Study No-148

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

Study Sponsored by
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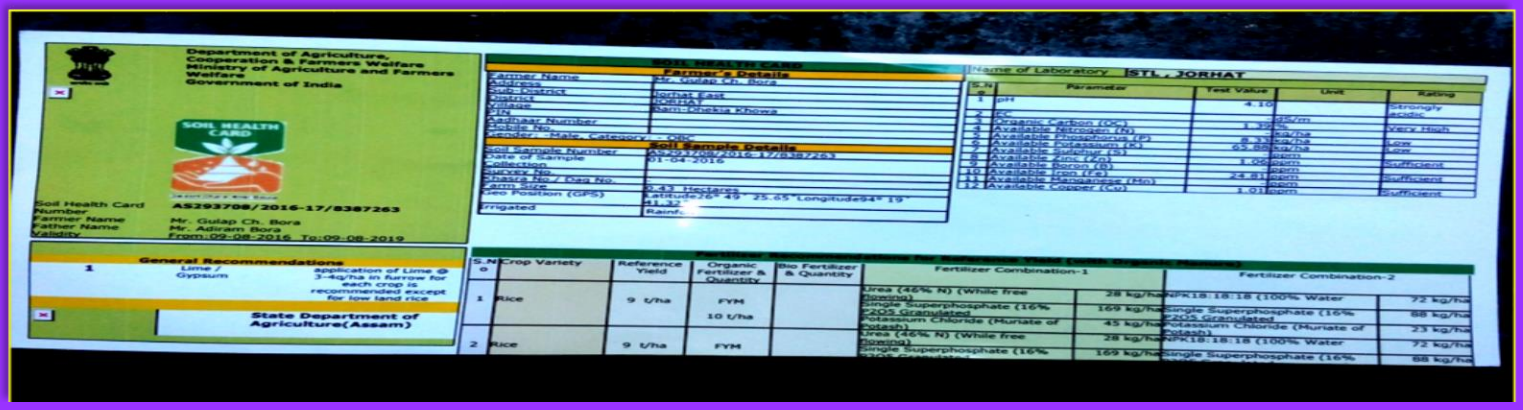

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Agro-Economic Research Centre for North-East India
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2017

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Agricultural Development and Rural Transformation Centre (ADRTC)
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2017

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Preface

Healthy Soils can provide healthy crops. Soils naturally contain many nutrients, out of which nitrogen, phosphorous, calcium and potassium are of prime importance. These nutrients are essential for plants' growth and development. When soil nutrients are missing or in short supply, plants suffer from nutrient deficiency and stop growing. Then, application of fertilizers to soils as per requirement is very important to provide balanced nutrients to the plants grown on it. The soils of Assam are basically acidic in nature. The productivity potential of soil is also limited. Together with cultivation of crops for years, the soils need to be replenished periodically. As such, soil test based application of fertilizers in the form of 'Soil Health Card' is a great step towards sustainable agriculture by the Government of India. The scheme is considered as a holistic measure for soil health and farm economy.

Considering the growing importance of soil testing, the present study entitled, "Impact of Soil Health Card Scheme 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, Bangalore and were incorporated in the final report.

This study was based on both primary and secondary level data. The reference period of the study was related to *Kharif* 2015. The primary data were collected from two districts (Jorhat and Golaghat) of Assam. Altogether, the study covered 120 sample farmers comprising 60 soil health card holders and 60 control farmers.

As per objectives and guidelines, a comparative study was supposed to be undertaken between the two groups of sample respondents to see the impact of the SHC Scheme on production and productivity of crops and to see the awareness of the farmers along with adoption of Recommended Doses of Fertilizers (RDF) on soil test basis, as well. But, no visible inference could be drawn from the study conducted in the state, as no farmers having SHCs so far, adopted the RDF till the date of field survey. Nevertheless, sincere attempts were made to portray a real picture of the field situation in the context of implementation of Soil Health Card Scheme. Such kind of evaluation study will be more meaningful only after the progamme reaches the field.

The present study is a joint output of the AER Centre, Jorhat. The names of the research staff associated with this study have been mentioned elsewhere in the report.

Anup Kr. Das
Director i/c
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CHAPTER - 1
Introduction

1.1 Background of the study

"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. To protect soil health and for sustainable agriculture, the Government of India launched Soil Health Cards (SHC) Scheme in February 2015. A SHC is meant to give each farmer soil nutrient status of his holding and advise him on the dosage of fertilizers and micronutrient and also the needed soil amendments that he should apply to maintain soil health in the long run. The scheme is considered as a holistic measure for soil health and farm economy. A SHC carries crop wise recommendation of nutrients and fertilizer required for the individual farms to help farmers to improve productivity through judicious use of inputs. In this programme, technical guidelines are given on how to collect the soil samples and where to test it. The job of soil testing is done in soil testing labs across the country. The experts in this line will analyze the strength and weaknesses (micro-nutrient deficiency) of the soil and suggest measure to deal with and the concerned department will distribute the cards amongst farmers of each state. In the guidelines, there is also an instruction to devise a mechanism to issue soil health cards every 3 years in respect of all holdings in order to capture the soil fertility changes occurring due to plant uptake or other natural causes.

As per Press Information Bureau, Government of India, December 23, 2015, Gujarat has been the first state to introduce Soil Health Cards Programme in 2003-04 to initiate scientific measures for Soil Health Care. In Gujarat, over 100 soil laboratories were set up and the result of the scheme was found quite satisfactory. The agricultural income of Gujarat rose from Rs. 14,000 crore in 2000-01 to staggeringly high of Rs.80,000 crore in 2010-11.

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 strategies by the soil scientists in order to reap a good harvest year after year.

Distribution and classification of soils in Assam is presented (percentage) in Table-1.1.1 and Fig-1.1

Table-1.1.1

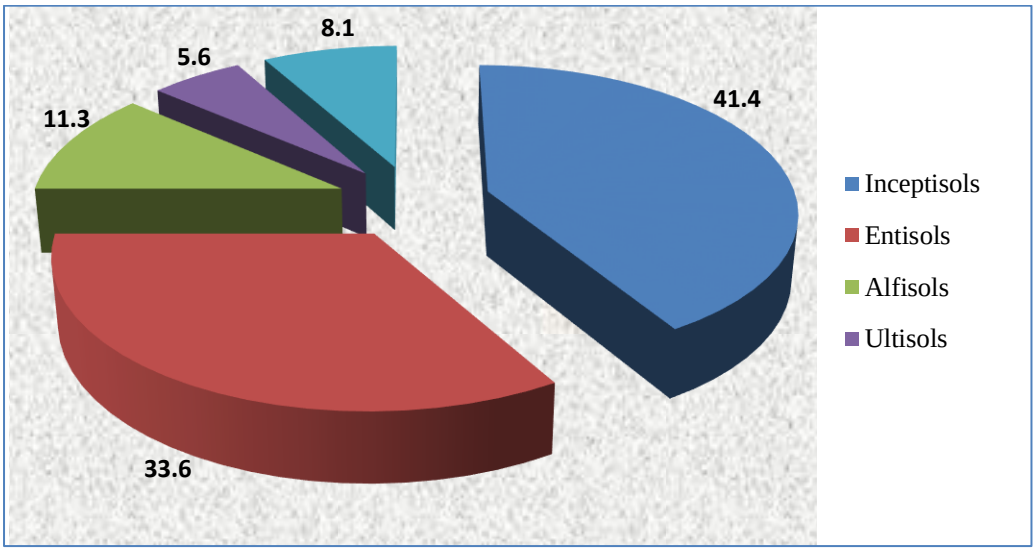
Distribution of soils (order) in Assam

Sl. No.	Classification	Percentage of Area
1	Inceptisols	41.4
2	Entisols	33.6
3	Alfisols	11.3
4	Ultisols	5.6
5	Miscellaneous	8.1

Source: NBSS (National Bureau of Soil Survey and Land Use Planning), Soils of India Series, Soils of Assam (ICAR) NBSS Publication 66

Fig.- 1.1

Distribution of soils (order) in Assam



In Assam, altogether there are 71 soil testing laboratories (STL) distributed in different districts of Assam. Of the total, only a few STL (10) in the state are doing the job of analyzing the collected soil sample under the SHC scheme. As per report of the Economic Survey of Assam, these soil testing laboratories have the capacity of analyzing 9000 soil samples in a year. According to the Directorate of Agriculture, Govt. of Assam, existing infrastructure of the STLs are not up to the mark for which the state is yet to reach the target in the given time line. Besides this, all Krishi Vigyan Kendras (KVKs) across the state of Assam also collect soil samples,

undertake soil analysis and distribute of SHCs amongst the farmers under the Rashtriya Krishi Vikash Yojona (RKVY) Scheme.. In addition Assam Agricultural University (AAU), Jorhat is also doing the job in its own STL under the same scheme. Recently the Government of India has distributed mini soil test lab. named as *Mridaparikshak* (Fig 1.2) in 21 districts of Assam, one for each district to speed up the work. (Table-1.1.2).

Table-1.1.2

Distribution of Soil Testing Laboratories (STL) in Assam

SL.No.	Particulars	No. of districts covered	No. of STL
1	STL under KVK	25	25
2	Mridaparikshak (A mini Lab for Soil Analysis and Fertilizer Advisory)	21	21
3	Mini STL (State Department)	7	7
4	Mobile Soil Testing Lab. Dibrugarh	1	1`
5	STL in the state	10	10
6	ICAR-NBSS & LUP ,Jorhat	1	1
7	Assam Agricultural University(AAU),Jorhat	2	2
8	College of Agriculture, Biswanath Chariali (AAU), Sonitpur	1	1
9	Central Laboratory, North East Institute of Science & Technology (NEIST), Jorhat	1	1
10	Central Silk Board, Jorhat	1	1
11	Soil & Water Testing Laboratories, Kamrup	1	1
Total			71

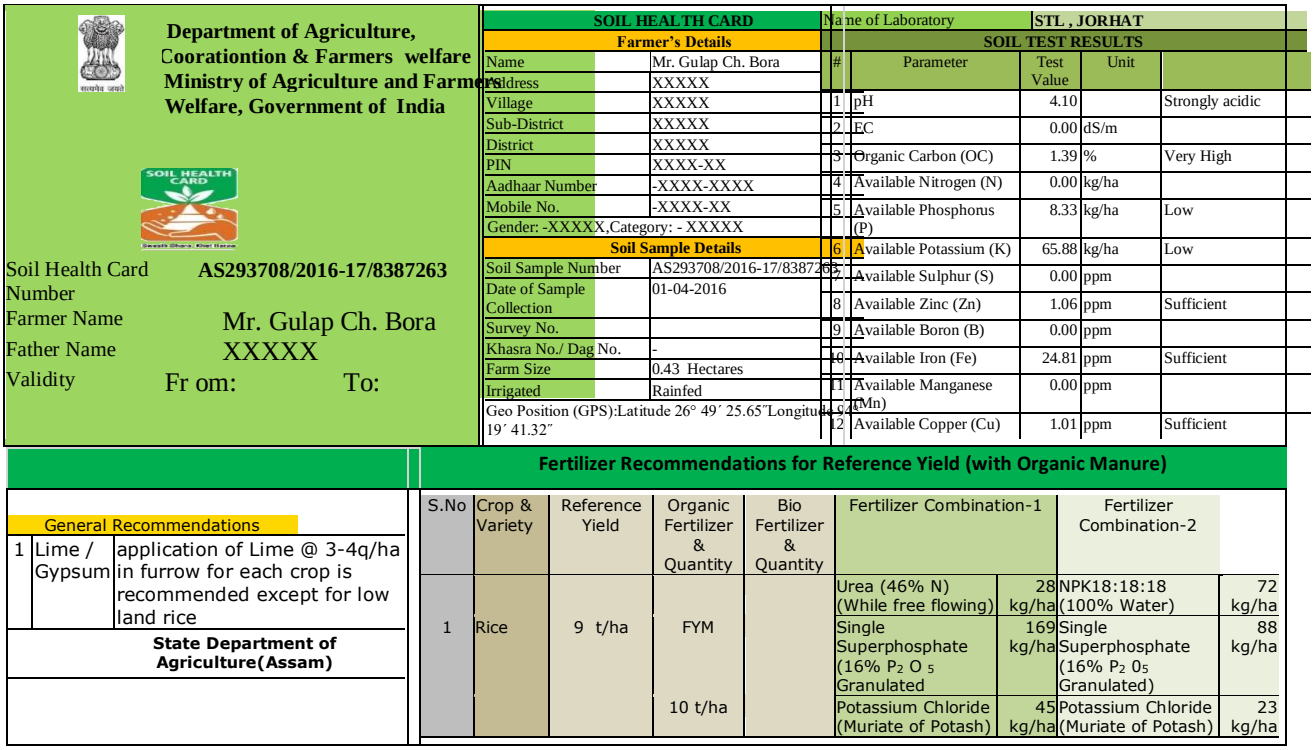
Source: Assam Small Farmers' Agri Business Consortium.

