent of the respondents. With application of NCU, there was a decline in the incidence of pests & diseases as noted by 52.33 per cent of the respondents in their crop fields. Also, no respondents came across any problems in accessing NCU in the market.
- With the application of NCU, the yield rate(ctl./acre) of paddy was found to increase to the extent of 5.34 per cent over NU and in case of jute, the yield rate (ctl./acre) on usage of NCU increased to the extent of 3.02 per cent as compared to NU. The by- products of paddy and jute (qtl./acre) also increased by 5.41 per cent and 2.99 per cent, respectively on usage of NCU over NU. The price of main product of paddy (Rs./ctl.) has increased by 1.30 per cent per acre on NCU over NU usage. But in case of jute, it declined marginally by 0.54 per cent on NCU over NU usage. It might be due to prevalent situation of the marketing yard. The usage of NCU did not impact on the prices of the by-products for both the crops.
- The total input cost of paddy which include the cost of pest and disease control, cost of weed management, cost of NCU/NU and cost of other fertilizers per acre was found to reduce by 10.37 per cent when the crop was grown with NCU as compared to NU usage while the total input cost of jute was reduced by 1.94 per cent in NCU over NU usage.
- The value of main product of paddy in the reference year 2015 was recorded at Rs.15,686.10 per acre for NCU users while it was recorded at Rs. 14,702.70 per acre for NU users. The value of main product was increased by 6.69 per cent in NCU over NU. This change was found statistically significant at 1.00 per cent probability level. The value of its by-product was recorded at Rs.3,138.59 per acre for NCU users and Rs. 2,980.10 per acre for NU users. The rate of increase was recorded at 5.32 per cent in NCU over NU. Interestingly, this change was also found statistically significant at 1.00 per cent probability level.
- The value of main product of jute in the reference year 2015 was recorded at Rs.18,104.67 per acre for NCU users while it was recorded at Rs. 17,675.27 per acre for NU users.

The value of main product was increased by 2.43 per cent in NCU over NU. This change was found statistically significant at 5.00 per cent probability level. The value of its by-product was recorded at Rs.775.07 per acre for NCU users and Rs. 752.61 per acre for NU users and increase was recorded at 2.98 per cent in NCU over NU and was also found statistically significant at 1.00 per cent probability level.

- The partial budgeting technique was also used to work out the economic feasibility of NCU for paddy and jute. It showed an additional return of Rs.1, 311.81 per acre for paddy and Rs. 615.96 per acre for jute from NCU usage.

Status of Soil Health Card Scheme in Assam

- Based on secondary level data (as per report of the Directorate of Agriculture, the Government of Assam), the State has already issued 64,168 SHCs as on August / 2016 to the farmers of different districts of Assam.
- The State Department of Agriculture was the only source of information and training on SHC for all the sample farmers. Only 8.75 per cent of the total sample respondents (400) got their soil tested at the time of field survey.
- Of the farmers who got tested their soil, the collection of soil samples facilitated by the Officials of State Department of Agriculture(60.00 per cent), Farmer Facilitator (37.14 per cent) and by themselves (2.86 per cent).
- Under the new SHC scheme, all the constraints faced by the farmers are being eliminated and concentrated efforts are on in a massive way to distribute SHCs to all the farmers of the State.
- Of the total respondents, about 33.25 per cent of the sample farmers adopted Recommended Doses of Fertilizers (RDF) in their field crops without undertaking soil testing. About 47.50 per cent of paddy respondents (200) and 19.00 per cent of jute samples (200) are reported to follow RDF in their crop fields.

Policy Recommendations

On the basis of the field survey and observations made by the investigators, the following recommendations and policy suggestions can be drawn

- A large chunk of farmers and even some of the officials in the line Department did not know the intricacies of the new policy of the Govt. for introduction of the Neem Coated Urea. Therefore the Govt. may come up with elaborate training programme at village level to educate the farmers on application of NCU and its advantages. To do away with

the apprehension of a section of the farmers, some field trials may also be taken up at village level to motivate the farmers.