As per literature, at least 16 plant food nutrients are essential for proper crop development. These include Carbon (C), Hydrogen(H), Oxygen(O), Nitrogen(N), Phosporous (P), Sulpher (S), Potassium(K), Calcium(Ca), Magnesium(Mg), Iron(Fe), Manganese(Mn), Zink(Zn), Copper(Cu), Molybdnum(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 plants in large quantities.

As per SHC report, soil samples are analyzed for 12 parameters *viz.*, pH, EC (Electrical Conductivity), OC (Organic Carbon), Available Nitrogen(N), Available Phosphorus (P), Available Potassium (K), Available Sulpher (S), Available Zink (Zn), Available Boron (B), Available Iron (Fe), Available Manganese (Mn) and Available

Copper (Cu). In the card, required recommended dosages of urea, single super phosphate and muriate of potash per hectare are given with FYM per hectare against the specified crop indicating potential yield per hectare. An image of the SHC possessed by a farmer is shown below.

Image - 1.1
Soil Health Card distributed amongst the farmers of Assam



Department of Agriculture, Cooperation & Farmers Welfare
Ministry of Agriculture and Farmers Welfare, Government of India

Soil Health Card Number: AS293708/2016-17/8387263
Farmer Name: Mr. Gulap Ch. Bora
Father Name: XXXXX
Validity: Fr om: To:

SOIL HEALTH CARD

Farmer's Details

Name	Mr. Gulap Ch. Bora
Address	XXXXX
Village	XXXXX
Sub-District	XXXXX
District	XXXXX
PIN	XXXX-XX
Aadhaar Number	-XXXX-XXXX
Mobile No.	-XXXX-XX
Gender: -XXXXX,Category: - XXXXX	

Soil Sample Details

Soil Sample Number	AS293708/2016-17/8387263
Date of Sample Collection	01-04-2016
Survey No.	
Khasra No./ Dag No.	-
Farm Size	0.43 Hectares
Irrigated	Rainfed
Geo Position (GPS):Latitude 26° 49′ 25.65″Longitude 94° 19′ 41.32″	

Name of Laboratory: STL , JORHAT

SOIL TEST RESULTS

#	Parameter	Test Value	Unit	
1	pH	4.10		Strongly acidic
2	EC	0.00	dS/m	
3	Organic Carbon (OC)	1.39	%	Very High
4	Available Nitrogen (N)	0.00	kg/ha	
5	Available Phosphorus (P)	8.33	kg/ha	Low
6	Available Potassium (K)	65.88	kg/ha	Low
7	Available Sulphur (S)	0.00	ppm	
8	Available Zinc (Zn)	1.06	ppm	Sufficient
9	Available Boron (B)	0.00	ppm	
10	Available Iron (Fe)	24.81	ppm	Sufficient
11	Available Manganese (Mn)	0.00	ppm	
12	Available Copper (Cu)	1.01	ppm	Sufficient

General Recommendations

1	Lime / Gypsum	application of Lime @ 3-4q/ha in furrow for each crop is recommended except for low land rice

State Department of Agriculture(Assam)

Fertilizer Recommendations for Reference Yield (with Organic Manure)

S.No	Crop & Variety	Reference Yield	Organic Fertilizer & Quantity	Bio Fertilizer & Quantity	Fertilizer Combination-1		Fertilizer Combination-2	
1	Rice	9 t/ha	FYM		Urea (46% N) (While free flowing)	28 kg/ha	NPK18:18:18 (100% Water)	72 kg/ha
					Single Superphosphate (16% P_2O_5 Granulated	169 kg/ha	Single Superphosphate (16% P_2O_5 Granulated)	88 kg/ha
			10 t/ha		Potassium Chloride (Muriate of Potash)	45 kg/ha	Potassium Chloride (Muriate of Potash)	23 kg/ha

The Mini Soil Testing Lab ***(MRIDA PARIKSHAK)*** is developed by ICAR-Indian Institute of Soil Science, Bhopal in collaboration with Nagarjuna Agro-Chemicals (NAC) Pvt. Ltd., Hyderabad. With the help of this Mini Lab. 15 parameters of a soil sample can be analyzed. In Assam, analysis has been done for 12 parameters which is clearly reflected in the image of the soil health card. Analysis was not done for 3 parameters *viz.*, Lime requirement/ LpH, Calcareousness and Gypsum requirement.

Image – 1.2
MRIDA PARIKSHAK (A Mini Soil Testing Lab)

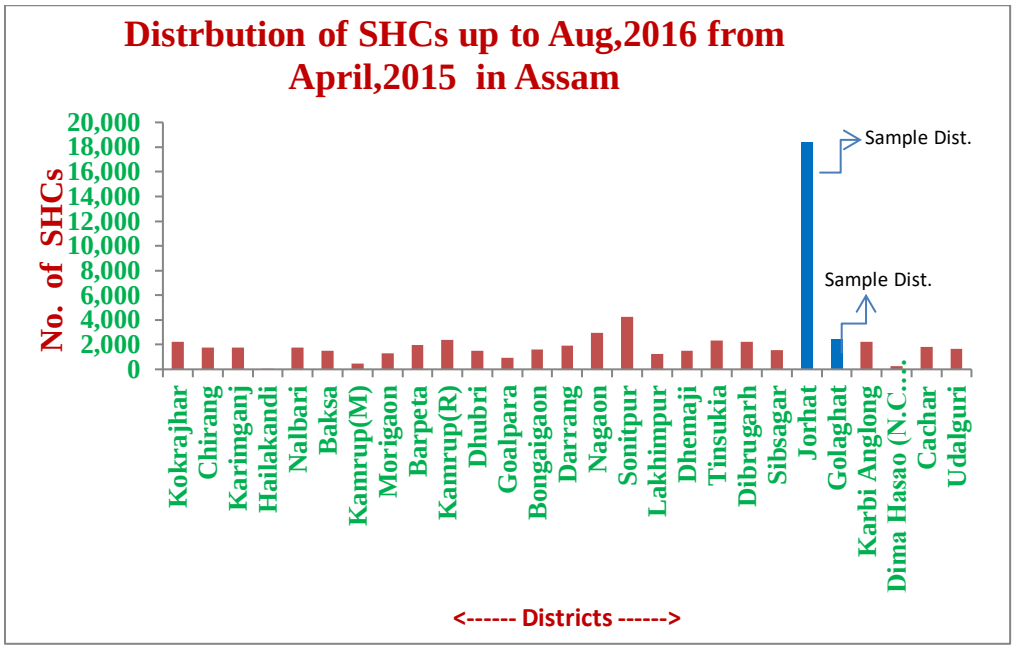
As per report of the Directorate of Agriculture, Government of Assam has so far issued 64,168 Soil Health Card (SHC) up to Aug/2016 to the farmers of different districts of Assam under the new policy of the Government of India. The district wise distribution of SHC is presented in Table-1.1.3 and Fig. 1.2

Table- 1.1.3
Soil Health Card Status

Sl. No.	District	Soil Health Card Distributed (Nos.) (up to April, 2016 from April, 2015)	Soil Health Card Distributed (Nos.) (up to August, 2016 from April, 2016)	Soil Health Card Distributed (Nos.) (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

Fig-1.2



It is seen from the table that the highest nos. of SHCs were distributed in Jorhat district (18,438) and the lowest nos. of SHCs were distributed in Hailakandi district (61) of Assam up to August, 2016 from April, 2015. Clearly, the State has to do a lot to accomplish the herculean task of covering 27.02 lakh farm families of the State.

The progress of Soil Health Card Scheme in all the States/ UTs has been worked out by the Press Information Bureau, Government of India, Ministry Agriculture. As per the report, about 1.39 lakh cards have been distributed to the farmers of Assam as on 14.03.2017 and the state detail is presented in Table-1.1.4.

Table-1.1.4
Number of soil samples collected, analyzed and number of soil health cards issued to the farmers in Assam

State	Total soil samples target for 2015-16 & 2016-17	Soil samples		Total soil health card target for 2015-16 & 2016-17	Soil Health Card issued
		Collected	Tested		
Assam	2,78,707	1,81,041	51,119	15,40,968	1,39,150

Note: This information was given by the Minister of State for Agriculture & Farmers' Welfare, Parshottam Rupala, in reply to question in Rajya Sabha

The revised status of the SHC scheme published by the Department of Agriculture Cooperation & Farmers' Welfare, for soil sample tested as on 14.03.2017 in the state is presented in Table – 1.1.5. Total target for Soil Samples collection &

testing during Cycle -1 (2015-16 & 2016-17) was 2.79 lakh. About 1.81 lakh (cumulative) soil samples were tested up to 14.03.2017 and the progress of soil sample tested during the period was about 64.96 per cent. The cumulative target of 2.32 lakh soil samples testing has been achieved during 2015-16 and about 1.35 lakh cumulative number of soil samples has been collected. The progress of soil samples collected was 57.98 per cent during 2015-16.

Table-1.1.5
Status of Soil Health Card Scheme for Soil Samples Tested up to 14.03.2017

(Figures in Lakh)

State	Total Target for Soil Samples collection & Testing during Cycle -1(2015-16 & 2016-17)	Cumulative No. of soil Samples Tested up to 14.03.2017	Percent Progress of soil sample Tested	Cumulative Target for Soil Samples Testing during Cycle-I (2016-17 +Backing of 2015-16)	Cumulative No. of Soil Samples Tested during April-2016 to 14 March,2017	Percent Progress of soil samples Tested during April-2016 to 14 March, 2017
Assam	2.79	1.81	64.96	2.32	1.35	57.89

Note: Progress report of SHC scheme, Department of Agriculture Co-operation & Farmer's Welfare.

Trend in Urea Consumption and Price Variation in the State

It has been observed (from the Table-1.1.6) 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.5,750.00 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.

Table-1.1.6
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

Fig –2.1 & 2.2 showed an increasing trend of sales/consumption of Urea and its price in Assam during the reference period, respectively.

Figure:1.3
Trend of Sales/Consumption of Urea in Assam

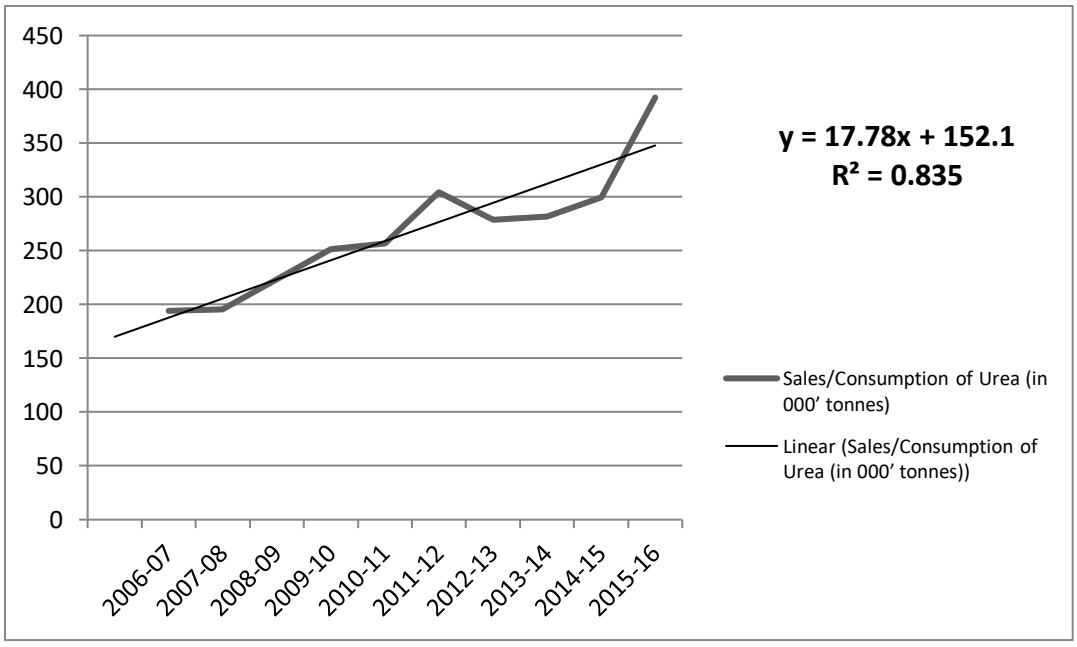
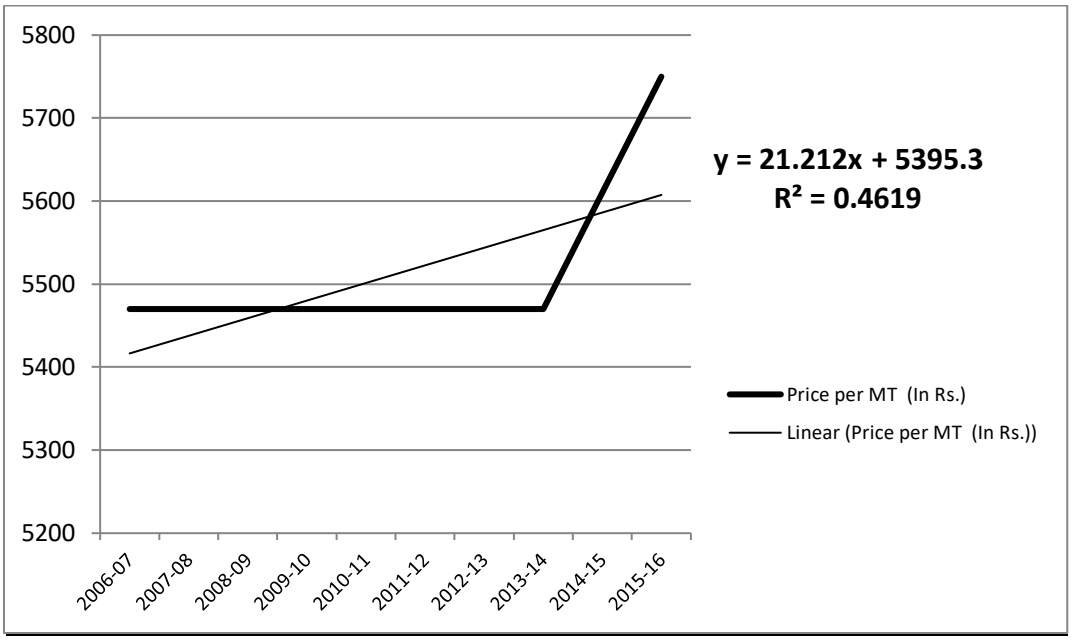


Figure:1.4
Urea Price Trend in Assam



1.2 Review of literature

Soil is the life line of all the living beings. Sustainable agriculture is solely dependent on soil health which is directly linked with the economic productivity of the crops. Proper management of soil health is a vital issue since introduction of artificial nutrient to raise the productivity level of the crops. In this regard, agricultural scientist, farmers and stake holders have raised their voice against excessive dosages of fertilizers in fear of damage of natural soil structure and warn at different point of times that once the natural structure of soil is damaged, it will not be able to repair easily. The SHC scheme has emerged as an important programme on restoring and improving the soil health.

The north-eastern region occupies eight per cent of India's land area and is home to four per cent of its population. Agriculture provides livelihood to 70% of the region's population. In Mizoram, around 51% of population lives in rural areas and is dependent on agriculture. The figure in Sikkim is as high as 89%. However, the pattern of agricultural growth has remained uneven across the region. The states continue to be net importers of food grains for their own consumption. However, over the last decade, the demand-supply gap of food grains in the north-eastern region had

narrowed down. The proportion of area under irrigation in the region is very low and investment in building irrigation capacity has been insufficient. Assam and rest of the North-Eastern states have abundant natural resources and congenial climatic conditions, and as such, the large chunk of educated youth can make the region suitable to trigger India's Second Green Revolution. Comparative advantages of the region in producing fruits, vegetables and other horticulture products can be tapped by setting up small-scale processing units for the local market which can also boost the rural employment. As stated by the Prime Minister of India, Shri Narendra Bhai Modi, the North-East should focus on a Second Green Revolution through organic farming (Press Information Bureau, Government of India, Ministry of Agriculture, 14 –February-2016).

The Union Agriculture & Farmers' Welfare Minister, Shri Radha Mohan Singh reviewed the status of the Soil Health Card Scheme with Secretaries (Agriculture)/Directors (Agriculture) of States on 23.02.2016 and in his opening remarks, he mentioned that Soil Health Card (SHC) Scheme is an important Scheme of the Government. It aims at promoting soil test based balanced use of fertilizers, so that the farmers can realize higher yields at lower cost.

The target for the year 2015-16 was to collect 100 lakh soil samples and test these for issue of Soil Health Cards to the farmers. During discussion with the states, it was observed that States like Andhra Pradesh, Arunachal Pradesh, Nagaland, Sikkim, Gujarat, Bihar, Tripura, Tamil Nadu, Meghalaya, Maharashtra, Punjab, Himachal Pradesh, Kerala, Telangana, Rajasthan and Jharkhand had shown good performance in soil sample collection. Gujarat, Andhra Pradesh, Tamil Nadu, Maharashtra Goa and Sikkim had shown satisfactory performance in distribution of Soil Health Card and they also achieved the target by March, 2016. The Agriculture & Farmers' Welfare Minister urged upon the other States to expedite the process so as to fulfill the target as per time schedule.

Against the target of 104 lakh soil samples, the States have reported collection of 81 lakh soil samples and tested 52 lakh soil samples. The States distributed 1.12 crore Soil Health Cards and 2 more crore cards were under printing, and would be distributed before March, 2016.

Shri Singh stressed upon building network of soil testing laboratories. The guidelines of the scheme have been amended to set up soil testing labs as well as mini labs through Capital Investment Subsidy Scheme (CISS) implemented through

NABARD. The guidelines have been modified to involve students of Agriculture and other Science Colleges in soil health card programme.

Agriculture and Farmers' Welfare Minister also reviewed setting up of soil testing labs. Most of the States are under the process of tender for purchase of equipment for the labs. Shri Singh advised the States to use the funds released by the Government and set up more laboratories with facility for micronutrient testing. He also advised them to promote portable mini labs and position them at Block/Panchayat level so that target is achieved in time.

National Portal of Soil Health Card was reviewed and was found that some States had not come on board; they were Arunachal Pradesh, Assam, Bihar, Goa, Manipur, Meghalaya, Mizoram, Nagaland, Telangana and Tripura. Against 80 lakh samples collected only 6.5 lakh samples were registered on the Portal. These States were advised to train their staff through e- learning programme being conducted by NIC and to start use of the National Portal. The NIC Officers made a presentation on Mobile Phone Application at village level to capture soil health card data using Android Phone. (Press Information Bureau, Government of India, Ministry of Agriculture, 24 – February-2016).

In the study done by Amundson (2015), it was reported that domestication of soils by human disturbances for intensive farming hampered a large number of important soil processes. These were reflected through three major events *viz.*, a higher loss of soil than its production, a greater loss or release of nutrient than its addition and a higher loss of carbon than its replenishments.

In a study carried out by the Indian Council of Agricultural Research (ICAR) and State Agricultural University (SAU) it was shown that soil health could be restored and improved through soil test-balanced and integrated use of plant nutrients. Farmer's awareness regarding soil health restoration technology had to be increased, so as to prevent further deterioration of this valuable natural resource. (Soil Health Mission: Government initiatives, paper published by Ashok Dalwai and Vandana Dwivedi)

To make an effective rehabilitation, knowledge about the recuperative/ resilient capacity – the ability to bounce back to original conditions after a disturbance of soil is needed. Good protocol for measuring the resilience capacity of soil is, however, not available; although many researchers have made modest attempts to such a protocol (Seybold *et.al*. 1999; Mandal 2013; Basak *et.al*.2014)

Major reasons for soil fertility deterioration include wide gap between nutrient demand and supply, high nutrient turnover in soil-plant system coupled with low and imbalanced fertilizer use, emerging deficiencies of secondary and micronutrients, rise of soil acidity and nutrient immobilization in red, lateritic and clayey soils. Faulty management of irrigation water stimulates leaching of nutrients and development of water logging, salinization and alkalization. (Chaudhari S.K (2016) Soil Health in India: Retrospective and Perspective published in the Bulletin of the Indian Society of Soil Science, No.30 pp 34-52)

Soil quality can be defined as the fitness of a specific kind of soil, to function within its capacity and within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality and support human health and habitation (Karlen et al. 1997, Arshad and Martin 2002).

Consideration of soil as a finite and living resource, led to the concept of soil health defined as the continued capacity of soil to function as a vital living system, within ecosystem and land-use boundaries, to sustain biological productivity, maintain or enhance the quality of air and water and promote plant, animal and human health (Doran et al. 1996, 1998, Doran and Zeiss 2000).

Though the use of soil health has emerged in recent years, variation in ability of soils to suppress plant diseases is known since many decades (Janvier et al. 2007). Baker and Cook (1974) described the suppressive soils in which disease severity or incidence remains low, in spite of the presence of a pathogen, a susceptible host plant and climatic conditions favourable for disease development.

Another concept linked to soil suppressiveness is the concept of soil receptivity to diseases addressing the role of soil factors in determining the expression of inoculums density and pathogenic capacity of the inoculums or intrinsic aggressivity of the inoculums in terms of appearance or severity of the disease (Linderman et al. 1983).

Arbuscular mycorrhizal fungi not only improve crop nutrition but also protect corps from pathogens and toxic substances (Jeffries et al. 2003). Further, a soil rich in organic carbon and nutrients (considered commonly as high quality soils) may not be considered to be a healthy soil if it causes injury to crops or supports large parasite populations (Abawi and Widmer 2000). Van Bruggen and Semenov (2000) viewed soil health as a dimension of ecosystem health and explained soil health as the resistance and resilience of soil in response to various stresses and disturbances. Thus,

there is a considerable degree of overlapping in the meaning of soil quality and sol health (Doran 2002), though soil health perceptions tend to focus more on biotic components of soil (Anderson 2003). Soil degradation or deterioration in soil health or quality implies loss of the vital functions of soil: (i) providing physical support, water and essential nutrients required for growth of terrestrial plants; (ii) regulation of the flow of water in the environment and (iii) elimination of the harmful effects of contaminants by means of physical, chemical and biological processes, i.e., environmental buffer or filter (Constanza et al. 1992 a, b, Bastida et al. 2006). The quality and health of soil determine agricultural sustainability and environmental quality, which jointly determine plant, animal and human health (Haberern 1992, Doran 2002).

1.3 Major objectives of the study and Scope of the study

The specific objectives of the study are as follows:

1. to document the status and implementation of soil health card scheme.
2. to analyze the impact of adoption of soil testing technology and recommended doses of fertilizers on the basis of SHCs, on crop production, productivity and soil health.

In Assam, the cropping pattern remains almost same in the last few years. The farmers are not fully aware of the level of soil nutrients in their crop fields. Soil Health Card will be helpful for optimizing land use and proper crop planning for higher productivity. In this regard, the Union Agriculture Minister Radha Mohan Singh the rightly mentioned that the scheme is a path breaking initiative which would create a golden opportunity for the farmers to improve the productivity of the crops and also to go for crop diversification. This will certainly contribute significantly to ensure food security of the country. Therefore, the scope of the study is very vast and needs periodical assessment to capture the changes in the agricultural scenario after introduction of this holistic programme.