- To assess on soli health, the Govt. may entrust some R&D agencies located in the State viz., Assam Agriculture University (AAU) or Indian Council of Agriculture (ICAR) institutes.
- As evidenced from the research findings, the merits & demerits of NU *vis-a-vis* NCU and their mode of action should be made known to the farmers by the Govt. machineries so that the farmers on its own can take judicious decision.
- Appropriate doses of NCU needs to be defined/ recommended for each crop grown by the farmers.
- The pace of achieving target for issuance of SHC was found to be very slow in Assam, reason being that the Govt. Department does not have adequate infrastructure. The job of collecting soil samples has therefore been assigned to three private agencies recently. Under the circumstance, the Govt. should develop a kind of supervisory mechanism to see that the scheme is being implemented in right spirit.
- The price of NCU is needed to be monitored weekly at distributor's and retailer's levels so that no unscrupulous forces can take undue advantages.
- Supply of NCU at right time and right place needs focussed attention and should be ensured by all possible means.

Conclusions

Introduction of NCU (Neem Coated Urea) is a new initiative by the Union Government, primarily intended to replace the NU from the crop field in consideration of its comparative advantages. Added to this is yet another new programme launched by the Government is the Soil Health Card Scheme (SHC) initiated in Feb/ 2015. As a matter of fact, both the schemes complement each other with the ultimate objective of benefitting the farming community.

From the field study undertaken in the state of Assam, one can readily observe that the NCU-users are in a better off position as compared to NU-users, in terms of production, productivity & income. Diversion of NU for industrial purpose and the artificial shortage often encountered are found fast disappearing at the advent of NCU. If both the schemes (NCU & SHC) go hand in hand, with regular monitoring and supervision by the Govt. agencies, it can be a happy augury to bring about a desired change in Indian agriculture as conceived by the Union Government. And for this to happen, the need of the hour would be a dedicated approach on the part of the implementing agencies and a responsive farming community to move forward.

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Appendix- I

Action taken report on comments from ISEC, ADRTC, Bengaluru on the draft report “Impact of Neem Coated Urea on Production, Productivity and Soil Health in Assam” submitted by AERC, Jorhat.

1. Title of the draft report examined:

Impact of Neem Coated Urea on Production, Productivity and Soil Health in Assam.

2. Date of receipt of the Draft report: 11th January, 2017

3. Date of dispatch of the comments: 23rd January, 2017

4. Comments on the Objectives of the study:

All the objectives of the study have been addressed.

5. Comments on the methodology:

Common methodology proposed for the collection of field data and tabulation of results has been followed. However, partial budgeting technique needs to be followed properly.

Action: The observation has been taken care of, accordingly

6. Comments on analysis, organization, presentation etc:

- i. In Chapter II, Trend values need to be estimated properly and kindly, fit the trend equation in graph. Re-analyze CAGR with significant levels, the figure reported seems to be wrong. The share of district-wise urea consumption is not worked out. Kindly, estimate the same at least for last ten years.

Action Trend values have been worked out and the graphical representation of trend equations have been presented as per suggestion. The worked out CAGRs have been re-checked and found correct. The share of district-wise urea consumption could not be worked out due to non-availability of district-wise data.

- ii. The overall values have been reported in the report using simple averages, instead, weighted average need to be considered.

Action: Done as per suggestion

- iii. The partial budgeting framework need to be followed in the report as per the methodology circulated to all the participant centers in the study. Estimations should be reported indicators-wise using partial budgeting (i.e., Added costs due to NCU in different indicators such as cost on pest & diseases, labour costs, fertilizers etc., should be reported separately).

Action: Done as per suggestion.

- iv. T-test was not worked-out for all the impact tables. Kindly, do the same.

Action: Done as per suggestion.

- v. Please, provide suitable policy suggestions in the last Chapter based on the results obtained.

Action: Done as per suggestion.

- vi. It is suggested to copy edit the report before finalizing.

Action: Done as per suggestion.

7. Overall view on acceptability of report

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

Suggestion incorporated and submitted.