1.4 Data and methodology

The present study is based on secondary and primary level data. The primary level data were collected from 2 districts (Jorhat and Golaghat) having the highest number of the SHC distributed across the state. The list of the card holders were collected from the District Agricultural Office and the Pro-Tech Associate (A private agency hired by the Government to collect soil samples, printing of cards and distribution amongst the farmers. The primary level information was collected with

the help of a prescribed schedule designed by the coordinating centre through interaction with sample farmers. In aggregate, the study covered 120 sample households with 60 each from both the selected districts. Required data were collected from 30 recipients of SHCs under the scheme and 30 non-recipients (as control group) farmers in each of the districts.

1.5 Limitation of the study

The main limitation of the study was that it was too early to conduct such an impact study as the cards were distributed very recently and that too for rice only and no beneficiary farmers were found to use the RDF (Recommended dosages fertilizer) and micronutrient in their crop field. The sample farmers are yet to apply the RDF in their cultivation practices.. The sample farmers also desired that a training programme is needed to understand the guidelines for effective use of SHC.

The village head-man in the sample area of Golghat district also complained that they were not aware of how and when soil samples were collected and refused to receive the cards. At the same time, the village headman of the Jorhat district sample helped the agency in collection of samples, were not paid any kind of remuneration in spite of verbal commitment till date of field survey.

Further, the farmers do not have the habit of record keeping in black and white and as such, most of the information was based on their recall memory.

As the cards are distributed very recently, the farmers may go for applying the RDF in the next crop season ,*i.e., Kharif* paddy,2017-18.

Moreover, some of the sample farmers in Jorhat district were reluctant to go for *Kharif* paddy because of elephant (wild) disturbance. Also area being flood affected one, a very few households have the interest to go for *Kharif* paddy, 2017-18.

In the secondary level data, it was shown that about 1.39 lakh cards have already been issued to the farmers in the state during 2015-16 to 2016-17. But the details of the list could not be provided by the concerned district/ state agricultural offices.

In the same reference period, it was recorded that as many as 18,438 and 2,426 cards were issued to the farmers in Jorhat and Golaghat district, respectively. But in Jorhat district, before going to the field survey, a list of 45 farmers only could be collected from the District Agriculture Office and M/S Pro Tech Associate, out of

which, there was a ceremonial distribution of 10 SHCs on August 15, 2016 (Independence Day Celebration) and the rest 35 cards were distributed in April, 2017.

In Golaghat district, the SHCs were distributed to the farmers in March/April, 2017 only. During field survey, some of the beneficiaries reported that they did not know much about the scheme and the procedure involved, for which they have doubt on the creditability of the cards issued (RDF) to them. Therefore, the farmers emphasized on the need for training programme to learn about the scheme and its implementation. A large proportion of the sample farmers (about 66.67%) also agreed to go with the instruction given in the SHC for *kharif* paddy in the forth coming season.

After completion of the study, the State Department of Agriculture published another District wise portal entry status of SHCs as on 14.06.2017 for Assam [presented in APPENDIX (Table- A-1)] which is quite contradictory to the above tables. The reason behind of it was not known.

1.6 Chapter Stream of the study

The chapter stream of the study is planned as per guidelines given by the Coordinating Centre. Keeping in view of the objectives, the study was divided into 6 chapters. Each chapter further subdivided into some sub-sections. The chapters include Introduction (Chapter-I), Socio-Economic Characteristics of the Sample Households (Chapter-II), Status of Awareness of SHC Scheme (Chapter-III), RDF as per SHC Scheme (Chapter-IV), Impact of SHC Scheme (Chapter-V), Summary and Policy Suggestions (Chapter-VI).

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Chapter II
Socio-Economic Characteristics of the Sample Households

This chapter gives a comparative analysis of the socio-economic status of the control farmers vis-*à-vis* the farmers who got their soil tested over time.

2.1 General Characteristics

A comparative picture of general characteristics between the control farmers and soil tested sample farmers is presented in Table-2.1. At over all level, the average age of the respondents was 48.15 years and the level of education of the respondents were found to vary from primary to HSLC level. Agriculture was the main occupation for about 84.17 per cent of the respondents. Of the total respondents, 95 per cent were male and only 5 per cent were female respondents. In overall, the average family size was 4.89 persons. In each sample household, on an average, 3 persons were engaged in farming. Each respondent had 28.40 years of experience in farming. The caste structure of the sample respondents indicated 4.17 per cent SC, 71.67 per cent OBC and 24.17 per cent were under General category. There were no respondents in the ST category in the study area.

Table- 2.1
General characteristics of sample households

Particulars	Control Farmers (60)	Soil tested farmers (60)	Overall (120)
Average age of respondents	47.4	48.9	48.15
Average years of respondent education	4	4	4
Agriculture as main occupation	85.00	83.33	84.17
Gender (% of respondents)			
Male	100.00	90.00	95.00
Female	0.00	10.00	5.00
Average family size (No.)	4.8	4.97	4.89
Average number of people engaged in farming in a family	2.92	3.08	3.00
Average years of experience in farming	27.43	29.37	28.40
Caste (% of respondents)			
SC	6.67	1.67	4.17
ST	-	-	
OBC	71.67	71.67	71.67
General	21.67	26.67	24.17

Source: Primary Survey

Average years of respondent education (Code): Iliterate =1, Literate =2, primary=3, higher Primary=4, SSLC=5, PUC=6, Degree=7,MSc=8, Ph=9

2.2 Land holdings

The operational land holding owned by the sample respondents indicated the main economic status of each household. Table-2.2 gives the status of land holding of the respondents with important breakup of the land across the two groups, i.e. control and Soil Tested farmers. At overall level, about 161.45 acres of land were possessed by both the groups of farmers with an average size of 1.35 acre per household. About 22.98 acres were under leased in land, 10.75 acres under leased out land and 6.45 acres remained as uncultivable land. Rental value of leased in land and leased out land usually varied depending upon the status of the soil along with irrigation facility. No sample farmers were found to have irrigated leased in land in both the groups of farmers. The rental value of un-irrigated leased in land at the overall level was found at Rs. 7,541.43 per acre. The per acre rental value of irrigated leased out land and un-irrigated leased out land at the overall level were found to be Rs. 9,250.00 per acre and Rs. 7,405.40 per acre, respectively. Of the total net operated area, only 8.64 per cent had irrigation facility and a large percentage of area (91.35%) were not covered under irrigation**.**

Table- 2.2
Operational land holdings of sample Households

(Area in Acre)

Particulars	Control Farmers (60)		Soil tested farmers (60)		Overall (120)	
	Area	%	Area	%	Area	%
Owned land	153.14	-	169.76	-	161.45	-
Leased in	20.99	13.71	24.96	14.70	22.98	14.23
Leased out	5.95	3.89	15.54	9.15	10.75	6.66
Uncultivated land	3.31	2.16	9.59	5.65	6.45	4.00
Rental value of Irrigated leased in land (Rs/acre)	-		-		-	
Rental value of Un- irrigated leased in land (Rs/acre)	7,340.00		7,742.86		7,541.43	
Rental value of Irrigated leased out land (Rs/acre)	-		9,250.00		9,250.00	
Rental value of Un-irrigated leased out land (Rs/acre)	7,188.00		7,625.00		7,405.40	
Total irrigated land	7.93	4.81	21.00	12.38	14.47	8.65
Total un-irrigated land	156.94	95.19	148.59	87.62	152.77	91.35
Net operated land	164.87	100.00	169.59	100.00	167.23	100.00

Source: Primary Survey

2.3 Sources of irrigation

There are different sources of irrigation such as Dug well, Bore well, Canal, Tank and others. In the sample area, farmers accessed irrigation water from the STW source only (Table-2.3).

Table- 2.3
Sources of irrigation of sample households (% of HH)

Particulars	Control Farmers (60)	Soil tested farmers (60)	Overall (120)
Dug well	0.00	0.00	0.00
Bore well	0.00	0.00	0.00
Canal	0.00	0.00	0.00
Tank	0.00	0.00	0.00
Others (STW)	100.00	100.00	100.00

Source: Primary Survey

2.4 Cropping pattern

Table-2.4 presents the cropping pattern followed by both the groups of farmers in *Kharif* season from April to September. *Kharif* Paddy is the dominant crop of Assam. Of the total gross cropped area during the season, paddy covered 89.34 per cent in case of the control farmers group and 82.94 per cent in the soil tested group. About 10.65 per cent and 17.06 per cent of the area were covered by the vegetables in case of control farmers group and the soil tested group, respectively. No other crops were reported to be grown by both the groups.

Table- 2.4
Cropping pattern of the sample households (% of area)

(Area in Acre)

Season	Crops	Control farmers	Soil tested farmers
Kharif ,2015	Paddy	147.31	140.65
		(89.34%)	(82.94 %)
	Vegetables	17.56	28.93
		(10.65%)	(17.06 %)
	Other crops	0.00	0.00
		(0.00 %)	(0.00 %)

Source: Primary Survey

2.5 Gross income from agricultural production

Gross income realized by the sample households from agriculture during *Kharif* season is presented Table-2.5 In both the groups, all the sample farmers cultivated *Kharif* paddy. Further, 85 per cent of the farmers in control group and 86.67 per cent of the soil tested group cultivated *Kharif* vegetables. The total production of *Kharif* paddy stood at 1,859.75 qtl with an average yield of 31.00 qtl. per household against the control farmers group and 1,844.99 qtl. with an average yield of 30.75 qtl per household against the soil tested group. In control group, the area under *Kharif* paddy was marginally higher than that of the soil tested farmers groups, for which production per household showed a marginal increase in case of control group farmers. However, the yield rate (13.12 qtl./acre) was more in soil

Table- 2.5

Gross income realized by the sample households by agricultural production

Crops	Control farmers							Soil tested farmers						
	% of farmers	Production (Qtls.)		Avg. qty sold (Qtls)	Avg. price (Rs/Qtl)	Gross income obtained (Rs)		% of farmers	Production (Qtls.)		Avg. qty sold (Qtls)	Avg. price (Rs/Qtl)	Gross income obtained (Rs)	
		Total	Avg. per HH			Total	Per Acre		Total	Avg. per HH			Total	Per Acre
Kharif Paddy	100.00	1,859.75	31.00	13.18	1,223	2,274,474	15,440	100.00	1,844.99	30.75	12.98	1,225	2,260,113	16,069
Kharif Vegetables	85.00	199.58	3.91	2.30	1,145	228,519	13,014	86.67	331.47	6.37	3.68	1,143	378,870	13,096

Source: Primary Survey

tested farmers groups as compared to the control group (12.62 qtl/acre). It might be due to difference in quality of soil, available irrigation facility and other inputs used. In case of *kharif* vegetables, the control farmers group produced 199.58 quintal with an average yield of 3.91 qtl per house hold while the soil tested group produced 331.47 quintal with an average yield of 3.68 qtl per household.

In the control group, each household sold 13.18 quintal of *kharif* paddy out of the total production at Rs.1,223.00/qtl. constituting 42.52 per cent. And in case of soil tested farmers group, each household sold 12.98 quintal of paddy at almost the same rate constituting 41.87 per cent of the total average production.

The average price of vegetables was recorded at Rs.1,145.00/qtl in case of control farmers group and Rs.1,143/qtl. in case of soil tested farmers' group.

In control farmers group, a gross return of Rs.2,274,474.00 (Rs.15,440/acre) and Rs.228, 519.00 (Rs.13,014/acre) were recorded in *kharif* paddy and *kharif* vegetables, respectively and in case of soil tested farmers' group, the gross returns were worked out at Rs.2,260,113.00 (Rs.16,069/acre) and Rs.378,870.00(Rs.13,096/acre) for *kharif* paddy and *kharif* vegetables, respectively. The area under the reference crops and marginal price variation were the major factors of difference in gross return per acre.

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Chapter –III
Status of Awareness of SHC Scheme

3.1 Awareness on soil testing

The level of farmers' awareness on soil testing in the study area is presented in Table-3.1 on the basis of the responses obtained during the field survey. The farmers in both the groups were not aware of Integrated Nutrient Management (INM) and therefore, they did not experience any reduction in consumption of chemical fertilizers due to adoption or non-adoption of INM. But, 79.17 per cent of the sample farmers were aware of the imbalanced application of fertilizers and its ill effect on soil and crop production. The sample households however, did not have any information about the ongoing programmes on Soil Health Mission in the study area. However, 58.33 per cent of the sample households in the control group and 100.00 per cent farmers in soil tested group were aware of the Soil Health Card Scheme. Under the SHC scheme, soil samples were collected by grid sampling technique by the agency which is considered to be an efficient and cost-effective technique. The sample farmers however, were completely ignorant about the grid system practiced under the SHC Scheme.

Table- 3.1
Awareness on soil testing among sample households

(% of farmers)

Particulars	Control farmers	Soil tested farmers	Total
Households know about INM	0.00	0.00	0.00
Households experienced the reduction in consumption of chemical fertilizers due to INM	0.00	0.00	0.00
Households awareness on imbalanced application of fertilizers and its effects	78.33	80.00	79.17
Households knowledge about ongoing programmes on Soil Health Mission	0.00	0.00	0.00
Households aware of Soil Health Cards	58.33	100.00	81.67
Households awareness on grid system under SHC scheme	0.00	0.00	0.00

Source: Primary Survey

3.2 Sources of information about soil testing

Usually there are different sources of information on soil testing *viz.,* State Agricultural University (SAU), Krishi Vigyan Kedras (KVKs), Private Companies, Agriculture Department, Friends, Neighbours/ Village Head-man, *etc.,*. Among these, Private Company, Agriculture Department and Neighbours/ Village Head-man played

a significant role in making the farmers aware of the benefits of soil testing (Table-3.2). The Private Company provided the information backup to 48.33 per cent of the soil tested farmers and 37.14 per cent of the control group. The Agriculture Department recorded a coverage of 23.33 per cent of the soil tested farmers and 17.14 per cent of the control farmers. About 28.33 and 45.71 per cent of the farmers in the corresponding groups were covered by neighbors/ village-headman.

Table-3.2
Sources of information about soil testing

(% of farmers)

Sources	Soil tested farmers	Control farmers
SAUs	0.00	0.00
KVKs	0.00	0.00
Private companies (Pro-Tech Associate)	48.33	37.14
Agriculture Department	23.33	17.14
Friends	0.00	0.00
Neighbors/Village Head	28.33	45.71

Source: Primary Survey

3.3 Training programs attended on application of chemical fertilizers

As reported by the sample respondents, no farmers from either of the groups attended any training programmes organized by the Agriculture Department on application of chemical fertilizers (recommended dosages). They applied chemical fertilizers on the basis of their own experience and in consultation with the co-farmers.

3.4 Methods of application of fertilizers

The sample farmers in the field area mainly applied Urea, DAP, SSP, MOP and Micronutrients. There was no report of applying any Complex and Other fertilizers. Micronutrients were applied in vegetable crops only. About 52 households from SHC holders and 51 from Control group cultivated vegetable crops in *Kharif* season.

Table-3.4.a
Method of application of fertilizers
(SHC holders)

(% of farmers)

Method of fertilizer application	Urea	DAP	SSP	Potash	Micro nutrients	Complex fertilizers	Other fertilizers
Broadcasting	100.00	100.00	100.00	100.00	0.00	0.00	0.00
Spraying	0.00	0.00	0.00	0.00	90.38	0.00	0.00
Fertigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drilling	0.00	0.00	0.00	0.00	9.62	0.00	0.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source: Primary Survey

Table-3.4.b
Method of application of fertilizers
(Control Group)

(% of farmers)

Method of fertilizer application	Urea	DAP	SSP	Potash	Micro nutrients	Complex fertilizers	Other fertilizers
Broadcasting	100.00	100.00	100.00	100.00	0.00	0.00	0.00
Spraying	0.00	0.00	0.00	0.00	90.20	0.00	0.00
Fertigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drilling	0.00	0.00	0.00	0.00	9.80	0.00	0.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source: Primary Survey

The methods of application of fertilizers and micronutrients as adopted by the sample farmers are presented in Table-3.4.a and Table-3.4.b. All the sample respondents (100%) applied all the fertilizers through broadcasting method of application while the micronutrients were applied by the method of spraying (about 90%) and drilling (about 10%) only in vegetable crops for both the groups.

3.5 Details of soil sampling

Although the sample farmers heard about the ongoing SHC scheme, they were quite ignorant about the scheme in details, especially on implementation part. They did not have any knowledge on average cost of soil testing (Rs./sample), average number of samples to be taken for soil testing, average number of plots to be considered for soil testing and average area covered under soil testing. The average distance from the farmers' field to the Soil Testing Laboratories was about 25.35 Km as reported by the sample respondents. (Table-3.4)

Table 3.5
Details of soil sampling

Sl. no.	Particulars	Soil tested farmers
1	Average cost of soil testing (Rs/sample)	0.00
2	Average distance from filed to soil testing lab (kms)	25.35
3	Average samples taken for soil testing	Not known
4	Average no. of plots considered for soil testing	Not known
5	Average area covered under soil testing	Not known

Source: Primary Survey

3.6 Sources for fertilizer purchase

Generally farmers purchase fertilizers/ micronutrients from different sources *viz.*, Private fertilizer shops/ dealers, Company authorized dealers, Co-operative Societies, Government Agency and Others. In the sample area, all the respondents from

Table -3.6.a
Sources for fertilizers purchase
(SHC holders)

(% of farmers)

Sources	Urea	DAP	SSP	POTASH	COMPLEX	Micronutrient	Bio-fertilizers
Private fertilizer shops/dealers	100.00	100.00	100.00	100.00	0.00	100.00	0.00
Company authorized dealers	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Co-operative societies	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Government agency	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Others	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: Primary Survey

Table -3.6.b
Sources for fertilizers purchase
(Control Group)

(% of farmers)

Sources	Urea	DAP	SSP	POTASH	COMPLEX	Micronutrient	Bio-fertilizers
Private fertilizer shops/dealers	100.00	100.00	100.00	100.00	0.00	100.00	0.00
Company authorized dealers	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Co-operative societies	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Government agency	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Others	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: Primary Survey

both the groups (SHC holders & Control group) reported that they used to purchase fertilizers/ micronutrients from the Private fertilizer shops/ dealers (100%) only as there were no other types of supplies agencies available in their locality (Table-3.6.a and Table-3.6.b)

3.7 Soil sampling

The sample card holders reported that the soil sample collection is being done by a Private Company (Pro Tech Associate) on behalf of the RSK officials of the State Agriculture Department in the study area and in some pockets, the concerned

Table 3.7
Sources of soil sample collection

(% of farmers)

Particulars	**Soil tested farmers**
Self	0.00
Private company on behalf of RSK officials	60.00
SAUs	0.00
KVKs	0.00
Farmer facilitator (Village Head man)	40.00

Source: Primary Survey

Private Company employed some farmer facilitators/ village headmen to collect the soil samples under their jurisdiction. A training programme was organized by the private agency for collection of samples in the vicinity of the village area. A large percentage (60%) of the total soil samples was collected by the private agency alone and the remaining 40.00 per cent was collected by the village headman. (Table-3.7)

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Chapter IV
RDF as per SHC Scheme

4.1 Recommended quantity of fertilizers based on soil test results

The average recommended quantity of fertilizers as given in the SHC received by the sample respondents vis-a-vis farmers' practiced for rice crop is presented in Table-4.1. The average recommended doses for rice were FYM @ 4.05 ton /acre, Urea @ 11.34 kg/acre, SSP @ 68.59 kg/acre, MOP @ 17.83 kg/acre and Lime @ 1.42 qtl./acre. There was no recommendation against DAP, $MgSo_4$ and Potash as evident from the SHC. On the other hand, the farmers applied FYM @ 0.45 ton/acre, Urea @ 9.08 kg/acre, DAP @ 18.15 kg/acre and MOP @ 15.13 kg/acre.

Table -4.1
Average recommended quantity of fertilizers

Crops	FYM (ton/acre)	Urea (Kg/acre)	DAP (Kg/acre)	SSP (Kg/acre)	MOP (Kg/acre)	MgSo4 (Ks/acre)	Potash (Kg/acre)	Lime (Qtl/acre)
Based on soil test results (for Rice only) [as given in the SHC]								
Paddy	4.05	11.34	-	68.59	17.83	-	-	1.42
Based on Farmers opinion								
Paddy	0.45	9.08	18.15	-	15.13	-	-	-

Source: Primary Survey

4.2 Organic fertilizer for reference crops

Only 25 (41.67%) sample households out of the total 60 SHC holders applied organic fertilizers (FYM) in the study area. They applied FYM in 30.91 acres of area under reference crop (*Kharif* paddy). The average area covered under organic fertilizers was recorded at 1.24 acre per household. The average quantity of FYM applied per acre was 397.28 kg and the price of FYM was Rs. 2.00 per kg. The total quantity of FYM was recorded at 122.80 quintal (Table-4.2). Application of FYM was found to decline over time due to decrease of livestock population in the study area.

Table -4.2
Applied organic fertilizers for reference crop (*kharif* paddy)

Particulars	FYM	VC/Biogas	Bio-fertilizer	Green manure	Other organic manure	Total quantity applied (in qtls.)
% of farmers applied organic fertilizers	41.67	-	-	-	-	-
Average area covered under organic fertilizers (Acres)	1.24	-	-	-	-	-
Average quantity applied (Kgs/acre)	397.28	-	-	-	-	122.80
Price (Rs/kg)	2.00	-	-	-	-	-

Source: Primary Survey

4.3 Problems encountered in implementation of the SHC scheme

Following problems were encountered by the implementing agencies in implementation of the SHC Scheme:

1. In Assam, there are about 27.02 lakh farm families. But no agency maintains authentic records of the bona fide farmers with proper address and land holding till date. Problems, many a time arose in identifying the real owner of the farm for collection of soil samples, which ultimately posed difficulties in implementation of the SHC scheme.
2. Collection and analysis of soil samples, printing of SHCs and its distribution seem to be an arduous task for the State Agriculture Department. This may be the reason for which the jobs were entrusted to a private agency (Pro-Tech Associate).
3. Existing infrastructure of the State Labs are not up to the mark to achieve the target(s) within the given time line.
4. Initially, micronutrient analysis of soil samples could not be undertaken in the state labs due to technical problems. Mini Soil Test Labs *(Mridha Parikshak)* were issued to the State Labs in January, 2017 only.
5. Short supply of reagents often hampered a lot in analyzing the soils samples.
6. Lack of technical guidance and training programme to handle the *Mridha Parikshak*, were identified to be yet other problems for soil sample analysis.
7. Shortage of employees and frequent transfer of the Lab staff stood as a major hindrance in accomplishing the job in right earnest.

4.4 Suggestions for improvement of SHC scheme

1. Proper monitoring of the work of the agency associated with collection of soil samples and distribution of card is necessary. As such, the Govt. should develop a kind of supervisory mechanism to see that the scheme is being implemented in letter and spirit.
2. Soil map for each district is needed which would be helpful to capture the soil structure of the district at a glance.
3. Adequate infrastructure development of soil labs in the state needed focussed attention.
4. Farmers must be taken into confidence while collecting the soil samples from their crop field.
5. There is an urgent need to develop a functional data base of the farmers of the state. This will facilitate implementation of any agricultural development programme.
6. The implementing agency, for each programme should maintain up to date information in public domain.

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Chapter-V
Impact of SHC Scheme

The primary objective of the present study was to see the impact of the SHC Scheme on production and productivity of crops. As per guidelines a comparative study was supposed to be undertaken between the two groups of sample respondents *i.e.* soil tested farmers and control group farmers (*i.e.* without SHCs). However, no visible inference could be drawn from the study conducted in Assam, as no farmers having SHCs so far, adopted the RDF till the date of field survey. The following are the reasons for non-adoption of RDF:

- Most of the sample farmers have received the SHC very recently, just one or two month before the field survey (*i.e.* in March and April, 2017 only).
- Only a few sample farmers received the SHC in August, 2016. In the mean time *Kharif* crop season for the main crop rice (as the RDF on SHC was recorded for rice only) was over in the state.
- It was too early to see the impact of SHC Scheme in the state, reason being that the pace of implementation of the scheme continues to be very low due to inadequacy of facilities available, already highlighted elsewhere in the report.
- Most of the farmers could not understand and interpret the importance of the RDF given in the SHCs. Arranging training prgrammes amongst the farmers would be essential for adoption of the RDF in the forth coming *Kharif* season.
- Some of the sample farmers also reported that they were not taken into confidence while collecting the soil samples from their crop fields by the concerned private agency (Pro-Tech Associate) on behalf of the State Agriculture Department, Assam. Many of the farmers, therefore, still reluctant to go with the RDF given in the card. For obvious reasons, the farmers who are associated with this scheme are required to be motivated so that they can understand the benefits of the SHC scheme in terms of yield and ultimately the profit.

5.1 Cost of cultivation and income of major crop (*Kharif* Paddy)

As the RDF was not adopted by any of the sample farmers, the impact of application of recommended doses of fertilizer on yield and visible changes could not be found and incorporated in the report. In spite of that it was tried to work out the cost of cultivation and income of major crop (*Kharif* Paddy) for the sample farmers.

The cost of cultivation and income of *Kharif* Paddy for the sample farmers have been presented in Table-5.1. From the table it is seen that the quantity and cost of most of the inputs (i.e. total labour, FYM, Fertilizers, *etc.*) are marginally in higher side for the soil tested farmers as compared to control group farmers except the rental

Table 5.1
Changes in cost of cultivation of *Kharif* paddy crop and income in Assam, 2015

(Per Acre)

variables	Unit	Soil Tested Farmers		Control Group		Difference	
		Qty	Cost (Rs)	Qty	Cost (Rs)	Qty	Cost (Rs)
Cost							
Total labour cost		45.38	10,222	44.62	10,207	0.76	15
Manure/ FYM	Tonnes	0.09	175	0.08	169	0.01	6
Seed	No/Kgs	18.63	466	18.60	465	0.03	1
Fertilizers- N (Urea)	Kgs	9.08	82	8.80	79	0.28	3
P (DAP)	Kgs	18.15	635	17.42	610	0.73	26
K (MOP)	Kgs	15.13	303	14.30	287	0.83	16
Complex	Kgs	-		-		-	
Others	Kgs	-		-		-	
	Kgs	-		-		-	
PPC	Litres	-		-		-	
Irrigation *	Acre inch	-	14	-	6	-	8
Others		-		-		-	
Rental value of land		-	795	-	993	-	-198
Land revenue		-	176	-	176	-	0
Total Cost			**12,868**		**12,993**		**-125**
Return							
Variables	**Unit**	**Qty**	**Value (Rs.)**	**Qty**	**Value**	**Qty**	**Value**
Main product yield	Qtls	13.12	16,072	12.62	15,434	0.50	638
By- product yield	Qtls	2.04	509	1.87	468	0.17	41
Gross Income			**16,581**		**15,902**		**679**
Net Income			**3,713**		**2,909**		**804**

Note: *Out of total paddy areas 140.65 acres (for Soil tested group) and 147.32 acres (for Control group), only 10.76 acre and 4.84 acre areas are irrigated respectively.

value of the land. The rental value of land (Rs. 795/acre) for soil tested farmers was less than that of control group (Rs. 993/ acre) by Rs. 198, as the leased in area under control group was more than that of the soil tested group. The total costs of cultivation of *Kharif* paddy per acre of land were calculated at Rs. 12,868 and Rs. 12,993 for Soil tested and the control group farmers, respectively, with a marginal difference of Rs.125.

On the return part, per acre yield (13.12 qtls.) for soil tested farmers was marginally higher *i.e.* 0.50 qtl. valued at Rs. 638 than the yield of the control farmers (12.62 qtl). There was a marginal difference of 0.17 qtl. (valued at Rs. 41) in the yield of by-product also, and the net income difference between the two groups was worked out at Rs. 804 per acre. Although, the soil tested farmers got slightly higher yield than the control group, it might not be due to judicious use of fertilizer as there was no such noticeable difference. It might have happened due to some other exogenous factors.

Impact of any development programme can be assessed only when it goes to the field for execution. As the farmers in the sample area received the Soil Health Cards a bit late and could not go with the RDF as yet, proper evaluation of the scheme in Assam could not be undertaken in the true sense of the term. An assessment of this flagship programme can be carried out meaningfully in subsequent crop seasons if timely measures in the line are taken by the implementing agencies.

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Chapter VI
Summary and policy suggestions

6.1.1 Background

"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. To protect soil health and for sustainable agriculture, the Government of India launched Soil Health Cards (SHC) Scheme in February 2015. A SHC is meant to give each farmer soil nutrient status of his holding and advise him on the dosage of fertilizers and micronutrient and also the needed soil amendments that he should apply to maintain soil health in the long run. The scheme is considered as an holistic measure for soil health and farm economy. A SHC carries crop wise recommendation of nutrients and fertilizer required for the individual farms to help farmers to improve productivity through judicious use of inputs. In this programme, technical guidelines are given on how to collect the soil samples and where to test it. The job of soil testing is done in soil testing labs across the country. The experts in this line will analyze the strength and weaknesses (micro-nutrient deficiency) of the soil and suggest measure to deal with and the concerned department will distribute the cards amongst farmers of each state. In the guidelines, there is also an instruction to devise a mechanism to issue soil health cards every 3 years in respect of all holdings in order to capture the soil fertility changes occurring due to plant uptake or other natural causes.

The soils of Assam are acidic in nature. The productivity potential of soil generally is also limited. With the 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 strategies by the soil scientists in order to reap a good harvest year after year.

6.1.2 Major objectives of the study and Scope of the study

The major objectives of the study are as follows:

1. to document the status and implementation of soil health card scheme.
2. to analyze the impact of adoption of soil testing technology and recommended doses of fertilizers on the basis of SHCs, on crop production, productivity and soil health.

In Assam, the cropping pattern remains almost same in the last few years. The farmers are not fully aware of the level of soil nutrients in their crop field. The Soil Health Cards will be helpful for optimizing land use and proper crop planning for higher productivity. In this regard, the Union Agriculture Minister Radha Mohan Singh had rightly mentioned that the scheme is a path breaking initiative which would create a golden opportunity for the farmers to improve the productivity of the crops and also to go for crop diversification. This will certainly contribute significantly to ensure food security of the country. Therefore, the scope of the study is very vast and needs periodical assessment to capture the changes in the agricultural scenario after introduction of this holistic programme.

6.1.3 Data and methodology

The present study is based on secondary and primary level data. The primary level data were collected from 2 districts (Jorhat and Golaghat) having the highest number of the SHC distributed across the state. The list of the card holders were collected from the District Agricultural Office and the Pro-Tech Associate (A private agency hired by the Government to collect soil samples, printing of cards and distribution amongst the farmers). The primary level information was collected with the help of a prescribed schedule designed by the coordinating centre, through interaction with sample farmers. In aggregate, the study covered 120 sample households with 60 each from both the selected districts. Required data were collected from 30 recipients of SHCs under the scheme and 30 non-recipients (as control group) farmers in each of the districts.

6.1.4 Limitation of the study

The main limitation of the study was that it was too early to conduct such an impact study as the cards were distributed very recently and that too for rice only and no beneficiary farmers were found to use the RDF (Recommended dosages fertilizer) and micronutrient in their crop field. The sample farmers are yet to apply the RDF in their cultivation practices. The sample farmers also desired that training programmes are needed to understand the guidelines for effective use of SHC.

The village head-man in the sample area of Golaghat district also complained that they were not aware of how and when soil samples were collected and ultimately refused to receive the cards. On the other side, the village headman of the Jorhat district sample came forward to help the agency in collection of samples. However,

were not paid any kind of remuneration in spite of verbal commitment till the date of field survey.

Further, the farmers did not have the habit of record keeping and as such, most of the information was based on their recall memory.

As the cards are distributed very recently, the farmers may go for applying the RDF in the next crop season, i.e., *Kharif* paddy, 2017-18.

Moreover, some of the sample farmers in Jorhat district were reluctant to go for *Kharif* paddy because of elephant (wild) disturbance. Also area being flood affected one; very few households have shown their interest to go for *Kharif* paddy, 2017-18.

In the secondary level data, it was shown that about 1.39 lakh cards have already been issued to the farmers in the state during 2015-16 to 2016-17. But the details of the list could not be provided by the concerned district/ state agricultural offices.

In the same reference period, it was recorded that as many as 18,438 and 2,426 cards were issued to the farmers in Jorhat and Golaghat district, respectively. But in Jorhat district, before going to the field survey, a list of 45 farmers only could be collected from the District Agriculture Office and M/S Pro Tech Associate, out of which, there was a ceremonial distribution of 10 SHCs on August 15, 2016 (Independence Day Celebration) and the rest 35 cards were distributed in April, 2017.

In Golaghat district, the SHCs were distributed to the farmers in March/April, 2017 only. During field survey, some of the beneficiaries reported that they did not know much about the scheme and the procedure involved, for which they have doubt on the creditability of the cards issued (RDF) to them. Therefore, the farmers emphasized on the need for training programme to learn about the scheme and its implementation. A large proportion of the sample farmers (about 66.67%) also agreed in principle to go with the instruction given in the SHC for *Kharif* paddy in the forth coming season.

After completion of the study, the State Department of Agriculture published another District wise portal entry status of SHCs as on 14.06.2017 for Assam [presented in APPENDIX (Table- A-1)] which is quite contradictory and the reason behind it was not known.

6.1.5 Trend in Urea Consumption and Price Variation in the State

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 consumption of urea per hectare 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 consumption of urea per hectare in the State grew @ 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.

6.1.6 Chapter Stream of the study

The chapter stream of the study is planned as per guidelines given by the Coordinating Centre. Keeping in view of the objectives, the study was divided into 6 chapters. Each chapter further subdivided into some sub-sections. The chapters include Introduction (Chapter-I), Socio-Economic Characteristics of the Sample Households (Chapter-II), Awareness of SHC Scheme (Chapter-III), RDF as per SHC Scheme (Chapter-IV), Impact of SHC Scheme (Chapter-V), Summary and Policy Suggestions (Chapter-VI).

6.2 Socio-economic characteristics of sample households

This chapter gives a comparative analysis of the socio-economic status of the control farmers' vis-*à-vis* the farmers who got their soil tested over time. However, the analysis is not in line of impact study as the farmers are yet to go for adopting the RDF as indicated in the SHC issued.

6.2.1 General Characteristics

At over all level, the average age of the respondents was 48.15 years and the levels of education of the respondents were found from primary to HSLC level. Agriculture was the main occupation for about 84.17 per cent of the respondents. Of the total respondents, 95 per cent were male and only 5 per cent were female respondents. The average family size was 4.89 persons. In each sample household, on an average, 3 persons were engaged in farming. Each respondent had 28.40 years of experience in farming. The caste structure of the sample respondents indicated 4.17

per cent SC, 71.67 per cent OBC and 24.17 per cent were from General category. There were no respondents in ST category in the study area.

6.2.2 Land holdings

At overall level, about 161.45 acres of land were possessed by both the groups of farmers with an average size of 1.35 acre per household. About 22.98 acres were under leased in land, 10.75 acres under leased out land and 6.45 acres remained as uncultivable land. Rental value of leased in land and leased out land usually varied depending upon the status of the soil along with irrigation facility. The rental value of leased in land at the overall level was Rs. 7,541.43 per acre and it was Rs.7, 677.34 per acre in case of leased out land. Of the total net operated area, only 8.64 per cent had irrigation facility and the remaining area (91.35%) were not covered under irrigation**.**

6.2.3 Sources of irrigation

There are different sources of irrigation such as Dug well, Bore well, Canal, Tank and others. In the sample area, farmers accessed irrigation water from the STW source only.

6.2.4 Cropping pattern

Kharif season starts from April to September in Assam. *Kharif* Paddy is the dominant crop of Assam. Of the total gross cropped area during the season, paddy covered 89.34 per cent in case of the control farmers group and 82.94 per cent in the soil tested group. About 10.65 per cent and 17.06 per cent of the area were covered by vegetables in case of the control farmers group and the soil tested group, respectively. No other crops were reported to be grown by both the groups.

6.2.5 Gross income from agricultural production

Gross income realized by the sample households from agriculture during *Kharif* season were estimated for both the groups. In both the groups, all the sample farmers cultivated *Kharif* paddy. Further, 85 per cent of the farmers in control group and 86.67 per cent of the soil tested group cultivated *Kharif* vegetables. The total production of *Kharif* paddy stood at 1,859.75 qtl with an average yield of 31.00 qtl. per household against the control farmers group and 1,844.99 qtl. with an average yield of 30.75 qtl per household against the soil tested group. In control group, the area under *Kharif* paddy was marginally higher than that of the soil tested farmers groups, for which the production per household showed a marginal increase in case of control group farmers. However, the yield rate (13.12 qtl./acre) was more in soil

tested farmers groups as compared to the control group (12.62 qtl/acre). It might be due to difference in quality of soil, available irrigation facility and other inputs used. In case of *Kharif* vegetables, the control farmers group produced 199.58 quintal with an average yield of 3.91 qtl per house hold while the soil tested group produced 331.47 quintal with an average yield of 3.68 qtl per household.

In the control group, each household sold 13.18 quintal of *Kharif* paddy out of the total production at Rs.1,223.00/qtl. constituting 42.52 per cent. And in case of soil tested farmers group, each household sold 12.98 quintal of paddy at almost the same rate constituting 41.87 per cent of the total average production.

The average price of vegetables was recorded at Rs.1,145.00/qtl in case of control farmers group and Rs.1,143/qtl. in case of soil tested farmers' group.

In control farmers group, a gross return of Rs. 2,274,214.00 (Rs.15,438 /acre) and Rs. 228,519.00 (Rs.13,014 /acre) were recorded in *Kharif* paddy and *Kharif* vegetables, respectively and in case of soil tested farmers' group, the gross returns were worked out at Rs. 2,260,113.00 (Rs.16,069/acre) and Rs.378,870.00 (Rs. 13,096 /acre) for *Kharif* paddy and *Kharif* vegetables, respectively. The area under the reference crops and marginal price variation were the major factors of difference in gross return per acre.

6.3 Awareness on SHC scheme

The level of farmers' awareness on soil testing was studied on the basis of the responses obtained during the field survey. The farmers in both the groups were not aware of Integrated Nutrient Management (INM) and therefore, they did not have any experience of reduction in consumption of chemical fertilizers due to adoption of INM. But, 79.17 per cent of the sample farmers were aware of the about imbalanced application of fertilizers and its ill effect on soil and crop production. The sample households however, did not have any information about ongoing programmes on Soil Health Mission in the study area. However, 58.33 per cent of the sample households in the control group and 100.00 per cent farmers in soil tested group were aware of the Soil Health Card Scheme. Under the SHC scheme, soil samples were to be collected by grid sampling technique by the agency, which is considered to be an efficient and cost-effective technique. The sample farmers however, were completely ignorant about the grid system practiced under the SHC Scheme.

6.3.1Sources of information about soil testing

Usually there are different sources of information on soil testing *viz.*, State Agricultural University (SAU), Krishi Vigyan Kedras (KVKs), Private Companies, Agriculture Department, Friends, Neighbours/ Village Head-man, *etc.*,. Among these, Private Company, Agricultural Department and Neighbours/ Village Head-man played a significant role in making the farmers aware of the benefits of soil testing. The Private Company provided the information backup to 48.33 per cent of the soil tested farmers and 37.14 per cent of the control group. The Agriculture Department recorded coverage of 23.33 per cent of the soil tested farmers and 17.14 per cent of the control farmers. About 28.33 and 45.71 per cent of the farmers in the corresponding groups were covered by neighbors/ village-headman.

6.3.2 Training programs attended on application of chemical fertilizers

As reported by the sample respondents, no farmers from either of the groups attended any training programmes organized by the Agriculture Department on application of chemical fertilizers (recommended dosages). They applied chemical fertilizers on the basis of their own experience and in consultation with the co-farmers.

6.3.3 Methods of application of fertilizers

The sample farmers in the field area mainly applied Urea, DAP, SSP, MOP and Micronutrients. There was no report of applying any Complex and Other fertilizers. Micronutrients were applied in vegetable crops only. About 52 households from SHC holders and 51 from Control group cultivated vegetable crops in *Kharif* season.

All the sample respondents (100%) applied the fertilizers through broadcasting method of application while the micronutrients were applied by the method of spraying (about 90%) and drilling (about 10%) only in vegetable crops for both the groups.

6.3.4 Details of soil sampling

Although the sample farmers heard about the ongoing SHC scheme, they were quite ignorant about the scheme in details especially on implementation part. They did not have any knowledge on average cost of soil testing (Rs./sample), average number of samples to be taken for soil testing, average number of plots to be considered for soil testing and average area covered under soil testing. The average distance from the farmers' field to the Soil Testing Laboratories was about 25.35 Km as reported by the sample respondents.

6.3.5 Sources for fertilizer purchase

Generally farmers purchase fertilizers/ micronutrients from different sources *viz.*, Private fertilizer shops/ dealers, Company authorized dealers, Co-operative Societies, Government Agency and Others. In the sample area, all the respondents reported that they used to purchase fertilizers/ micronutrients from the Private fertilizer shops/ dealers (100%) only as there were no other types of supplying agencies available in the locality.

6.3.6 Soil sampling

The sample card holders reported that the soil sample collection is being carried out by a Private Company (Pro Tech Associate) on behalf of the State Agriculture Department in the study area and in some pockets, the concerned Private Company employed some farmer facilitators/village headman to collect the soil samples under their jurisdiction. A training programme was organized by the private agency for collection of samples in the vicinity of the village area. A large percentage (60%) of the total soil samples were collected by the private agency alone and the remaining 40.00 per cent was done by the village headmen.

6.4 Recommended doses of fertilizers

6.4.1 Recommended doses of fertilizers based on soil test result

Recommended quantity of fertilizers based on soil test results were well reflected in the SHC received by the sample respondents. The average recommended doses for rice were FYM @ 4.05 ton /acre, Urea @11.34 kg/ acre, SSP @ 68.59 kg / acre, MOP @ 17.83 kg/ acre and Lime @ 1.42/acre. There was no recommendation against DAP, $MgSo_4$ and Potash as evident from the SHC. On the other hand, the farmers applied FYM @ 0.45 ton/acre, Urea @ 9.08 kg/acre, DAP @ 18.15 kg/acre and MOP @ 15.13 kg/acre.

6.4.2 Organic fertilizer for reference crops

Only 25 (41.67%) sample households out of the total 60 SHC holders applied organic fertilizers (FYM) in the study area. They applied FYM in 30.91 acres of area under reference crop *Kharif* paddy). The average area covered under organic fertilizers was recorded at 1.24 acre per household. The average quantity of FYM applied per acre was 397.28 kg and the price of FYM was Rs. 2.00 per kg. The total quantity of FYM was recorded at 122.80 quintal Application of FYM was found to decline over time due to decrease of livestock population in the study area.

6.4.3 Problems encountered in implementation of the SHC scheme

Following problems were encountered by the implementing agencies in implementation of the SHC Scheme:

1. In Assam, there are about 27.02 lakh farm families. But no agency maintains authentic records of the bona fide farmers with proper address and land holding till date. Problems, many a time arose in identifying the real owner of the farm for collection of soil samples, which ultimately posed difficulties in implementation of the SHC scheme.
2. Collection and analysis of soil samples, printing of SHCs and its distribution seem to be an arduous task for the State Agriculture Department. This may be the reason for which the jobs were entrusted to a private agency (Pro-Tech Associate).
3. Existing infrastructure of the State Labs are not up to the mark to achieve the target(s) within the given time line.
4. Initially, micronutrient analysis of soil samples could not be undertaken in the state labs due to technical problems. Mini Soil Test Labs *(Mridha Parikshak)* were issued to the State Labs in January, 2017 only.
5. Short supply of reagents often hampered a lot in analyzing the soils samples.
6. Lack of technical guidance and training programme to handle the *Mridha Parikshak,* were identified to be yet other problems for soil sample analysis.
7. Shortage of employees and frequent transfer of the Lab staff stood as a major hindrance in accomplishing the job in right earnest.

6.4.4 Suggestions for improvement of SHC scheme

1. Proper monitoring of the work of the agency associated with collection of soil samples and distribution of card is essential. As such, the Govt. should develop a kind of supervisory mechanism to see that the scheme is being implemented in letter and spirit.
2. Soil map for each district is needed which would be helpful to capture the soil structure of the district at a glance.
3. Adequate infrastructure development of soil labs in the state needed focussed attention.
4. Farmers must be taken into confidence while collecting the soil samples from their crop field.
5. There is an urgent need to develop a functional data base of the farmers of the state. This will facilitate implementation of any agricultural development programme.

6. The implementing agency, for each programme should maintain up to date information in public domain.

6.5. Impact of SHC scheme

The primary objective of the present study was to see the impact of the SHC Scheme on production and productivity of crops. As per guidelines a comparative study was supposed to be undertaken between the two groups of sample respondents *i.e.* soil tested farmers and control group farmers (*i.e.* without SHCs). However, no visible inference could be drawn from the study conducted in Assam, as no farmers having SHCs so far, adopted the RDF till the date of field survey. The following are the reasons for non-adoption of RDF:

- Most of the sample farmers have received the SHC very recently, just one or two month before the field survey (*i.e.* in March and April, 2017 only).
- Only a few sample farmers received the SHC in August' 2016. In the mean time, *Kharif* crop season for the main crop rice (as the RDF on SHC was recorded for rice only) was over in the state.
- It was too early to see the impact of SHC Scheme in the state, reason being that the pace of implementation of the scheme continues to be very slow due to inadequacy of facilities available, already highlighted elsewhere in the report.
- Most of the farmers could not understand and interpret the importance of the RDF given in the SHCs. Arranging training prgrammes amongst the farmers would be on effective step for adoption of the RDF in the forth coming *Kharif* season.
- Some of the sample farmers also reported that they were not taken into confidence while collecting the soil samples from their crop fields by the concerned private agency (Pro-Tech Associate) on behalf of the State Agriculture Department, Assam. Many of the farmers, therefore, still reluctant to go with the RDF given in the card. For obvious reasons, the farmers who are associated with this scheme are required to be motivated so that they can understand the benefits of the SHC scheme in terms of yield and ultimately the profit.

Impact of any development programme can be assessed only when it goes to the field for execution. As the farmers in the sample area received the Soil Health Cards a bit late and could not go with the RDF as yet, proper evaluation of the scheme in Assam could not be undertaken in the true sense of the term. An assessment of this flagship programme can be carried out in the subsequent crop season if timely measures in the line as indicated above, are taken by implementing agencies with all sincerity on a mission mode.

Chapter – VII
Executive Summary

Soil is the most precious gift of nature. So any kind of torture on it is a sin. Healthy Soils can provide healthy crops. To protect soil health and for sustainable agriculture, the Government of India launched Soil Health Cards (SHC) Scheme in February 2015. A SHC is meant to give each and every farmer of our country, soil nutrient status of his holding and advise him on the dosage of fertilizers and micronutrient and also the needed soil amendments that he should apply to maintain soil health in the long run.

The soils of Assam are acidic in nature. The productivity potential of soil generally is also limited. With the cultivation of crops for years, the soils need to be replenished periodically.

For sustainable agriculture, judicious use of fertilizer is must. It is possible only when the farmers know the natural health of the soils of their crop fields. 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 too. The lower doses of fertilizers result in low productivity and low quality of crops. Both the situations are equally undesirable for all the stakeholders. Considering the growing importance of soil testing, the present study entitled, "Impact of Soil Health Card Scheme 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 specific objectives of the study were as follows:

1. to document the status and implementation of soil health card scheme in Assam.
2. to analyze the impact of adoption of soil testing technology and recommended doses of fertilizers on the basis of SHCs, on crop production, productivity and soil health in Assam.

Summary of Findings and Policy Suggestions

As per objectives and guidelines, a comparative study was supposed to be undertaken between the two groups of sample respondents to see the impact of the SHC Scheme on production and productivity of crops and to see the awareness of the farmers along with adoption of Recommended Doses of Fertilizers (RDF) on soil test

basis, as well. But, no visible inference could be drawn from the study conducted in the state, as no farmers having SHCs so far, adopted the RDF till the date of field survey. It happened due to delay in distribution of SHC amongst farmers in the sample areas. The analysis was therefore not in the perspective of impact of the Soil Health Card, but on the status of implementation of the scheme. Nevertheless, sincere attempts were made to portray a real picture of the field situation in the context of implementation of Soil Health Card Scheme.

Status and Implementation of Soil Health Card Scheme

- As per report of the Directorate of Agriculture, Government of Assam, 64,168 Soil Health Card (SHC) were issued up to Aug/2016 to the farmers of different districts of Assam under the new policy of the Government of India.
- The highest nos. of SHCs were distributed in Jorhat district (18,438) and the lowest nos. of SHCs were distributed in Hailakandi district (61) of Assam up to August, 2016 from April, 2015. Clearly, the State has to do a lot to accomplish the herculean task of covering 27.02 lakh farm families of the State.
- The progress of Soil Health Card Scheme in all the States/ UTs has been worked out by the Press Information Bureau, Ministry of Agriculture, Government of India. As per the report, about 1.39 lakh cards have been distributed to the farmers of Assam as on 14.03.2017

Awareness on SHC scheme

- The farmers in both the groups (Soil tested and Control groups) were not aware of Integrated Nutrient Management (INM) and therefore, they did not have any experience any reduction in consumption of chemical fertilizers due to adoption or non-adoption of INM.
- At overall level 79.17 per cent of the sample farmers were aware of imbalanced application of fertilizers and its ill effect on soil and crop production.
- The sample households, however, did not have any information about ongoing programmes on Soil Health Mission in the study area.
- About 58.33 per cent of the sample households in the control group and 100.00 per cent soil tested group were aware of the Soil Health Card Scheme.

- Under the SHC scheme, soil samples were collected by grid sampling technique by the agency which is considered to be an efficient and cost-effective technique.
- The sample farmers however, were completely ignorant about the grid system practiced under the SHC Scheme.
- Private Company (Pro-Tech Associate), Agricultural Department and Neighbours /Village Head-man played a significant role in making the farmers aware of the benefits of soil testing.
- The Private Company provided the information backup to 48.33 per cent of the soil tested farmers and 37.14 per cent of the control group.
- The Agriculture Department recorded coverage of 23.33 per cent of the soil tested farmers and 17.14 per cent of the control farmers.
- About 28.33 and 45.71 per cent of the farmers in the respective groups were covered by neighbors/ village-headman.
- As reported by the sample respondents, no farmers from either of the groups attended any training programmes organized by the Agriculture Department on application of chemical fertilizers (recommended dosages).
- All the sample respondents (100%) applied the fertilizers through broadcasting method of application while the micronutrients were applied by the method of spraying (about 90%) and drilling (about 10%) only in vegetable crops for both the groups.
- The sample farmers did not have any knowledge on average cost of soil testing (Rs./sample), average number of samples to be taken, average number of plots to be considered and average area covered under soil testing.
- The average distance from the farmers' field to the Soil Testing Laboratories was about 25.35 Km.
- In the sample area, all the respondents reported that they used to purchase fertilizers/ micronutrients from the Private fertilizer shops/ dealers (100%) only as there were no other types of supplying agencies available in their locality.
- A large percentage (60%) of the total soil samples was collected by the private agency alone and the remaining 40.00 per cent was done by the village headmen.

Recommended doses of fertilizers

- The average recommended doses for rice were FYM @ 4.05 ton /acre, Urea @11.34 kg/ acre, SSP @ 68.59 kg / acre, MOP @ 17.83 kg/ acre and Lime @ 1.42/acre. There was no recommendation against DAP, $MgSo_4$ and Potash as evident from the SHC. On the other hand, the farmers applied FYM @ 0.45 ton/acre, Urea @ 9.08 kg/acre, DAP @ 18.15 kg/acre and MOP @ 15.13 kg/acre.
- Only 41.67 per cent sample households out of the total 60 SHC holders applied organic fertilizers (FYM).

Impact of SHC scheme

No visible inference could be drawn from the study conducted in Assam, as no farmers having SHCs so far, adopted the RDF till the date of field survey. The following are the reasons for non-adoption of RDF:

- Most of the sample farmers have received the SHC very recently, just one or two month before the field survey (*i.e.* in March and April, 2017 only).
- Only a few sample farmers received the SHC in August' 2016. In the mean time *kharif* crop season for the main crop rice (as the RDF on SHC was recorded for rice only) was over in the state.
- It was too early to see the impact of SHC Scheme in the state, reason being that the pace of implementation of the scheme continues to be very slow due to inadequacy of facilities available, already highlighted elsewhere in the report.
- Most of the farmers could not understand and interpret the importance of the RDF given in the SHCs. Arranging training prgrammes amongst the farmers would be on effective steps for adoption of the RDF in the forth coming *Kharif* season.
- Some of the sample farmers also reported that they were not taken into confidence while collecting the soil samples from their crop fields by the concerned private agency (Pro-Tech Associate) on behalf of the State Agriculture Department, Assam. Many of the farmers, therefore, still reluctant to go with the RDF given in the card. For obvious reasons, the farmers who are associated with this scheme are required to be motivated so that they can understand the benefits of the SHC scheme in terms of yield and ultimately the profit.

Problems encountered in implementation of the SHC scheme

- In Assam, there are about 27.02 lakh farm families. But no agency maintains authentic records of the bona fide farmers with proper address and land holding till date. Problems, many a time arise in identifying the real owner of the farm for collection of soil samples, which ultimately posed difficulties in implementation of the SHC scheme.
- Collection and analysis of soil samples, printing of SHCs and its distribution seem to be an arduous task for the State Agriculture Department. This may be the reason for which the jobs were entrusted to a private agency (Pro-Tech Associate).
- Existing infrastructure of the State Labs are not up to the mark to achieve the target(s) within the given time line.
- Initially, micronutrient analysis of soil samples could not be undertaken in the state labs due to technical problems. Mini Soil Test Labs *(Mridha Parikshak)* were issued to the State Labs in January, 2017 only.
- Short supply of reagents often hampered a lot in analyzing the soils samples.
- Lack of technical guidance and training programme to handle the *Mridha Parikshak,* were identified to be yet other problems for soil sample analysis.
- Shortage of employees and frequent transfer of the Lab staff stood as a major hindrance in accomplishing the job in right earnest.

Policy Suggestions for improvement of SHC scheme

1. Proper monitoring of the work of the agency associated with collection of soil samples and distribution of card is entrusted. As such, the Govt. should develop a kind of supervisory mechanism to see that the scheme is being implemented in letter and spirit.
2. Soil map for each district is needed which would be helpful to capture the soil structure of the district at a glance.
3. Adequate infrastructure development of soil labs in the state needed focussed attention.
4. Farmers must be taken into confidence while collecting the soil samples from their crop field.
5. There is an urgent need to develop a functional data base of the farmers of the state. This will facilitate implementation of any agricultural development programme.

6. The implementing agency, for each programme should maintain up to date information in public domain.

Conclusions

Impact of any development programme can be assessed only when it goes to the field for execution. As the farmers in the sample area received the Soil Health Cards a bit late and could not go with the RDF as yet, proper evaluation of the scheme in Assam could not be undertaken in the true sense of the term. An assessment of this flagship programme can be carried out in the next crop season if timely measures in the line as indicated above, are taken by implementing with all sincerity in a mission mode.

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2. Chaudhari S.K (2016) Soil Health in India " Retrospective and Perspective" published in the Bulletin of the Indian Society of Soil Science, No.30 pp 34-52

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4. National Bureau of Soil Survey and Land Use Planning (ICAR) Soils of Assam for Optimising Land Use (1999), NBSS Publ.66, Soils of Indian Series.

5. Press Information Bureau, Government of India ,Ministry of Agriculture, 24 – February-2016.

6. Press Information Bureau, Government of India, Ministry of Agriculture, 2016 14 –February.

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APPENDIX - I

Table – A-1

District wise portal entry status as on 14-06-2017 10:00 PM
ASSAM

SL.No.	State Name/District Name	Samples Entered	No of farmers Covered	Samples Tested	SHC Printed
1	**ASSAM**				
1	BONGAIGAON	1812	4295	106	153
2	LAKHIMPUR	1	1	0	0
3	DIBRUGARH	1619	7912	482	1482
4	CACHAR	135	232	14	109
5	MARIGAON	168	546	148	457
6	HAILAKANDI	27	252	25	250
7	KAMRUP	356	741	99	192
8	DHUBRI	45	155	17	50
9	BAKSA	239	304	2	0
10	NALBARI	32	133	16	91
11	CHIRANG	316	646	205	428
12	KOKRAJHAR	444	983	308	449
13	GOALPARA	149	223	21	2
14	TINSUKIA	154	708	146	289
15	BARPETA	6515	14143	1512	3046
16	UDALGURI	10	152	8	128
17	JORHAT	1156	9430	530	4856
18	SONITPUR	473	2098	150	678
19	DHEMAJI	635	659	249	0
20	DARRANG	80	178	6	103
21	KARBI ANGLONG	159	159	0	0
22	NAGAON	1154	5811	419	403
23	SIVASAGAR	606	3318	65	344
24	KARIMGANJ	467	467	0	0
25	GOLAGHAT	2093	10949	563	2308
26	KAMRUP METRO	182	443	19	94
	Total:	**19027**	**64938**	**5110**	**15912**

Note: Designed and Developed by National Informatics Centre Information and data in this application is managed by State Agricultural Departments and Department of Agriculture and Cooperation STCR formulas and other related information for generation of Soil Health Cards have been provided by Indian Council of Agricultural Research helpdesk-soil@gov.in

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APPENDIX – II

ACTION TAKEN REPORT ON COMMENTS FROM ADRTC, ISEC, BANGALORE ON THE DRAFT REPORT "IMPACT OF SOIL HEALTH CARD SCHEME (SHCS) ON PRODUCTION, PRODUCTIVITY AND SOIL HEALTH IN ASSAM" SUBMITTED BY AERC, JORHAT, ASSAM

1. **Title of the draft report examined:**
   Impact of Soil Health Card Scheme on Production, Productivity and Soil Health in Assam
2. **Date of receipt of the Draft report:** 24th June, 2017
3. **Date of dispatch of the comments:** 13th July, 2017
4. **Comments on the Objectives of the study:**
   The objectives of the study need to be revised as per the proposal.
   Action: Done as per suggestion
5. **Comments on the methodology**
   Common methodology proposed for the collection of field data and tabulation of results has been followed.
6. **Comments on analysis, organization, presentation etc.**

(i) In Table 2, the rental value of leased-in and leased-out land for irrigated and un irrigated can be given separately, as there will be an huge difference between these two.
Action: Done as per suggestion

(ii) Chapter -III can be given a title "Status of Awareness on SHC Scheme" instead of Awareness of SHC Scheme.
Action: Done as per suggestion

(iii) In the method of application of fertilizers and sources for fertilizer purchase, the information should be bifurcated with regard to soil-tested farmers and control farmers in separate tables.
Action: Done as per suggestion

(iv) The average recommended quantity of fertilizers based on soil test results should also include the quantity as per the farmer's opinion, for better understanding the knowledge of the farmers on soil testing and their level of adoption.
Action: Done as per suggestion

(v) The tables such as 'impact of application of recommended doses of fertilizers on yield, visible changes found after application of RDF, cost of cultivation of major crops and details of training programmes attended on application of chemical fertilizers' were missing and need to be included as per the Table Templates shared across AERCs.

Action: Three tables as mentioned above could not be included in the report and the reasons for the same were also clearly mentioned in the respective chapters. The table on 'cost of cultivation of major crop' is included as per suggestion.

(vi) Throughout the report, the units mentioned in Tables (especially percentages) should be in two digits for better clarity on the information provided.

Action: Done as per suggestion

(vii) *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.

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